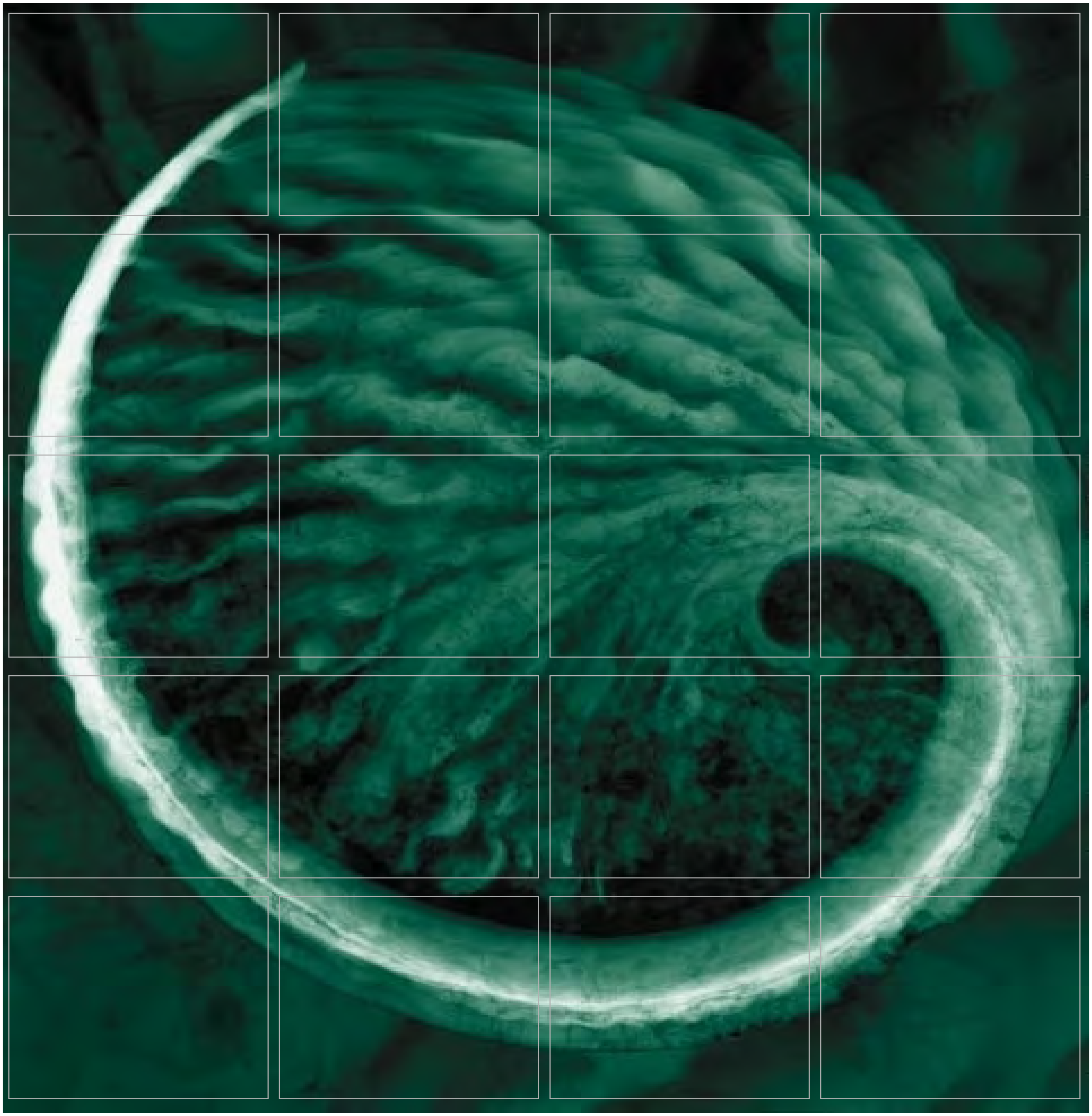

DRAFT Operable Unit 1 Remedial Design Work Plan

Fulton Avenue Superfund Site
150 Fulton Avenue
Garden City Park, Nassau County, New York

January 2010

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LIST OF ACRONYMS

ACRONYM	DEFINITION
AOC	Administrative Order on Consent
AS	Air Sparge (ing)
ARARs	Applicable or Relevant and Appropriate Requirements
BGS	Below Ground Surface
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulations
CJ	Consent Judgment
CQAPP	Construction Quality Assurance Project Plan
DART	Days Away from Work, Restricted Time or Transfer from Job
EMR	Experience Modification Rate
ERM	Environmental Resources Management
FAPG	Federal-Aid Policy Guide
FS	Feasibility Study
FSWD	Franklin Square Water District
GAC	Granular Activated Carbon
Garden City	Incorporated Village of Garden City
GCPIA	Garden City Park Industrial Area
GCWD	Garden City Water District
HASCP	Health and Safety Contingency Plan
RESPONDENT	Genesco Inc.
GPM	Gallons Per Minute
GRP	Green Remediation Plan
IRM	Interim Remedial Measure
ISCO	In-Situ Chemical Oxidation
LIPA	Long Island Power Authority
OSWER	Office of Solid Waste and Emergency Response
MCLs	Maximum Contaminant Levels
MGD	Million Gallons Per Day
NAICS	North American Industry Classification System
NCDPW	Nassau County Department of Public Works

ACRONYM	DEFINITION
NCP	National Contingency Plan
NPL	National Priorities List
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
OM&M	Operations, Maintenance and Monitoring
OU1	Operable Unit No. 1
PCE	Perchloroethene a.k.a. (Tetrachloroethene)
PRAP	Proposed Remedial Action Plan
PRPs	Potentially Responsible Parties
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RI	Remedial Investigation
ROD	Record Of Decision
SMP	Site Management Plan
SOD	Soil Oxidant Demand
SPDES	State Pollution Discharge Elimination System
SVE	Soil Vapor Extraction
TBC	To Be Considered
TCE	Trichloroethene
TRIR	Total Recordable Incidence Rate
TNH	Town of North Hempstead
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VE	Value Engineering
VECPs	Value Engineering Change Proposals
VOC	Volatile Organic Compound
VP	Vertical Profile

1.0 INTRODUCTION

The property located at 150 Fulton Avenue, Garden City Park, Nassau County, New York (hereinafter, "the Fulton Avenue Property") is owned by Gordon Atlantic Corporation. It is located within the Garden City Park Industrial Area (GCPIA), Village of Garden City Park, Town of North Hempstead (TNH), Nassau County, New York. Figure 1 shows the location of the 150 Fulton Avenue Property.

The Fulton Avenue Property has been identified as a contributing source of Tetrachloroethene (PCE) contamination of groundwater beneath the Site creating plumes in the Upper Glacial and Magothy aquifers which extend to the southwest, impacting certain public supply wells owned by the Incorporated Village of Garden City (Garden City).

The Fulton Avenue Property is listed on the Registry of Inactive Hazardous Waste Disposal Sites in New York State (Registry) as Site Number 130073. The United States Environmental Protection Agency (USEPA) also included the Fulton Avenue Property on the National Priorities List (NPL) of Federal Superfund Sites as part of USEPA's Fulton Avenue Superfund Site in April 1998.

The New York State Department of Environmental Conservation (NYSDEC) defines the "Site" as the 0.8-acre Fulton Avenue Property and environmental conditions, including groundwater contamination that has migrated beyond the property boundary (the "NYSDEC Site"). In contrast, the USEPA defines the Fulton Avenue Superfund Site as the 0.8-acre property located at 150 Fulton Avenue, Garden City Park, Nassau County, New York (hereinafter, the Fulton Property), all contamination emanating from the Fulton Property, as well all other contamination impacting the groundwater in the vicinity of the Fulton Avenue Property including an overlapping trichloroethene (TCE) -dominant plume in the Upper Glacial and Magothy aquifers, whose origin is currently unknown, and all sources of this contamination.

The source of the PCE contamination at the Fulton Avenue Property was identified as a former drywell which was subject to an interim remedial measure (IRM) that involved soil/sediment removal, air sparging (AS) and soil vapor extraction (SVE). The former dry well was closed as part of the IRM. The IRM removed an estimated 10,000 lbs of PCE during its period of operation (1999 – 2001). A sub-slab depressurization system was installed beneath the building at the conclusion of the Soil IRM to mitigate the potential for intrusion of soil vapor containing residual PCE into the existing building.

Between 1999 – 2006, a Remedial Investigation (RI), Exposure Pathways Analysis, Baseline Risk Assessment, and a Feasibility Study (FS) (collectively an "RI/FS") was performed under a NYSDEC Administrative Order on Consent (AOC), Index # W1-0707-94-08. The RI/FS focused on environmental conditions at the Fulton Avenue Property and contamination that has migrated beyond the property boundary.

The RI and FS Reports were reviewed by NYSDEC and USEPA, and approved under the AOC. At that point in time, lead-agency status changed from NYSDEC to USEPA. USEPA subsequently developed a Proposed Remedial Action Plan (PRAP) for Operable Unit No. 1 (OU1) which, following a public comment period, was finalized and presented a selected remedy in a Record of Decision (ROD) issued on 28 September 2007. The ROD defines OU1 as follows, "…includes a 0.8-acre property located at 150 Fulton Avenue, Garden City Park, Nassau County, New York (hereinafter, the Fulton Property), all contamination emanating from the Fulton Property, as well all other contamination impacting the groundwater in the vicinity of the Fulton Property including an overlapping TCE-dominant plume in the Upper Glacial and Magothy aquifers, whose origin is currently unknown, and all sources of this contamination."

During 2007 – 2009, USEPA issued a Statement of Work (SOW) for the OU1 Remedial Action (RA) and commenced negotiation with a number of potentially responsible parties (PRPs) to implement the RA set forth in the OU1 ROD. One of the identified PRPs, Genesco Inc. (Respondent) agreed to implement the OU1 RA and entered into a Consent Judgment (CJ) with USEPA.

The CJ (USEPA CJ No. CV–09–3917) and attached SOW were lodged with the United States District Court for the Eastern District of New York on 10 September 2009. Notice of the same inviting public comment was published in the Federal Register / Vol. 74, No. 179, 17 September 2009. On 18 November 2009, USEPA issued notice to proceed initiating the OU1 Remedial Design (RD) and subsequent implementation of the OU1 RA.

This OU1 RD Work Plan sets forth the objectives, performance standards, scopes of work, required deliverables and schedules for pre-design investigations, design activities, implementation and monitoring of the OU1 RA. Appended to this document are a Quality Assurance Project Plan (QAPP) and Health and Safety Contingency Plan (HASCP) which are integral parts of the OU1 Remedial Design (RD) Work Plan. The QAPP presents the policies, organization, objectives, functional activities and specific quality assurance/quality control (QA/QC) activities designed to achieve the data quality goals associated with the OU1 RD and RA. The HASCP establishes ERM's occupational health and safety requirements, responsibilities and procedures to protect workers during the OU1 RD pre-design and design studies, groundwater monitoring and OU1 RA construction activities. Both are dynamic documents that will be subject to revision as the OU1 RD/RA progresses. Revisions will likely be required to address changes in regulatory requirements or field conditions to ensure the protection of Site workers and the public, and that data goals are met including the accuracy and representativeness of all analytical results.

Background information describing the nature and extent of the problem to be addressed by the OU1 RA is presented in Section 1.2 to assist the reader in understanding the basis for the OU1 RA.

1.1 BACKGROUND INFORMATION

The RI, Soil IRM and results thereof provide a basis for understanding the nature of environmental conditions and extent of the VOCs in groundwater emanating from the Fulton Property and the GCPIA to be addressed by the OU1 RA.

1.1.1 Remedial Investigation

The RI evaluated groundwater in the Upper Glacial and Magothy aquifers that underlie the Site. The Magothy aquifer is the primary source of water to public water supply in the region. The RI was implemented in a phased manner beginning at the Fulton Property and expanding outward to the southwest in the direction of regional groundwater flow. The details of the RI were summarized in the RI and FS Reports.

1.1.2 Findings

The key findings of the RI are summarized below.

1.1.2.1 Subsurface Stratigraphy

The observations, both visual and geophysical, of the subsurface stratigraphy at the Fulton Property and in the Study Area were consistent with the descriptions reported in the literature. The Upper Glacial aquifer, in which the water table occurs, consists of fine, medium and coarse sands with fine to coarse gravels, and locally thin clay lenses. The Upper Glacial aquifer exhibits a low total organic carbon content.

The Magothy aquifer is a completely saturated groundwater system, consisting of fine to medium sands and silts, clayey sands, sandy clays to solid clays and some coarse sand and gravel areas. In the upper to middle zones of the Magothy, discontinuous lenses of lignitic clays, consisting of brown to brownish black coals, woody plant fragments and fragile pyrite crystallization were observed locally, embedded within silty sand matrices. The Magothy aquifer exhibits a higher total organic carbon content than observed in the Upper Glacial aquifer.

1.1.2.2 Groundwater Flow

Regional groundwater flow in both the Upper Glacial and Magothy aquifers tends naturally toward the south-southwest. As the groundwater moves south-southwest, public supply wells in the Study Area influence the local groundwater flow paths. In particular, Garden City Water District (GCWD), Well Nos. 9: {N-03881}, 13: {N-07058} and 14: {N-08339}) and Franklin Square Water District (FSWD) public supply wells Nos. 1 and 2 (N-03603 and N-03604) located further downgradient.

As groundwater flow moves toward the southwest in the Upper Glacial aquifer through the " RI Study Area", the hydraulic information indicates the vertical flow potential is not a predominant factor within 700 feet downgradient of the Fulton Property. Beyond this point, the vertical groundwater flow potential increases significantly in the downward direction. As a result, groundwater beyond a point approximately 700 feet downgradient of the Fulton Property will naturally move downward in the aquifers as it moves horizontally through the subsurface. These hydraulic factors, in conjunction with the stratigraphy in the Upper Glacial and Magothy aquifers, impart a strong influence over the distribution of the Fulton Property-related VOCs in groundwater. Specifically, the significant variations in the material texture of strata sequences create preferential groundwater flow pathways within a complicated aquifer system. Hence, the more transmissive strata (coarser-grained deposits) presumably are responsible for preferential transport of groundwater and any plumes of dissolved VOCs. Moreover, the heterogeneity of the Upper Glacial and Magothy aquifer systems, coupled with variable hydraulic gradients resulting from public supply well pumping and/or local stratigraphic profiles, cause spatial and temporal variation in local horizontal groundwater flow velocities within the Study Area. Once the southwest traveling groundwater approaches one or more of the five downgradient public supply wells, the zone of capture created by the pumping wells exert control over the groundwater flow paths and velocities.

1.1.2.3 Groundwater Quality

The RI and subsequent groundwater monitoring data set establishes a distinct PCE-dominant plume that appears to emanate from the Fulton Property. The RI data set also confirms the presence of shallow groundwater contamination emanating from upgradient properties within the GCPIA, and the presence of a deeper, regional groundwater contamination issue, both of which are distinguishable from the PCE-dominant plume that emanates from the Fulton Property. Along with this PCE-dominant plume whose origin appears to be primarily from the former dry well at the Fulton Property, historic public supply well sampling data and the data generated by the RI identified an adjacent, larger and distinctly different, TCE-dominant plume in the Magothy aquifer whose origin is from other, unknown sources that are not related to the Fulton Property. Historic public supply well, vertical profile (VP) and groundwater monitoring well sampling data confirm that a large, deep regional TCE-dominant plume has been present in the RI Study Area since the early 1980s. This TCE-dominant plume is larger than the PCE-dominant plume and remains undefined to the north, south, east and west of the Fulton Property, as it is beyond the scope of the RI.

Although there have been a number of reports of public supply wells impacted by chlorinated VOCs in the area of Garden City, only three GCWD public supply wells (Well Nos. 9, 13 and 14) lie directly in the trajectory of groundwater flow from the Fulton Property. All three wells are impacted by chlorinated VOCs. The predominant VOC in GCWD Well Nos. 13 and 14 is currently PCE with lower concentrations of TCE. In contrast, the predominant VOC in GCWD Well No. 9 is TCE with lower concentrations of PCE, consistent with the profile of the TCE-dominant plume. Water from all these public supply wells is treated to remove the VOCs and ensure that potable water supplied to the community meets Federal and NYS drinking water standards and guidelines.

Two other public supply wells (FSWD Nos. 1 and 2 (N-03603 and N-03604) are located directly downgradient of the aforementioned GCWD wells in the direction of groundwater flow. As discussed further below, the FSWD public supply have recently become impacted by TCE, consistent with the observed advance of the TCE-dominant plume discussed in the RI report and evident in the groundwater monitoring results data set. An air stripper treatment system is being installed to remove the VOCs and ensure that potable water supplied to the community meets Federal and NYS drinking water standards and guidelines.

Groundwater data from the three GCWD Wells confirm that VOC impacts were apparent as early as 1979. The predominant VOC in these three wells at that time was TCE. In the 1998-1999 timeframe, PCE concentrations began to rise disproportionately to TCE concentrations, and it was not until circa 2000 that PCE became the dominant VOC at two of the wells (GCWD Well Nos. 13 and 14. The change to a PCE-dominant impact at two of these downgradient supply wells is consistent with the PCE distribution in the aquifer observed during the RI delineation, where VOC concentrations in the aquifer upgradient of the supply wells were much higher than that was observed at the supply wells or at monitoring points immediately upgradient (~1,000 feet) of the wells. Subsequent monitoring results at these locations and in GCWD Well Nos. 13 and 14 indicate a continued increasing PCE concentration trend, further confirming that the PCE-dominant plume attributable to the Fulton Property has arrived at the supply wells long after the occurrence of a TCE dominated groundwater plume.

This investigative information has been shared with various regulatory and municipal entities (e.g. Garden City) and resulted in upgrades to the treatment equipment shared by wells GCWD Nos. 13 and 14 to ensure continued delivery of potable water meeting the Federal and NYS drinking water standards and guidelines to the community.

GCWD Well No. 9 was not operated for a period of 12 years between 1987 and 1999. Since being put back into service in 2000, TCE has remained the predominant contaminant and concentrations have increased to levels greater than when it was taken out of service.

1.1.2.4 Fulton Property-Related VOC Distribution and Mass in Groundwater

The PCE-dominant plume emanating from the Fulton Property was found to extend 6,500 feet downgradient of the Fulton Property (Figure 1). The average width of the PCE-dominant plume was found to be 1,000 feet. PCE extends to a depth of 420 feet, exhibiting an average thickness of 250 feet. As discussed above, this PCE-dominant plume is both definable and distinguishable from an adjacent TCE-dominant plume positioned more toward the northwest and west of the PCE-dominant plume. Figure 2 presents a plan view of the Garden City area showing the known areal extent of the PCE and TCE-dominant plumes, the public supply wells, and all groundwater sampling points used during the RI, Soil IRM and subsequent monitoring.

Figure 3 presents Cross Section B-B′ from the RI Report to better illustrate the distribution of VOC impacts to groundwater related to the Fulton Property. Cross Section B-B′ is oriented longitudinally along the axis of regional groundwater flow and then turns almost due south following the flow path of the PCE-dominant plume to GCWD Supply Well Nos. 13 and 14 approximately 6,500 feet to the southwest of the Fulton Property, and then further south to multi-level MW27.

This section depicts groundwater quality in the heart of the PCE-dominant plume extending from the Fulton Property for approximately 6,500 feet, where it is captured by the GCWD Supply Well Nos. 13 and 14. As the PCE plume leaves the Fulton Property in the shallow, Upper Glacial aquifer that travels southwest, the hydraulic information indicates the vertical flow potential is not a predominant factor within 700 feet downgradient of the Fulton Property. Beyond this point, the vertical groundwater flow potential increases significantly in the downward direction. Groundwater beyond a point 700 feet downgradient of the Fulton Property will naturally move downward in the aquifers as it moves horizontally through the subsurface. This causes the Fulton Property-related impacted groundwater to occur below a zone of "cleaner" groundwater. As the plume descends, it increases in thickness due to "fingering" by interbedded silt and clay layers within the Magothy aquifer. Higher concentration portions of the PCE-dominant plume tend to follow more permeable strata (preferential flow pathways) as the groundwater moves horizontally as it moves through the subsurface. The TCE and PCE tend to exhibit higher concentrations at locations within these higher permeability zones immediately above intervals where elevated gamma response/silty clay zones were found. At a point in between well pair GCP14S and GCP14D, and well cluster MW21, the PCE-dominant plume turns due south toward the supply wells GCWD Nos. 13 and 14 as the zone of capture created by the pumping wells exert control over groundwater flow paths. This section shows that a zone of PCE at concentrations greater than 1,000 μg/l extends from just downgradient of the Fulton Property to some point between the location of the MW21 well cluster and GCWD Nos. 13 and 14. A pronounced downward vertical flow potential was identified based on mapping of water levels recorded in 14 permanent wells on 4 April 2002. The hydraulic influence due to the operation of public water supply wells including GCWD Nos. 13 and 14 is readily evident. These hydraulic factors, in conjunction with the stratigraphy in the Upper Glacial and Magothy aquifers, impart a strong influence over the distribution of the PCE-dominant plume.

The RI data set generated by the installation/sampling of well clusters and multi-level wells in the vicinity of the GCWD Wells (upgradient, side-gradient and downgradient to groundwater flow direction) confirms that the PCE-dominant plume continues to migrate toward the downgradient public supply wells, but based on a substantial body of data and within a reasonable degree of certainty, the PCE-dominant plume does not appear to extend past the GCWD Wells. However, the adjacent, larger and distinctly different, TCE-dominant plume from other, unknown sources that are unrelated to the Fulton Property has migrated past the GCWD wells and as discussed above, FSWD Well Nos. 1 and 2 (N-03603 and N-03604) have recently become impacted with TCE as a result of the southwesterly regional groundwater flow and the operational history of the three supply wells (when the westernmost well {GCWD No. 9} was not operated for a period of approximately 12 years). The USEPA and the NYSDEC have made efforts to alert FSWD to this trend. Identification of the source(s) of a TCE-dominant plume is currently the focus of the USEPA.

The VOC mass within the PCE-dominant plume was estimated in two separate ways. One method relied upon an average VOC concentration within the plume areas depicted on a series of cross-sections presented in the RI Report. The areas within the cross-section were multiplied over the distance between the sections and an average VOC concentration of 100µg/l. A second method relied upon a computer simulation to calculate the VOC plume size attributed to the PCE-dominant plume.

The two methods used to calculate the current mass of PCE-dominated VOCs in groundwater attributable to the Fulton Property is estimated at 3,000 lbs of VOCs. This contrasts with the approximate 10,000 lbs of VOCs that was removed from the Fulton Property during the Soil IRM and approximately 4,000 lbs. of PCE removed by the pumping and treatment at GCWD Well Nos. 13 and 14.

1.2 *SUMMARY OF REMEDIAL DESIGN/REMEDIAL ACTION*

1.2.1 *Objectives/Performance Standards*

The OU1 RA will be designed to achieve compliance with the following remedial action objectives/performance standards set forth in the ROD as elaborated in the SOW:

- Minimize the migration of Site contaminants in the PCE-dominant plume from saturated soils to the groundwater. It is anticipated that actions taken to achieve this performance standard will be undertaken in the shallow portions of the aquifer;
- Prevent further migration of groundwater contaminated with PCE and TCE in the PCE-dominant portion of the groundwater plume;
- Achieve applicable or relevant and appropriate requirements (“ARARs”) for PCE in the PCE-dominant portion of the groundwater plume;

- Make significant progress toward achieving ARARs for TCE in the PCE-dominant portion of the groundwater plume;
- Compliance with all other ARARs as set forth in the ROD;
- Prevent or minimize potential, current, and future human exposures, including inhalation of vapors and ingestion of groundwater contaminated with volatile organic compounds (VOCs); and
- The OU1 RA will work towards restoring the drinking water aquifer at the Site to its beneficial use, with such restoration occurring after implementation of the OU2 remedial action.

1.2.2 *Overview of Remedial Design/Remedial Action*

As set forth in the ROD and elaborated in the SOW, the OU1 RD will address the following major components of the OU1 RA:

- Groundwater modeling will be considered during development of the pre-design investigation to assist in the placement of extraction, injection, monitoring, and observation wells.
- Approximately 10 chemical injection wells will be placed at and near the Fulton Property. In Situ Chemical Oxidation (ISCO) technology will be applied as an initial enhancement in the area at and near the Fulton Property; two rounds of chemical injection shall be planned;
- The PCE-dominant portion of the contaminant plume will be extracted, treated, and discharged. The number and location of extraction wells, configuration of each extraction well, pumping rates, and specific groundwater discharge alternatives may be evaluated using a three dimensional ("3D") model as part of the pre-design investigation and remedial design. It is expected that by remediating the high concentrations of PCE in groundwater at and near the Fulton Property using ISCO, the contamination that exceeds regulatory levels in the groundwater will be reduced more quickly. The groundwater treatment systems will consist of shallow-tray air stripping units, or comparable systems, with carbon adsorption of the contaminated off-gasses. These treatment systems will be maintained, operated and sampled to verify the effectiveness of each treatment process;
- Evaluation of the wellhead treatment system at GCWD Nos. Wells 13 and 14, which was upgraded in the Spring of 2007 in order to protect these public supply wells from the increasing levels of contamination observed at the Monitoring Well 21 location, to determine whether this upgrade is fully protective;
- A long-term groundwater monitoring program to assess migration and attenuation of groundwater contamination in the OU1 part of the plume, as well as the effects the groundwater extraction system will have on the flow dynamics with the local aquifer system. Effluent

samples will be collected to verify compliance with the NYSDEC surface water or groundwater discharge requirements and the State Pollution Discharge Elimination System ("SPDES") effluent criteria. Results from long-term groundwater monitoring will be used to evaluate system performance and to adjust operating parameters for the pump-and-treat system, as necessary;

- A Site Management Plan (SMP) that will provide for the proper management of all Site remedy components post-construction, such as institutional controls, and which will also include: (a) monitoring of Site groundwater to ensure that, following remedy implementation, the groundwater quality improves; (b) provision for any operation and maintenance required of the components of the remedy; and (c) periodic certifications by the owner/operator or other person implementing the remedy that any institutional and engineering controls are in place, shall be developed;
- A periodic review of Site conditions will be conducted no less often than once every five years because due to the interim nature of the OU1 remedy, performance standards may take longer than five years to achieve; and
- Lastly, the SOW states that Respondent shall design the OU1 remedy in accordance with EPA Region 2's Clean and Green Policy ("Green Strategy"). This policy may be found at: http://www.epa.gov/region02/superfund/green_remediation/ policy.html.

1.2.3 *Pre-Remedial Design and Remedial Design Activities*

In order to achieve the OU1 RA Objectives/Performance Standards and design the major components of the OU1 RA listed in Section 1.2.2 above, specific pre-remedial and remedial design activities associated with the OU1 RD include, but are not limited to, the following:

- Sampling at the Site to characterize the extent of the contaminated subsurface material that needs to be remediated by in-situ chemical oxidation (ISCO) to satisfy the RA objectives. The sampling will include testing for contaminants for which USEPA will establish cleanup goals during the OU1 RD.
- Development of plans and specifications for the locations and frequency of application of the in-situ chemical treatment oxidant;
- Development of plans and specifications for the groundwater extraction and treatment system to reach target cleanup levels within the PCE-dominant contaminant plume;
- Development of plans and specifications for the installation of the groundwater extraction treatment system, and the subsequent reinjection of the treated effluent;

- Development of plans and specifications for the performance of air monitoring during construction/remedial activities at the Site to ensure that air emissions resulting from the activities meet applicable or relevant and appropriate air emission requirements;
- Development of plans and specifications for the remediation of the contaminants of concern in Site groundwater. This may include groundwater modeling or an alternate method (subject to USEPA approval) to assist in the placement, and in determining the number, of injection, extraction and monitoring wells, and treatability studies to determine the number of injections, chemical usage, and well spacing necessary to achieve the cleanup objectives;
- Development of plans for evaluation of the wellhead treatment system at GCWD Nos. Wells 13 and 14, which was upgraded in the Spring of 2007, in order to protect these public supply wells from the increasing levels of contamination observed at the Monitoring Well 21 location, to determine whether this upgrade is fully protective;
- Development of a plan for collecting and analyzing groundwater samples from the following wells at the Site: MW 21A, MW 21B, MW 21C, MW 26A-H, and MW 27A-H. The available groundwater sampling data from the Site shall be considered in determining the frequency for collecting such samples. Such groundwater samples shall be analyzed for Target Compound List (TCL) VOCs using USEPA Method 8260B or another method as required by USEPA. The plan prepared pursuant to this subparagraph shall be performed within 30 days of USEPA's approval of the RD Work Plan. The results of all sampling performed pursuant to this subparagraph shall be reported to USEPA within 30 days after the samples are collected;
- Development of a plan to upgrade the wellhead treatment systems for GCWD Nos. Wells 13 and 14 if groundwater entering one or both of those wells is shown to contain PCE at levels that are at 85% or greater than the treatment capacity for those wells. The plan also shall provide for replacing components of, or repairing, the existing or upgraded wellhead treatment systems for wells 13 and 14 when necessary to ensure the protectiveness of those systems. USEPA, in its sole unreviewable discretion, will determine whether it is necessary to replace components of, or to repair, such existing or upgraded wellhead treatment systems pursuant to the plan submitted under this subparagraph. USEPA will consult with, and consider any recommendations of, the GCWD in determining whether any such repair or replacement is necessary;
- Development of plans and specifications for the performance of pre-design sampling, groundwater monitoring for the determination of short-term remedial performance (i.e., until the OU1 remedy is operational and functional as defined in the CJ), and long-term

remedial effectiveness. Such plans and specifications shall include the groundwater monitoring discussed above and be presented in the Remedial Design Work Plan, the Preliminary and Final Remedial Design Reports, and the SMP, and Operations, Maintenance & Monitoring (OM&M) Plan, respectively. These plans shall take into account the specific data requirements for the proper design, short-term remedial performance, and long-term remedial effectiveness evaluations of each remedial component, e.g., the ISCO component, and the groundwater extraction and treatment system. Such considerations shall include verifying that the concentrations and extent of groundwater contaminants are declining. In addition, the monitoring program shall also be used to assess the need for modifications (e.g., additional injections/applications of oxygenating compounds) to the remedy. This effort will include the installation of additional monitoring wells designed to monitor the additional effects of the groundwater extraction and treatment system on the regional groundwater flow dynamics;

- Development of a SMP as part of Operations, Maintenance and Monitoring ("OM&M") of the OU1 remedy; and
- Development of a Green Remediation Plan ("GRP") that specifies how the OU1 Remedial Action will be implemented using the principles in USEPA Region 2's Clean and Green Policy.

1.2.4 Regulatory Requirements

In accordance with the CJ and appended SOW, the OU1 Objectives & Performance Standards will be met through implementation of the OU1 RA selected in the ROD. The CJ requires Respondent to finance and perform the OU1 RA in accordance with the CJ, the ROD, and the SOW, including all terms, conditions and schedules set forth herein or developed and approved hereunder.

Table 1 presents potential ARARs, which may govern remedial actions for the PCE-dominant plume associated with the Site. This table lists: the citation; a description of the ARAR; ARAR type (i.e., chemical, action or location specific); and, reason the ARAR is listed (e.g., remedy selection and/or remedial action) and how it applies to the remedy evaluation. Also included are the TBCs (To Be Considered). In addition to ARARs, the National Contingency Plan (NCP) defines other advisories, criteria or guidance as well as proposed standards issued by federal or state agencies that do not meet the definition of an ARAR as TBC information NCP at 40 Code of Federal Regulations (CFR) 300.400(g)(3)). The preamble to the NCP states that TBCs are to be used on an "as appropriate" basis.

Interim groundwater sampling and reporting is presently being performed by the Respondent in accordance with USEPA Administrative Order No. CERCLA-02-2009-2028 (the Order). The Order requires that groundwater samples be collected, analyzed and the results thereof reported every 120 days for three events from certain monitoring wells in close proximity to the Garden City Supply Wells.

Environmental Resources Management, Inc. (ERM) is the Respondent's USEPA-approved Supervising Contractor. Respondent's Project and Alternate Project Coordinators are Mr. Chris Wenczel (ERM) and Mr. Jim Perazzo (ERM), respectively. USEPA's Project and Alternate Project Coordinators are Mr. Kevin Willis and Mr. Salvatore Badalamenti, respectively.

Monthly progress reports for the OU1 RA are required to be submitted to USEPA on or before the 10th day of each month.

2.0 *PRE-DESIGN ACTIVITIES*

2.1 *GROUNDWATER PLUME EVALUATION & MONITORING*

2.1.1 *Well Inspection/Repairs*

During the pre-design phase, all wells will be inspected and repaired or replaced as necessary to ensure continued integrity and function for groundwater level and quality monitoring use.

2.1.2 *Pre-Design Groundwater Monitoring Well Water Level Measurements & Sampling*

A total of 40 groundwater samples will be collected from wells located within the footprint of the PCE-dominant plume to get an updated snapshot of groundwater levels and quality conditions from the Fulton Property to the multi-level wells on the Garden City Country Club Golf Course. This one-time comprehensive pre-design groundwater water level measurement and sampling event will be initiated within 30 days of the USEPA's approval of the OU1 RD Work Plan and likely coincide with the timing of, and replace the third and final groundwater sampling event required by the Order[1].

The 40 groundwater samples (plus appropriate QA/QC samples) will be collected from multi-level wells MWs 26 & 27 (MWs 26A-H & 27A-H), and the following conventional wells: MWs 15A, 15B, 21A, 21B, 21C, 23A, 23B, 23C, 23D, and GCP 01, 01D, 04, 08, 09, 15S, 17S, 17D, 18S, 18D and 19S plus remaining wells in the vicinity of the Soil IRM Area (wells VOWs 1D, 3D, 4D & VEW-1). All groundwater samples will be analyzed for TCL VOCs using USEPA Method 8260B.

The water level and sample analytical data will be used to evaluate current groundwater flow and quality conditions within the footprint of the PCE-dominant plume for design of the ISCO and the groundwater pump and treatment components of the OU1 RA. If necessary, adjustments to the ISCO pre-design investigation will be affected based on the current distribution of VOCs in groundwater in close proximity to the Fulton Avenue Property.

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[1] The Order specified that groundwater samples be collected every 120 days from multi-level wells MWs 26 & 27 (MWs 26A-H & 27A-H), and the following conventional wells: MWs 21A, 21B & 21C for three events commencing in September 2009 and concluding in April 2010 with the third event.

2.1.3 *Continued Monitoring Near Garden City Public Supply Well Nos. 13 & 14*

The SOW requires a continuation of the groundwater monitoring program currently being performed under the Order at a yet to be determined frequency to monitor groundwater quality immediately upgradient and downgradient of Village of Garden City Public Supply Well Nos. 13 & 14. The SOW requires that the first round of this continued interim sampling commence within 30 days of USEPA approval of the OU1 RD Work Plan. However, the one-time comprehensive pre-design groundwater monitoring well water level measurements and sampling described in Section 2.1.2 will commence within 30 days of approval of the OU1 RD Work Plan and will suffice for the first event.

This continued sampling activity will occur at a frequency yet to be determined but will cover the interim period of time between April 2010 and implementation of the OU1 RA components at which time this monitoring would be replaced by short- term performance monitoring followed by long-term effectiveness monitoring. The results thereof, in conjunction with the existing data set will be used to select and propose the frequency of the continued interim sampling to USEPA.

Each continued sampling event will involve the collection 19 groundwater samples (plus appropriate QA/QC samples) will be collected from multi-level wells MWs 26 & 27 (MWs 26A-H & 27A-H), and the following conventional wells: MWs 21A, 21B & 21C. All groundwater samples will be analyzed for TCL VOCs using USEPA Method 8260B.

2.2 *PRE-REMEDIAL ISCO CHARACTERIZATION ACTIVITIES*

Effective implementation of in situ remediation technologies (e.g., chemical oxidation) requires a detailed understanding of the three-dimensional (3D) distribution (i.e., architecture) of contaminant mass in the subsurface. In situ remedial technologies require direct contact of a stoichiometrically appropriate amount of the remedial additive with the contaminants. If too little of the remedial additive is applied or not emplaced in the proper location, then the remediation program will not achieve the desired objective.

Typically, the distribution of chlorinated solvents in the subsurface is very complex and concentration gradients are very steep (i.e., concentration differences of two to three orders of magnitude typically occur over horizontal and vertical distances of less than 10 feet). Therefore, the probability of successful remediation can be significantly enhanced if the distribution of the most contaminated zones (i.e., source zones and plume cores) can be accurately defined.

A larger volume of the subsurface is typically treated in the absence of well-defined contaminant architecture. Usually, this means application of the same mass of remedial additive within a significantly greater volume of the subsurface, which results in an excess of remedial additive in relatively clean portions of the treatment zone and an inadequate amount in the most contaminated zones. Thus, once the remedial additive is consumed within the most contaminated zones, monitoring wells in these zones experience concentration rebound.

Therefore, it is necessary to effectively define the source area and/or plume architecture to an appropriate scale to enable successful remediation. A pre-remedial characterization work plan will use high resolution techniques to identify subsurface groundwater intervals at and near the Fulton Property where higher concentrations of PCE reside. This information will be used to design a targeted ISCO treatment program that makes the most of reducing PCE concentrations in shallow groundwater before it migrates vertically to and into the Magothy Aquifer. The high resolution characterization will entail:

- Advancing up to 16 Membrane Interface Probe (MIP) borings outside of the Fulton Property building to a depth of approximately 130 feet (i.e., approximate depth of the Upper Glacial-Magothy boundary). The tentative locations of the MIP borings are shown in Figure 4. Data generated from the MIP logs will be used to create real-time plan view and cross-sectional diagrams of the VOC distribution in the subsurface to aid in data interpretation and support the dynamic decision-making process;
- Advancing up to eight Waterloo^{APS} borings and collect up to 10 discrete-interval groundwater samples per boring for laboratory analysis of VOCs by EPA Method 8260B; and
- Conducting a site survey in order to gather horizontal and vertical coordinates for all MIP and Waterloo^{APS} boring locations.

The MIP will be used to define the zones containing the greatest contaminant mass. The MIP is a direct-push, real-time, direct-sensing tool that provides continuous data on the distribution of VOCs in both the vadose- and saturated zones (Ravella et al., 2007). The MIP detects VOCs present as soil gas, sorbed phase, dissolved phase and non-aqueous phase liquid (NAPL). The MIP is a semi-quantitative tool that provides detailed resolution of VOC distribution in the subsurface, but does not provide contaminant speciation or concentration data. The MIP data are interpreted in real time to support a dynamic decision-making process that will enable efficient definition of the source area and plume architectures.

Once the source area and plume architectures have been defined using the MIP, the Waterloo^{APS} will be used to generate continuous relative permeability data. At selected depths, which will be selected using a combination of MIP data and relative permeability data generated using the Waterloo^{APS}, discrete-interval groundwater elevation measurements will be collected and groundwater samples collected for laboratory analysis of VOCs. Collectively, these hydrogeologic and contaminant data sets will be used to generate a detailed conceptual site model (CSM) for the Fulton Property, which will be used to support development of an effective remedial design.

MIP and Waterloo^{APS} borings will be pressure grouted to minimize the potential for mobilizing VOC contamination. Prior to conducting subsurface investigation activities, ERM will conduct a rigorous subsurface utility evaluation, including review of available utility maps, contacting Dig Safe, and manual clearance of boreholes to a target depth of 4 feet using air knife and/or vacuum excavation techniques.

2.3 GROUNDWATER PUMP & TREATMENT TESTING ACTIVITIES

2.3.1 Pre-Design Local Hydraulic Evaluation

A pre-design hydraulic evaluation of groundwater flow dynamics within the capture field of Village of Garden City Public Supply Well Nos. 9, 13 & 14 will be preformed during the RD. These data would be used as a basis to better understand local groundwater response to pumping of the wells in constructing a preliminary groundwater flow model, identify data gaps, potential new monitoring well locations, and the design of the recovery wells.

Groundwater monitoring wells MWs 20A, 20B, 20C, 21A, 21B, 21C, 22A, 22B, 22C, 23A, 23B, 23C, GCP 14S, GCP-14D, and GCWD Well Nos. 9, 13 & 14 will be outfitted with water level data loggers. Presuming cooperation with the GCWD, the pumping of the three public supply wells during the time these aforementioned monitoring wells are recording water levels will be documented. Preferably, the Village of Garden City Water Department will coordinate pumping of GCWD Well Nos. 9, 13 and 14 during certain times to ensure the three public supply wells are pumped in various combinations as well as simultaneously for specified periods of time to optimize the quality of the data set obtained from this activity. The various pumping scenario combinations will, to the extent practicable, represent potential operating scenarios, e.g., 9 on/13 off/14 on, 9 on/13 on/14 off, etc. Again, the cooperation of the Village of Garden City Water Department will be required to effectively implement this pre-design task.

2.3.2 *Vertical Profiling At Recovery Well Locations*

Soil borings and VP temporary wells will be installed at the proposed location of each groundwater recovery well. The objectives of the soil boring and VP temporary well installation and sampling:

- Define the lithology and geologic/hydrogeologic character of the subsurface at each recovery well location (e.g., the contact between the Upper Glacial and Magothy aquifers, clay layers, etc.);
- Identify zones of high solute (PCE) concentrations at each recovery well location for the purpose of identifying target zones for groundwater recovery and recovery well design; and
- Obtain the necessary data to properly design each recovery well.

Specific activities to be performed as part of the vertical profiling temporary well sampling task to achieve these objectives will include:

- Collection of soil samples at 10-foot intervals from the water table to approximately 450 feet below ground surface (bgs);
- Geophysical logging of each borehole;
- Collection of groundwater samples at 10-foot vertical intervals for VOCs; and
- Description of the structure of soils encountered, including layering and stratification features, and dominant soil types.

The VP temporary well groundwater samples will be analyzed for TCL VOCs using USEPA Method 8260B. Gradation analysis will be performed on soil samples collected from select intervals in the Magothy aquifer, i.e., targeted screen intervals based on the groundwater sample analytical results.

The hydrogeologic and contaminant data set of each VP will be subsequently evaluated to design each recovery well in terms of configuration, diameter, well screen lengths, settings and size.

2.4 VILLAGE OF GARDEN CITY PUBLIC SUPPLY WELL NOS. 13 & 14 TREATMENT SYSTEMS

2.4.1 Pre-Design Information Gathering/Access

Complete and accurate information will be required to properly evaluate whether the existing wellhead treatment system at The GCWD wells 13 and 14 is fully protective, and develop a plan to upgrade the existing wellhead treatment systems if groundwater entering one or both of those wells is shown to contain PCE at levels that are at 85% or greater than the treatment capacity for those wells. Information that will be required from the Village of Garden City Water Department will include but not be limited to:

- Up to date well construction logs – have they been sleeved during a past rehabilitation/service;
- Information regarding the procedures and results of the last rehabilitation/service;
- Current supply well equipment configuration (pumps, motors, confirm drive system);
- Operational schedule/methods for logging operation;
- Sampling schedule;
- Missing water quality data;
- Access for water level monitoring;
- Drawings representing as-built configurations of treatment systems including air strippers, piping, GAC units, booster pumps, storage tanks; and
- Treatment capacity evaluations, calculations/reports.

A formal solicitation for this information will be prepared and submitted to Garden City during the pre-design process. Again, the cooperation of the Village of Garden City Water Department will be required to effectively implement this pre-design task.

3.0 REMEDIAL DESIGN ACTIVITIES

3.1 GROUNDWATER MODELING

The OU1 Remedy consists of two key components to actively address the PCE-dominant portion of the contaminant plume: 1) ISCO treatment of the shallower groundwater at and near the 150 Fulton Avenue Property, and 2) extraction and treatment of PCE-impacted groundwater from the deeper Magothy aquifer at locations upgradient of GCWD Nos. 13 & 14 followed by subsequent recharge of the treated groundwater to the Upper Glacial aquifer.

A three-dimensional groundwater flow model will be developed and used as a multi-purpose tool to assist in design of the ISCO and Extraction, Treatment & Recharge remedial components, and predict certain potential effects of implementing the same. The model will be used throughout the remedial design process and in order to maximize the use of this tool, the model will be updated, augmented and refined using information obtained throughout the course of the pre-design and design activities.

Subsequent use of the groundwater model will depend on the findings and/or needs of the pre-design activities and remedial design. The modeling objectives, format and data needs are discussed further below.

3.1.1 *Modeling Objectives*

The general purpose of a groundwater model is to simulate groundwater flow in an aquifer or system of aquifers in order to predict the movement of groundwater, and infer the paths that associated contaminants present in groundwater will follow. Such a model is performed by computer and utilizes software into which site-specific characteristics are entered. These characteristics include information regarding aquifer material, permeability, aquifer geometry, aquifer boundaries, various stresses on the aquifer and the relationship between the aquifers being simulated.

The primary project objectives for the modeling task are to:

- Develop a quantitative, Site-specific tool to illustrate groundwater flow within the Upper Glacial and Magothy aquifers;
- Understand the hydraulic influence of operating public supply wells on the Upper Glacial and Magothy aquifers, regional groundwater flow dynamics, the PCE-dominant plume, and the larger, regional TCE-dominant plume;

- Understand how the additive hydraulic influences of the extraction wells and subsequent recharge of treated groundwater may potentially affect:
    - the operating public supply wells,
    - regional groundwater flow dynamics,
    - the PCE-dominant plume, and
    - the larger, regional TCE-dominant plume;
- Assist in identifying the required number, configurations, and locations of extraction wells, pumping rates, and evaluate specific groundwater discharge alternatives and potential effects thereof;
- Assist in identifying the required number, configurations, and locations of ISCO injection points, and treatability studies to determine the number of injections, chemical usage, and well spacing necessary to achieve the cleanup objectives;
- Assist in identifying the required number, configurations, and locations where additional groundwater monitoring wells may be needed to properly assess short-term remedial performance, and long-term remedial effectiveness of the ISCO and Extraction, Treatment & Recharge remedial components through hydraulic and groundwater quality monitoring; and
- Develop a tool that can be used to evaluate various remedial scenarios (i.e. number and location of recovery wells, pump rates) and Village of Garden City public supply well operating scenarios.

3.1.2 Modeling Format & Data Needs

It is anticipated that the groundwater flow model developed for the remedial design will utilize the United States Geological Survey's (USGS) MODFLOW code (McDonald and Harbaugh, 1988). MODFLOW is a three dimensional finite-difference model that can account for heterogeneity, anisotropy and varying boundary conditions. MODFLOW is a publicly available code, well documented and widely used in the private and public sectors.

Construction of the groundwater flow model will require assimilation of regional hydrogeologic information available in published USGS reports, information derived from Site-specific studies conducted during the RI or pre-design studies discussed further in Section 2.0, information and information derived from investigative activities at nearby sites available from the USEPA and NYSDEC (e.g. Jackson Steel).

3.2 IN-SITU CHEMICAL OXIDATION

ISCO will be conducted in the Upper Glacial aquifer portion of the PCE-dominant plume. Approximately 10 chemical injection wells will be placed at and near the Fulton Property based on the results of the pre-remedial ISCO characterization activities. ISCO technology will be applied as an initial enhancement in the area at, and near the Fulton Property and two rounds of chemical injection are currently planned. The purpose of the ISCO component of the OU1 RA and conceptual design are discussed below.

3.2.1 Purpose

The purpose of ISCO would be to reduce the chemical mass in the PCE-dominant plume in the Upper Glacial aquifer. ISCO application at or near the Fulton Avenue Property would reduce or eliminate a secondary source (i.e., elevated PCE concentrations in shallow groundwater) before it is able to migrate into deeper portions of the aquifer.

3.2.2 System Description

Permanganate would be injected at ten injection locations in the immediate vicinity of the Fulton Avenue Property. Tentative locations are shown in Figure 5, were selected based on the assumption that vertical application wells have a 30-foot radius of influence and there is 200 feet of downgradient advective flow with minimal dispersion.[2] Each injection location would extend to approximately 80 feet bgs and would be targeted to treat the upper 20 to 35 feet of the shallow aquifer. The final ISCO injection locations proposed in the Pre-Final Design Package (Section 5.0) will be revised based on the findings of the Pre-Remedial ISCO Characterization Studies (Section 2.2) and the ISCO Design Studies discussed in Section 3.2.4 below.

Injection wells will either be dedicated points or direct push technology for oxidant delivery may be considered during the design-phase. This may allow for: greater flexibility in accessing initial injection locations, subsequent injections at different locations (e.g., “dead zones”), and a reduction in the volume of remedial wastes such as drill cuttings requiring management and disposal. Use of this technology would be considered in the context of the Site-specific conditions and constraints. In selecting the most suitable method of injection, the efficacy and ease of use

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[2] Selected based upon historical transport on LI projects

of permanent injection well points versus use of direct push technologies would be considered in conjunction with other advantages and disadvantages of both methods, as well as potential project cost implications (adders or savings).

3.2.3 Effectiveness Assessment

Following oxidant injection groundwater monitoring would be conducted to track the post injection performance of ISCO. A total of eight ISCO performance evaluation wells would be installed – two upgradient, two downgradient, two within the application area; one to east and one to the west of the ISCO injection area (at various radii and distance to the point(s) of injection as Site conditions allow).

The goal of the ISCO application will be to reduce VOC mass present in the shallow aquifer before it is able to migrate vertically downward and spread in the Magothy Aquifer. The criteria that will determine whether the ISCO treatment is effective are:

- Reduction of residual VOC concentrations in shallow groundwater at each measurement point within the ISCO treatment footprint to levels below the higher of the Maximum Contaminant Levels (MCLs) or upgradient concentrations;
- Reduction of residual VOC concentrations in shallow groundwater to levels below the higher of the MCLs or upgradient concentrations based on a calculation of the 95 percent confidence interval VOC concentrations as determined from post-treatment monitoring well samples obtained within the ISCO treatment footprint; or,
- Reduction of at least 75% percentage of the residual VOC mass in shallow groundwater based on a comparison of the pre-and post-treatment VOC concentrations from monitoring points within the ISCO treatment footprint.

A determination that the goal of the ISCO treatment has been met via one or more of the above criteria will be subject to at least one second confirmation round or post treatment sampling to evaluate whether rebound effects are apparent.

Subsequent ISCO injections, if needed, would then be planned taking into consideration the subsequent plume concentrations and configurations. The design studies would be used to address the various uncertainties associated with implementation of this remedial activity – additional chemical mass, potentially larger plume boundaries, variable soil oxidant demand (SOD) and the inability to meet the MCLs given the technology limitations and the presence of upgradient contamination.

3.2.4 *Design Studies*

As part of the OU1 RD, studies would be conducted to determine the most appropriate and effective oxidant for the Upper Glacial portion of the PCE-dominant plume and to refine the estimates regarding oxidant application. The two oxidants identified during the FS bench-scale testing would be evaluated during the design phase. They are dry media injection of potassium permanganate and injection of liquid potassium permanganate. Design testing would be conducted in the Upper Glacial aquifer. Parameters considered during the design study would include, but not be limited to: oxidant form, supply concentration, delivery concentration, most suitable method of injection (e.g., efficacy and ease of use of permanent injection well points versus use of direct push technologies), advantages and disadvantages of these parameters, and project costs, etc.

The design study would entail conducting single well applications using both techniques, monitored by three newly constructed monitoring wells. The design testing program would therefore simulate the full-scale application of each oxidant, using separate testing areas, monitored by several new, as well as existing, monitoring wells. At each location, the design oxidant dose would be mixed and injected into the installed wells. The two design study ISCO injection and three monitoring well locations will be selected based on the findings of the Pre-Remedial ISCO Characterization Studies (Section 2.2).

Post-application monitoring would then be used to evaluate the comparative efficiency and effectiveness of each oxidant. Review of the data from the pre-design program would be used to confirm the efficacy of the technology, select the proper oxidant, establish appropriate remedial goals for the ISCO component of the OU1 RA, and confirm the full-scale oxidant dosages.

3.3 *GROUNDWATER EXTRACTION, TREATMENT AND RECHARGE*

Groundwater will be extracted, treated and recharged at downgradient locations within the PCE-dominant portion of the plume. The extraction wells will be installed in the Magothy Aquifer.

3.3.1 *Purpose*

The purpose of the extraction wells will be to remove groundwater from zones within the Magothy Aquifer where high concentrations of PCE are apparent and represent the greatest impact to water quality GCWD Well Nos. 13 and 14. The goal will reduce the VOC mass within the PCE-dominant groundwater plume upgradient of the public supply wells such that the influent groundwater quality to GCWD Well Nos. 13 and 14 is reduced.

3.3.2 *System Description*

Up to two groundwater extraction wells will be placed within the PCE-dominant plume upgradient of GCWD Well Nos. 13 and 14.
These wells would intercept the PCE-dominant plume. The locations, configurations, pumping rates, and specific groundwater discharge alternatives will be evaluated using the existing data set, data obtained from the pre-design studies including the comprehensive pre-design groundwater water level measurement and sampling event, vertical profiling, the comprehensive groundwater sampling event, the public supply well pumping hydraulic evaluation, and the 3D groundwater flow model.

The extracted groundwater will either be pumped by subsurface pipes to a treatment system housed in a building constructed on vacant property adjacent to Nassau County Recharge Basin 232 or be treated and recharged at the point of extraction. The preferable treatment option will be evaluated during the OU1 RD.

The groundwater treatment systems will consist of shallow-tray air stripping units, or comparable systems. If off-gasses from the air stripping units exceed regulatory thresholds the emissions will be treated prior to discharge.

The amount of groundwater extraction will be moderated to minimize, to the extent practical, any reduction in water volume to the public supply wells. Hence, a portion of the PCE-dominant plume that has passed the extraction wells and is beyond the capture zone would continue to be treated via the treatment systems at GCWD Well Nos. 13 and 14. The conceptual combined treatment approach using ISCO and the conceptual extraction well layout showing estimated capture fields is depicted in Figure 6. (Note, this figure only shows centralized collection, treatment and recharge of extracted groundwater. The RD will evaluate alternatives for treatment and recharge locations).

3.3.3 *Effectiveness Monitoring*

The goal of groundwater extraction will be to capture PCE contaminated groundwater, treat and recharge it before it has the opportunity to enter the capture zones of GCWD Well Nos. 13 and 14. This goal needs to balance the extent to which the groundwater extraction wells create a hydraulic barrier with the physical limitations in locating the extraction wells and desire not to hydraulically impair the operation of GCWD Well Nos. 13 and 14. The criteria that will determine whether the groundwater extraction is being effective are:

- Establishing through measuring at a series of monitoring points a potentiometric surface that defines the extent of capture resulting from the pumping of extraction wells;
- Laboratory analysis of extracted water prior to treatment to document the amount of VOC mass removal;
- Laboratory analysis of treated groundwater to demonstrate treatment efficiency; and,
- Real-time measurement and periodic laboratory analysis of off gasses from treatment system (whether vapor phase treatment is required or not pursuant to regulatory emission standards)

The RD will also identify additional criteria to be used in assessing when continued operation of the groundwater extraction wells will no longer contribute, substantively, to a reduction in the VOC influent concentration to GCWD well Nos. 13 and 14 present in the PCE-dominant plume.

3.3.4 Design Studies

The OU1 RD will locate each groundwater extraction well in an accessible area to minimize impact to private property. The depth and diameter of each extraction well, screen length and pump rate will be based on the pre-design vertical groundwater profiling and modeling results.

Elements of the OU1 RD will include:

- Updated Extraction Well Location and Capture Area Evaluation;
- Extraction Well Design;
- Extraction Well Discharge Piping Route & Recharge Point;
- Treatment System Buildings/Pits;
- Treatability Testing/Evaluation (TOC, COD, BOD, TPH, TAL metals, hardness, alkalinity, TSS, TDS, ammonia, TKN, orthophosphate, total phosphorus, nitrate, nitrite, silica, sulfide, sulfate, and chloride); and
- Treatment System Evaluation/Selection (groundwater and/or vapor).

3.4 VILLAGE OF GARDEN CITY PUBLIC SUPPLY WELL NOS. 13 & 14 TREATMENT SYSTEMS EVALUATION

The GCWD relies on internal and external engineering support to maintain GCWD Well Nos. 13 and 14, including the design, installation and operation of treatment systems intended to remove VOCs from influent groundwater before conveying the water into the public supply system. The history of treatment design, installation and upgrades has been documented in various reports completed for the GCWD.

The OU1 RD will include an engineering evaluation of the existing wellhead treatment system at GCWD Well Nos. 13 and 14 to determine if the current system is fully protective in its current configuration, and development of a plan to upgrade the existing wellhead treatment systems if groundwater entering one or both of those wells is shown to contain PCE at levels at levels that are at 85% or greater than the treatment capacity for those wells. Information that will be required from the Village of Garden City Water Department to complete the aforementioned evaluation and prepare the plan is identified in Section 2.4.1. Background information concerning PCE concentration trends in groundwater and details concerning these two tasks to be undertaken are presented below.

3.4.1 Purpose

The SOW anticipates the RD to undertake an evaluation of the wellhead treatment system at GCWD Well Nos. 13 and 14 following the most recent upgrade completed in the Spring of 2007. The purpose of the evaluation is to render an independent assessment of ability of the upgrade to adequately treat influent water to meet applicable VOC water quality standards when under proper operation.

The evaluation should consider the trend in VOCs, particularly PCE, both at the closest monitoring wells (the MW21 cluster) and the two public supply wells discussed further below.

3.4.2 System Description

The wellhead treatment system at GCWD Well Nos. 13 and 14 currently includes primary and secondary treatment processes for the removal of VOCs. Raw water from each well is pumped from the ground to two counter-current, packed aeration air stripping towers, each one of which treats the flow capacity of one well. The raw water flows down through the towers via gravity as ambient air is blown into the bottom of the tower through a plenum. As the water flows down through the tower, its surface areas is maximized by inert "packing" media. This maximization of surface area creates intimate contact between the air and water, causing the VOCs to "strip" from the water and enter the air. The stripped water is collected in the sump of each tower, and the air is discharge to the atmosphere. The packed aeration system operates at a treatment efficiency of approximately 99.3%. Thus, with a maximum system contaminant influent level of 3,000 micrograms per liter (µg/l), 99.3% removal will result in an effluent concentration of approximately 20 µg/l, which would still exceed the drinking water MCLs of 5 µg/l.

The water treated by the primary process discharges from the tower sumps to the on-site 1,500,000-gallon storage tank. From the storage tank, water is withdrawn via the existing booster pumping system, which has a maximum pumping capacity of 2,800 gallons per minute (GPM), and pumped to the secondary treatment processes to remove any residual PCE that is found in the air stripping system effluent.

The secondary treatment process includes four exterior granular activated carbon (GAC) filter vessels, each of which can treat a maximum recommended flow of 700 GPM. Each vessel has a capacity to contain 20,000 pound of GAC, for a total GAC capacity of 80,000 pounds. The vessels are arranged in a parallel design such that each vessel is in service at all times. The parallel design is necessary to accommodate the 700 GPM hydraulic limitation of each vessel. Currently, the GAC filters are located on a concrete foundation without any freeze protection, requiring the vessels be shut down during the winter thereby limiting production to what the stripping towers alone can accommodate. Treated water exiting the GAC filter system feeds directly into the Village of Garden City Water Department public water distribution system[3].

3.4.3 Engineering Studies

The responsibility and control of operation and treatment systems associated with GCWD Well Nos. 13 and 14 lies with the Village of Garden City. It and its external engineering contractors have undertaken a number of studies that have resulted in modifications and additions to the treatment systems at these two wells in response the VOCs present in the aquifer (Magothy) the wells tap.

The treatment system was upgraded in the Spring of 2007 in response to increasing levels of PCE observed in groundwater at the Monitoring Well 21 location. Since that time, concentrations of PCE have either stabilized or decreased as shown in Figure 7.

The two charts presented in Figures 8 and 9 show the trend in concentration of PCE and TCE in the influent water quality of each well (Well Nos.13 and 14) along with the monthly pumping volume (in

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[3] The system description was obtained from the 19 October 2009 H2M comment letter (H2M, 2009), which was attached to the 19 October 2009 Sive Paget Letter (Sive Paget, 2009) that conveyed comments on the Fulton Avenue OU1 CJ and SOW on behalf of the Village of Garden City.

millions of gallons). Each chart also shows the maximum reported monthly pumpage capacity for each well along with the treatment capacity (3,000 µg/l) and 85% of the VOC treatment capacity threshold in comparison to the historic concentrations of PCE and TCE, the two predominant VOCs present in influent groundwater. [4]

As evident in these two charts, the historic influent concentrations to both wells have never approached 85% of the treatment design capacity. And the pumping rate of both wells have, at times, reached and even exceeded the maximum monthly production capacity. Together with the data from well clusters aligned down the spine of the PCE plume being periodically sampled to monitor changes in the plume, particularly the well cluster upgradient of wells 13 and 14 (the MW21 cluster), it appears unlikely that influent concentrations in the supply wells will ever approach the 85% treatment capacity threshold.

The RD will conduct an independent technical review the existing engineering documents prepared by or for the GCWD that relate to the treatment of GCWD Well Nos. 13 and 14. Additionally, the RD will compile the most existing and most recent operating information as described in section 2.4 to supplement its review provide an opinion of the ability of the 2007 upgrade to adequately treat influent water to meet applicable VOC water quality standards when under proper operation. This independent technical review will need to rely heavily on the information obtained from Garden City.

3.4.4 Wellhead Treatment System Upgrade Plan Development

In accordance with the SOW, a contingency plan will be developed to upgrade the wellhead treatment systems for the GCWD wells 13 and 14 if groundwater entering one or both of those wells is shown to contain PCE at levels that are at 85% or greater than the treatment capacity for those wells. The plan also will provide for replacing components of, or repairing, the existing or upgraded wellhead treatment systems for wells 13 and 14 when necessary to ensure the protectiveness of those systems.

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[4] The maximum monthly pumpage value was obtained from the 19 October 2009 H2M comment letter (H2M, 2009), which was attached to the 19 October 2009 Sive Paget Letter (Sive Paget, 2009) that conveyed comments on the Fulton Avenue OU1 CJ and SOW on behalf of the Village of Garden City. The H2M letter refers to 1.58 million gallons per day (MGD) as the maximum production capacity for each well. This translates to 48,980,000 gallons per month for each well.

3.5 SITE MANAGEMENT PLAN

A Site Management Plan will be prepared that provides for the proper management of all OU1 RA components post-construction, such as institutional controls, and which will also include: (a) monitoring of Site groundwater to ensure that, following remedy implementation, the groundwater quality improves; (b) provision for any operation and maintenance required of the components of the remedy; and (c) periodic certifications by the owner/operator or other person implementing the remedy that any institutional and engineering controls are in place.

3.5.1 Groundwater Monitoring

Groundwater monitoring will be required to assess the efficacy of the remedial action and to confirm the configuration of the PCE-dominant plume as the remedy progresses. The SMP will include groundwater monitoring plans that take into account the specific data requirements for short-term remedial performance, and long-term remedial effectiveness evaluations of each remedial component, *e.g.*, the ISCO component, and the groundwater extraction, treatment and recharge system.

Specific goals of the groundwater monitoring program would be to:

- Assess migration and attenuation of groundwater contamination in the OU1 part of the plume, i.e., verifying that the concentrations and extent of groundwater contaminants are declining;
- Evaluate the efficacy of the ISCO treatments and determine if additional oxidant injections are needed;
- Evaluate the effects the groundwater extraction and recharge on local flow dynamics and the regional aquifer system, adjust operating parameters as necessary to mitigate any potential negative effects; and
- Confirm that OU1 part of the plume has not migrated beyond Garden City Public Supply Well Nos. 13 &14.

A simple example of the proposed groundwater monitoring program to be refined during the OU1 RD is presented below.

For short-term performance and long-term remedial effectiveness monitoring, groundwater monitoring would be conducted for the duration of each OU1 RA component. However, sampling may cease at certain wells before others.

For example, an additional eight monitoring wells would be installed to evaluate the short-term performance and efficacy of the ISCO applications. These wells would be monitored for field parameters during weeks 1, 2, 6, 10 and 12 after ISCO application. Groundwater samples would then be collected and analyzed for TCL VOCs in week 6 and 12 after application, quarterly thereafter for a total of 2 years following injection. The results from these monitoring wells would be used to determine if additional oxidant injections were needed.

Long-term effectiveness monitoring of groundwater in the Upper Glacial portion of the PCE-dominant plume (i.e., sampling monitoring wells GCP-01, 01D, 08, 18S, 18D) would cease after ISCO has been implemented and demonstrated to have successfully treated this portion of the PCE-dominant plume to the higher of the MCLs and upgradient groundwater concentrations. For cost estimation purposes in the FS, this time period was conservatively been assumed to be five years.

Groundwater sampling in the Magothy wells (i.e., GCP-15S, MWs 26 & 27 (MWs 26A-H & 27A-H), MW-15A, 15B, 21A, 21B, 21C, , 23A, 23B, 23C and 23D) would be conducted until the PCE-dominant plume between GCP-08 and GCWD Supply Wells Nos. 13 and 14 has been treated to the higher of the MCLs or the upgradient concentrations.

All groundwater samples would be collected using USEPA-approved low flow protocols, and analyzed for TCL VOCs using USEPA Method 8260B.

Based on the above discussion, the groundwater monitoring frequency contemplated to assess the efficacy of the remedial action and to confirm the configuration of the PCE-dominant plume as the remedy progresses would be as follows:

<u>Upper Glacial Wells</u>
Years 1 through 2: semi-annual
Years 3 through 5: annual

<u>Magothy Wells</u>
Years 1 through 10: annual
Years 11 through 15: biennial

Lastly, effluent samples of treated groundwater to be recharged will be collected monthly to verify compliance with the NYSDEC surface water or groundwater discharge requirements and the State Pollution Discharge Elimination System ("SPDES") effluent criteria.

3.5.2 *Operations, Maintenance and Monitoring Plan*

An Operations, Maintenance and Monitoring (OM&M) Plan which shall include the elements of the SMP. The OM&M Plan shall be prepared in accordance with the Superfund Remedial Design and Remedial Action Guidance, Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-4A. The OM&M Plan shall also include, but not be limited to, the following:

- A description of the personnel requirements, responsibilities, and duties, including a discussion for training, lines of authority;
- A description of all construction-related sampling, analysis, and monitoring to be conducted under the CJ;
- A description of all OU1 Remedial Action-related monitoring requirements; and
- A description of how the OM&M will be performed in accordance with EPA Region 2's Clean and Green Policy.

3.5.3 *Institutional/Engineering Control Certifications*

Part 5 of the NYS Department of Health State Sanitary Code, which prevents installation of a private potable water supply well in areas, which are served by a public water supply system, would continue to be enforced. This would prevent contact with the PCE-dominant plume before it is either treated via ISCO, or is extracted and treated at GCWD Well Nos. 13 and 14.

3.5.4 *5-Year Reviews*

Due to the interim nature of the OU1 RA, it may take longer than five years to achieve the performance standards. Consequently, USEPA will conduct a periodic review of Site conditions no less often than once every five years.

3.6 *GREEN REMEDIATION PLAN*

The OU1 RA will be designed in accordance with USEPA Region 2's Clean and Green Policy ("Green Strategy"). This policy may be found at:

http://www.epa.gov/region02/superfund/green_remediation/ policy.html.
Accordingly, a Green Remediation Plan ("GRP") will be prepared that specifies how the OU1 Remedial Action will be implemented using the principles in EPA Region 2'sClean and Green Policy. Some of the approaches that will be considered during the design to reduce the carbon

footprint and operating costs of the OU1 RA will include the use of recycled and/or energy efficient building materials, energy efficient equipment, natural and high efficiency lighting, solar energy, heat pumps, capture and reuse of thermal energy from treatment equipment, and selective recycling of wastes generated by the construction and OM&M of the OU1 RA.

3.7 CONSTRUCTION QUALITY ASSURANCE PLAN

A Construction Quality Assurance Project Plan ("CQAPP") will be prepared detailing the approach to quality assurance during construction activities at the Site. The CQAPP will identify a Quality Assurance Official, independent of the Supervising Contractor (ERM), to conduct a quality assurance program during the construction phase of the project. The CQAPP will address sampling, analysis, and monitoring to be performed during the construction phase of the OU1 RA.

Quality assurance items to be addressed include, at a minimum, the following:

- Inspection and certification of the work;
- Measurement and daily logging;
- Field performance and testing;
- Post-construction drawings; and
- Testing of the OU1 RA e.g., post-excavation sampling) to establish whether the design specifications have been attained.

3.8 ACCESS, PERMITS & OTHER APPROVALS

Access to information and physical properties, various permits and other approvals (in addition to those from USEPA) will be required to design and implement the OU1 RA. The procurement processes for the same vary and not all have been identified since the design process has not yet begun. Preliminary information is presented in the subsections below, to be supplemented in the early stages of the OU1 RD process. To the extent known, the Preliminary Design (30%) Report (Section 4.1) will identify all required access, permits and other approvals, and include descriptions detailing how such access, permits and other approvals will be sought, and include a schedule for obtaining the same.

3.8.1 Access

Access to certain information and physical properties will be critical to the design and implementation of the OU1 RA. The preliminary list of required information presented in Section 2.4 will be supplemented as required during the OU1 RD process. Continued or new access to one or more of the following physical properties may be required:

- 150 Fulton Avenue Property;
- Town of North Hempstead (Garden City Park) Streets (ISCO);
- Garden City Streets (Extraction Wells, Vaults, New Monitoring Wells – Road Opening Permits);
- Garden City Empty Lot For Treatment Building Site;
- Garden City Information Regarding Public Supply Well Nos. 13 & 14 and Associated Treatment Systems;
- Garden City Public Supply Well Nos. 13 & 14 and Associated Treatment Systems;
- Nassau County Department of Public Works (NCDPW) Recharge Basin No. 132 (Recharge of Treated Groundwater);
- Bird Sanctuary on NCDPW Recharge Basin Property; and
- Garden City Country Club Golf Course (Sampling existing multi-level wells).

Once those access approvals are identified, written requests will be prepared and submitted in a timely manner to obtain those access approvals. If necessary, the approval process may include face to face meetings or other actions necessary to obtain all such permits or approvals in a timely manner.

3.8.2 Permits

As provided in Section 121(e) of CERCLA and Section 300.400(e) of the NCP, no permit shall be required for any portion of the OU1 RA conducted entirely on-Site (i.e., within the areal extent of contamination or in very close proximity to the contamination and necessary for implementation of the Work).

Where any portion of the OU1 RA that is not on-Site requires a federal or state permit or approval, appropriate applications will be prepared and submitted in a timely manner to obtain those permits or approvals. If necessary, the permit or approval process may include pre-application meetings or other actions necessary to obtain all such permits or approvals in a timely manner.

3.8.3 Other Approvals

Approvals may include the consent of property owners at or near the Site regarding access to conduct sampling, monitoring, remediation, restoration or other activities, and approval from any off-Site facility accepting waste materials from the Site. Once those other approvals are identified, written requests will be prepared and submitted in a timely manner to obtain those approvals. If necessary, the approval process may include face to face meetings or other actions necessary to obtain all such permits or approvals in a timely manner.

3.9 SURVEYING

As part of the design process, a NYS-licensed surveyor will be retained to prepare accurate surveys of all properties on which OU1 RA activities will be performed. Those areas include:

- The Fulton Avenue Property;
- In-Situ Oxidation Area;
- Extraction Well Locations;
- Recovered Groundwater Piping Runs;
- The Groundwater Treatment Plant Location; and
- NCDPW Recharge Basin No. 132 (Recharge of Treated Groundwater).

Where appropriate, the surveying subcontractor will obtain, rely upon and field verify existing survey information from Town of North Hempstead and Garden City. Typical survey information to be presented on the design drawings will include at a minimum:

- A topographic survey, including existing and proposed contours and spot elevations for all areas that will be affected by the remedial activities, based on U.S. Coast and Geodetic Survey data;
- All easements, rights-of-way, and reservations;
- All buildings, structures, wells, facilities, and equipment (existing and proposed) if any;
- Roadways, sidewalks and curbs.
- All utilities, existing and proposed, in areas where OU1 RA construction activities will be performed;

- Location and identification of all significant natural features including, inter alia, wooded areas, water courses, wetlands, flood hazard areas, and depressions;
- Flood hazard data and 100-year and 500-year flood plain delineation;
- North arrow, scale, sheet numbers and the person responsible for preparing each sheet; and
- Definitions of all symbols and abbreviations.

3.10 UTILITIES

3.10.1 Electric

Electrical service from the Long Island Power Authority (LIPA) will be required to operate the groundwater extraction wells and the groundwater treatment plant.

3.10.2 Natural Gas

Natural gas service from the National Grid will be required for heating purposes at the groundwater treatment plant.

3.10.3 Potable Water

Potable water service from the Garden City Water Department will be required at the groundwater treatment plant.

3.10.4 Telephone

Telephone service from the Verizon will be required at the groundwater treatment plant.

4.0 PRELIMINARY (30%) REMEDIAL DESIGN

The OU1 Remedial Design will include the preparation of a Preliminary (30%), a Pre-Final and a Final RD Packages. The OU1 RD Packages will be submitted to USEPA and NYSDEC in accordance with the schedule set forth in the approved OU1 RD Work Plan. Each OU1 RD Package will include a discussion of the design criteria and objectives, with emphasis on the capacity and ability to meet design objectives successfully. Each package will also include the plans and specifications that have been developed at that point in time, along with a design analysis. The content of the Preliminary OU1 RD Package is discussed below.

4.1 PRELIMINARY DESIGN REPORT

4.1.1 Introduction

The introduction of the OU1 Preliminary RD Report will summarize the purpose of the report, present an overview of the OU1 RA and each of its components, and reiterate the OU1 RA objectives, performance standards, and regulatory requirements such as ARARs.

4.1.2 Design Objectives & Criteria

4.1.2.1 Design Objectives

The design objectives for each component of the OU1 RA will be identified and discussed in terms of how those objectives are aligned with the overall OU1 RA Objectives (Section 1.3.2).

4.1.2.2 Design Criteria

The criteria for designing each component of the OU1 RA will be identified and discussed in terms of how those criteria are appropriate and achievable, and if met, how each component of the OU1 RA will achieve the OU1 RA Performance Standards (Section 1.3.3).

4.1.3 Design Analysis

The design analysis will provide the rationale for the plans and specifications, including results of all pre-design sampling and testing performed, supporting calculations and documentation of how the plans and specifications will meet the requirements of the ROD, the OU1 RA

Objectives and Performance Standards, and will provide a discussion of any impacts these findings may have on the OU1 RD.

To the extent known at that time, the design analysis will identify all required access, permits and other approvals, and include descriptions detailing how such access, permits and other approvals will be sought, and include a schedule for obtaining the same.

4.2 PRELIMINARY DRAWINGS

The OU1 Preliminary (30%) RD Package will include a complete list of anticipated drawing sheet titles, and copies of all preliminary design drawings that have been developed at that point in time. The drawings will present an accurate identification of existing site conditions of all properties on which OU1 RA activities will be performed (Surveying - Section 3.10), and to the extent completed and available, the general arrangement of all OU1 RA work planned, which would include proposed equipment, improvements, details and all other construction and installation items.

The preliminary drawing submittal will also include a specification for any signs to be posted at the Site. Such signs will describe the project, the name of the contractor performing the OU1 RD and OU1 RA work, the State (New York) that the project is being performed under USEPA oversight, and provide an USEPA contact for further information;

All drawings will be of standard size, approximately 24" x 36" and developed in accordance with the current standards and guidelines of the State of New York. Typical items to be provided on the drawings that are completed for the preliminary submittal will include, at a minimum, the following:

- Title sheet including at least the title of the project, a key map, the name of the designer, date prepared, sheet index, and USEPA/NYSDEC Project identification numbers.
- A site survey including the distance and bearing of all property lines for 150 Fulton Avenue and all other properties on which OU1 RA activities will be performed.
- All easements, rights-of-way, and reservations;
- All buildings, structures, wells, facilities, and equipment (existing and proposed) if any;
- A topographic survey, including existing and proposed contours and spot elevations for all areas that will be affected by the remedial activities, based on U.S. Coast and Geodetic Survey data;

- All utilities, existing and proposed, in areas where OU1 RA construction activities will be performed;
- Location and identification of all significant natural features including, inter alia, wooded areas, water courses, wetlands, flood hazard areas, and depressions;
- Flood hazard data and 100-year and 500-year flood plain delineation;
- North arrow, scale, sheet numbers and the person responsible for preparing each sheet;
- Decontamination areas, staging areas, borrow areas and stockpiling areas;
- Miscellaneous detail sheets;
- Definitions of all symbols and abbreviations;
- Site security measures;
- Roadways; and
- Electrical, mechanical, and/or structural plans, as required.

4.3 PRELIMINARY SPECIFICATIONS

The OU1 Preliminary (30%) RD Package will present a Table of Contents, as necessary, for the specifications, including a listing of items from the Construction Specifications Institute master format that are expected to be included in the OU1 RA Construction Specifications. This master format is presented in the Construction Specifications Institute's Manual of Practice, 1985 edition, available from the Construction Specifications Institute, 601 Madison Street, Alexandria, Virginia 22314.

In addition to the specification for OU1 RD/RA Site signage discussed in Section 4.2 above, the OU1 Preliminary (30%) RD Package will include a draft technical specification for photographic documentation of the remedial construction work.

4.4 PRELIMINARY OU1 RA AND OM&M SCHEDULES

The OU1 Preliminary (30%) RD Package will include updated versions of the preliminary draft schedules for OU1 RA and OM&M activities discussed in further Section 6.2 and submitted with this OU1 RD Work Plan. The schedules will be updated to reflect refinement in planning of the OU1 RA implementation achieved during the design process and address any comments from USEPA.

4.5 APPENDED PLAN OUTLINES

4.5.1 Site Management Plan

An outline (proposed Table of Contents) of ERM's project-specific Site Management Plan (SMP), discussed in Section 3.6, will be provided along with a narrative describing the components/aspects of the OU1 Remedy to which the plan is applicable. Key issues that have been identified at this stage requiring resolution will also be noted therein.

4.5.2 Operation, Maintenance & Monitoring Plan (OM&M) Plan

An outline (proposed Table of Contents) of ERM's project-specific Operation, Maintenance and Monitoring Plan (OM&M), discussed in Section 3.6.2, will be provided along with a narrative describing the components/aspects of the OU1 RA to which the plan is applicable. Key issues that have been identified at this stage requiring resolution will also be noted therein.

4.5.3 Green Remediation Plan

An outline (proposed Table of Contents) of ERM's project-specific Green Remediation Plan, discussed in Section 3.7, will be provided along with narrative describing/identifying components/aspects of the OU1 RA that can be aligned with the expectations of EPA's Clean and Green Policy. If there are to be significant departures from or obstacles to meeting basic expectations of the policy, those departures/obstacles will also be identified with supporting rationale for the same.

4.5.4 Construction Quality Assurance Plan

An outline (proposed Table of Contents) of ERM's project-specific Construction Quality Assurance Project Plan (CQAPP), discussed in Section 3.8, will be provided along with a narrative describing the components/aspects of the OU1 RA to which the plan is applicable. Key issues that have been identified at this stage requiring resolution will also be noted therein.

5.0 PRE-FINAL/FINAL REMEDIAL DESIGN

The OU1 Remedial Design will include the preparation of a Preliminary (30%), a Pre-Final and a Final RD Packages. The Pre-Final RD Package will reflect a 95% complete design of the OU1 RA conformed to USEPA comments on the Preliminary (30%) RD Package and any subsequent adjustments required to advance the design to 95%. The Final OU1 RD Package will reflect the complete design (100%) of the OU1 RA conformed to USEPA comments on the Pre-Final RD Package and any subsequent adjustments required to complete the design.

The OU1 RD Packages will be submitted to USEPA and NYSDEC in accordance with the schedule set forth in the approved OU1 RD Work Plan. Each OU1 RD Package will include a design report, drawings, plans and specifications that have been developed at that point in time. In addition to revised sections regarding the design objectives, criteria, and design analyses, the Pre-Final RD Report Design Report will include additional sections which are discussed below.

5.1 PRE-FINAL DESIGN REPORT

5.1.1 Introduction

This section will summarize the purpose of the report, present an overview of the OU1 RA and each of its components, and reiterate the OU1 RA objectives, performance standards, and regulatory requirements such as ARARs. Revisions will be made as required to conform this section to USEPA comments on the OU1 Preliminary (30%) RD Package.

5.1.2 Design Objectives & Criteria

5.1.2.1 Design Objectives

The design objectives for each component of the OU1 RA will be identified and discussed in terms of how those objectives are aligned with the overall OU1 RA Objectives (Section 1.3.2). Revisions will be made as required to conform this section to USEPA comments on the OU1 Preliminary (30%) RD Package.

5.1.2.2 Design Criteria

The criteria for designing each component of the OU1 RA will be identified and discussed in terms of how those criteria are appropriate and achievable, and if met, how each component of the OU1 RA will achieve the OU1 RA Performance Standards (Section 1.3.3). Revisions will be made as required to conform this section to USEPA comments on the OU1 Preliminary (30%) RD Package.

5.1.3 Design Analysis

The design analysis will provide the rationale for the plans and specifications, including results of all pre-design sampling and testing performed, supporting calculations and documentation of how the plans and specifications will meet the requirements of the ROD, the OU1 RA Objectives and Performance Standards, and will provide a discussion of any impacts these findings may have on the OU1 RD. Revisions will be made as required to conform this section to USEPA comments on the OU1 Preliminary (30%) RD Package.

The Design Analysis section of the OU1 Pre-Final RD Report will also include any Value Engineering Change Proposals (VECPs).

Value Engineering (VE) is defined in 23 CFR Part 627.3 as "the systematic application of recognized techniques by a multi-disciplined team to identify the function of a product or service, establish a worth for that function, generate alternatives through the use of creative thinking, and provide the needed functions to accomplish the original purpose of the project, reliably, and at the lowest life-cycle cost without sacrificing safety, necessary quality, and environmental attributes of the project."

VECPs are post-award value engineering proposals made by construction contractors during the course of construction under a value engineering clause in the contract. The Federal-Aid Policy Guide, FAPG G011.9, defines VECPs as "a construction contract provision which encourages the contractor to propose changes in the contract requirements which will accomplish the project's functional requirements at a less cost or improve value or service at no increase or a minor increase in cost. The net savings of each proposal is usually shared with the contractor at a stated reasonable rate."

5.1.4 Access Status

This section will describe those efforts made to secure access and institutional controls, obtain other approvals, the results of those efforts and any difficulties encountered along with proposed resolutions to the same. Legal descriptions of property or easements to be acquired will also be provided.

5.1.5 Updated RA Schedule

The preliminary draft schedules for OU1 RA and OM&M activities (discussed in further Section 6.2) will be revised and conformed to USEPA comments on the design drawings submitted with the OU1 Preliminary (30%) RD Package.

5.1.6 Contractor Selection Process

This section will describe the contractor selection process to be used subcontractor procurement to support implementation of the OU1 RA. Both competitive bidding and sole-source processes will be used to procure appropriate contractors and vendors for the various phases of the OU1 RA implementation.

Regardless of what procurement process is used, all contractors will have to meet ERM's minimum insurance requirements, and will have to be prequalified and approved to perform work for ERM.

In order to manage risks posed by high-hazard activities performed by ERM subcontractors, ERM has instituted a subcontractor health and safety prequalification process. The activities to be performed by the selected subcontractor may expose subcontractor personnel to hazardous chemicals or waste in the performance of their tasks. Therefore, requirements up to, and possibly including, OSHA standard 29 CFR 1910.120 (entitled Hazardous Waste Operations and Emergency Response) may be applicable to subcontractor services. The Subcontractor is required to recognize and comply with any OSHA or other regulatory requirements applicable to the services they provide to ERM. All prequalified subcontractors must complete an initial application to be reviewed by ERM's North American Health & Safety Team, and if approved, annual recertification is required.

Minimum ERM safety criteria are as follows:

- No fatalities in the past 5 years;
- A total recordable incidence rate (TRIR) at or below the industry average for the past 3 years based on North American Industry Classification System (NAICS) code;
- A lost/restricted rate (DART) at or below the industry average for the past 3 years based on NAICS code;
- Experience Modification Rate (EMR) at or below 1.0 for the past 3 years; and

- No open regulatory citations or willful OSHA citations received within the past 3 years.

5.1.7 RA Implementation and Oversight

This section will discuss the plans for implementation of construction and construction oversight of the OU1 RA inclusive of the requirements of the CQAPP and applicable elements of the GRP. Work task assignments and responsibilities of ERM (Supervising Contractor), the Quality Assurance Officer (QAO) and the subcontractors will be identified in a tabular format therein, which will supplement the OU1 RA QAPP.

5.1.8 RA Cost Estimate

The OU1 Pre-Final RD Package will include an updated and refined Final Engineer's Construction Cost Estimate based on the 95% design.

5.2 DRAWINGS

The OU1 Pre-Final RD Package will include a 95% complete set of design drawings for USEPA review, revised and conformed to USEPA comments on the design drawings submitted with the OU1 Preliminary (30%) RD Package. The drawings will present an accurate identification of existing site conditions of all properties on which OU1 RA activities will be performed (Surveying - Section 3.10), and the general arrangement of all OU1 RA work planned, which would include proposed equipment, improvements, details and all other construction and installation items.

All drawings will be of standard size, approximately 24" x 36" and developed in accordance with the current standards and guidelines of the State of New York. Typical items to be provided on the drawings that are completed for the preliminary submittal will include, at a minimum, the following:

- Title sheet including at least the title of the project, a key map, the name of the designer, date prepared, sheet index, and USEPA/NYSDEC Project identification numbers.
- A site survey including the distance and bearing of all property lines for 150 Fulton Avenue and all other properties on which OU1 RA activities will be performed.
- All easements, rights-of-way, and reservations;
- All buildings, structures, wells, facilities, and equipment (existing and proposed) if any;

- A topographic survey, including existing and proposed contours and spot elevations for all areas that will be affected by the remedial activities, based on U.S. Coast and Geodetic Survey data;
- All utilities, existing and proposed, in areas where OU1 RA construction activities will be performed;
- Location and identification of all significant natural features including, inter alia, wooded areas, water courses, wetlands, flood hazard areas, and depressions;
- Flood hazard data and 100-year and 500-year flood plain delineation;
- North arrow, scale, sheet numbers and the person responsible for preparing each sheet;
- Decontamination areas, staging areas, borrow areas and stockpiling areas;
- Miscellaneous detail sheets;
- Definitions of all symbols and abbreviations;
- Site security measures;
- Roadways; and
- Electrical, mechanical, and/or structural plans, as required.

5.3 SPECIFICATIONS

The OU1 Pre-Final RD Package will include a 95% complete set of construction specifications for USEPA review, revised and conformed to USEPA comments on the list of and/or specifications submitted with the OU1 Preliminary (30%) RD Package.

The specifications will be conformed to the Construction Specifications Institute master format. This master format is presented in the Construction Specifications Institute's Manual of Practice, 1985 edition, available from the Construction Specifications Institute, 601 Madison Street, Alexandria, Virginia 22314.

In addition to the specification for OU1 RD/RA Site signage discussed in Section 4.2, the OU1 Pre-Final RD Package will include a draft technical specification for photographic documentation of the remedial construction work.

5.4 APPENDED PLANS

5.4.1 Site Management Plan

A draft of the SMP (Section 3.6) will prepared and submitted to USEPA as an appendix to the OU1 Pre-Final RD Package for review and approval. The SMP will address/incorporate USEPA comments on the outline and narrative describing the plan content submitted with the OU1 Preliminary (30%) RD Package. The Pre-Final SMP will be finalized based on USEPA's comments and appended to the OU1 Final RD Package.

5.4.2 Operation, Maintenance and Monitoring Plan (OM&M) Plan

A draft of the OM&M Plan (Section 3.6.2) will be prepared and submitted to USEPA as an appendix to the OU1 Pre-Final RD Package for review and approval. The OM&M Plan will address/incorporate USEPA comments on the outline, narrative describing the plan content and preliminary OM&M Schedule submitted with the OU1 Preliminary (30%) RD Package. The Pre-Final OM&M Plan will be finalized based on USEPA's comments and appended to the OU1 Final RD Package.

5.4.3 Green Remediation Plan

A draft of the GRP (Section 3.7) will prepared and submitted to USEPA as an appendix to the OU1 Pre-Final RD Package for review and approval. The GRP will address/incorporate USEPA comments on the outline and narrative describing the plan content submitted with the OU1 Preliminary (30%) RD Package. The Pre-Final GRP will be finalized based on USEPA's comments and appended to the OU1 Final RD Package.

5.4.4 Construction Quality Assurance Plan

A draft of the CQAPP (Section 3.8) will be prepared and submitted to USEPA as an appendix to the OU1 Pre-Final RD Package for review and approval. The CQAPP will address/incorporate USEPA comments on the outline and narrative describing the plan content submitted with the OU1 Preliminary (30%) RD Package. The Pre-Final CQAPP will be finalized based on USEPA's comments and appended to the OU1 Final RD Package.

5.5 FINAL REMEDIAL DESIGN PACKAGE

The OU1 Pre-Final RD Package inclusive of all plans, drawings, specifications and appended plans will be finalized based on USEPA's comments and submitted as the OU1 Final RD Package to USEPA for final review and approval.

6.0 SCHEDULES

Gantt-format draft schedules for the OU1 RD and OU1 RA2 activities have been prepared showing key tasks including pre-design critical path activities and expected regulatory review and approval time periods.

6.1 REMEDIAL DESIGN SCHEDULE

The draft OU1 RD Schedule covering all RD activities is presented in Figure 10. The schedule shows completion and submittal to USEPA of the Final OU1 RD Package within eight months of USEPA's written notification of approval of the RD Work Plan. This aggressive schedule is contingent upon securing access to all required information in a timely manner, cooperation of all interested parties, and the regulatory reviews being completed within the specified time-frames concluding with prompt approvals from USEPA.

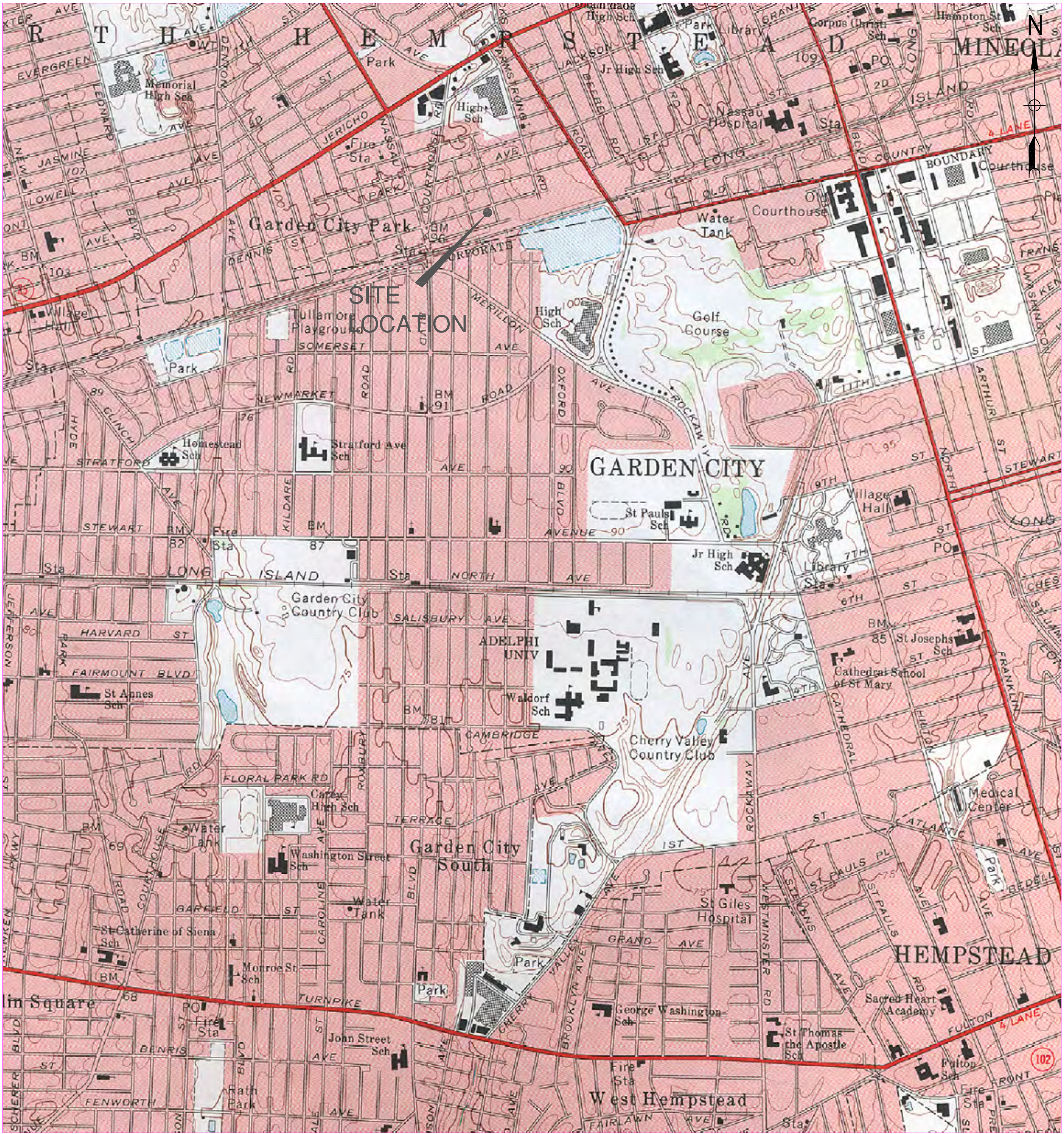
6.2 DRAFT REMEDIAL ACTION SCHEDULE

The draft OU1 RA Schedule covering all major RA and monitoring activities is presented in Figure 11. The schedule shows completion of the construction/deployment of the ISCO component of the OU1 RA within eight months of USEPA's written notification of approval of the Final OU1 RA Work Plan.

The construction and start up of the more complex groundwater extraction, treatment and recharge system will proceed on a separate track and the schedule shows completion and submittal to USEPA of the Final OU1 RA Report within twelve months of USEPA's written notification of approval of the Final OU1 RA Work Plan.

This aggressive schedule is contingent upon securing access to all required permits, properties and other approvals (Section 3.8) in a timely manner, cooperation of all interested parties, and the regulatory reviews being completed within the specified time-frames concluding with prompt approvals from USEPA. Consequently, revisions to the draft OU1 RA Schedule will likely be required during the remedial process.

LIST OF FIGURES



0 2,000' 4,000'

APPROXIMATE GRAPHIC SCALE

SOURCE: U.S.G.S. QUADRANGLE MAPS, LYNBROOK, N.Y.

TITLE

SITE LOCATION MAP
150 FULTON AVENUE
(GARDEN CITY PARK INDUSTRIAL AREA)
TOWN OF NORTH HEMPSTEAD, NEW YORK

PREPARED FOR

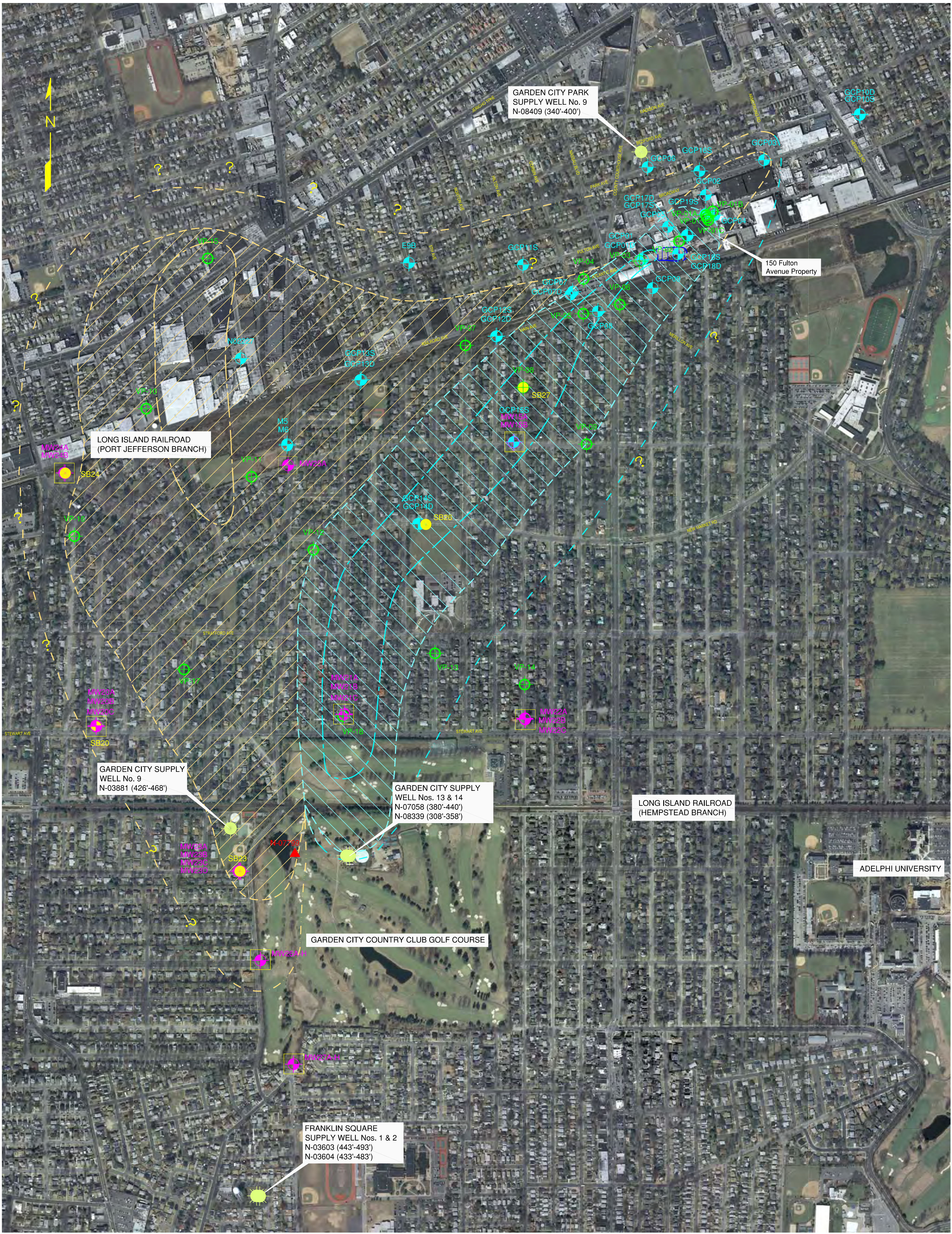
GENESCO INC.

ERM Environmental Resources Management

SCALE	FIGURE
1"=2000'	1
DATE	
1/11/10	

DRAWN:	JOB NO.:	FILE NAME:
MKR/EMF	0097881.06	0097881-06-012

R:\projects\GENESCO\0097881.06-Fulton Ave\0097881-06-012 Site Location Map.dwg (01/11/2010 - 10:11am Melville)



LEGEND

▨ TRICHLOROETHENE (TCE)–DOMINANT PLUME TOTAL VOLATILE ORGANIC CONCENTRATION GREATER THAN 100 ug/l

▨ TETRACHLOROETHENE (PCE)–DOMINANT PLUME TOTAL VOLATILE ORGANIC CONCENTRATION GREATER THAN 100 ug/l

▨ CIS 1, 2 DICHLOROETHENE–DOMINANT PLUME TOTAL VOLATILE ORGANIC CONCENTRATION GREATER THAN 100 ug/l

GCP10S ⊕ EXISTING MONITORING WELL LOCATION

MW-15A ⊕ NEW MONITORING WELL LOCATION (INSTALLED DURING RI)

VP-04 ⊕ VERTICAL PROFILE LOCATION

SB27 ● SOIL BORING LOCATION

No.9/N-03881 ✱ SUPPLY WELL

(426'–468')=SCREEN INTERVAL

N-07799 ▲ IRRIGATION WELL

0 300' 600'

GRAPHIC SCALE

— · — 10 ug/l CONTOUR LINE

— — 100 ug/l CONTOUR LINE

— - — 1,000 ug/l CONTOUR LINE

NOTE:

THE AREAL EXTENT OF CHLORINATED VOLATILE ORGANIC COMPOUNDS DEPICTED IN THIS FIGURE IS BASED ON THE MAXIMUM CONCENTRATIONS DETECTED IN GROUND WATER SAMPLES OBTAINED FROM VERTICAL PROFILE TEMPORARY WELLS INSTALLED DURING 1999 – 2000, AND PERMANENT WELLS DURING SEPTEMBER 2001 – MAY 2005.

TITLE

AREAL EXTENT OF CHLORINATED VOCS IN GROUND WATER 150 FULTON AVENUE GARDEN CITY PARK, NEW YORK

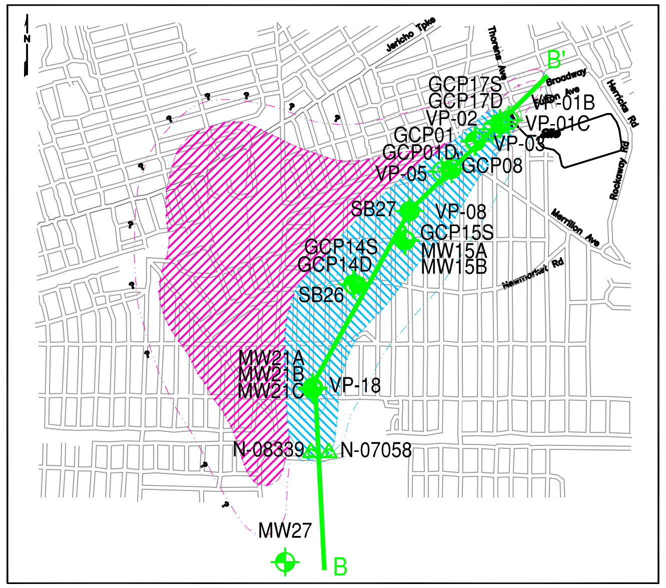
PREPARED FOR

GENESCO INC.

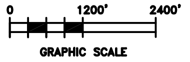
ERM Environmental Resources Management

DRAWN: YS/EMF	JOB NO.: 0097881.06	FILE NAME: 0097881-06-003	SCALE GRAPHIC	FIGURE 2
			DATE 12/24/09	

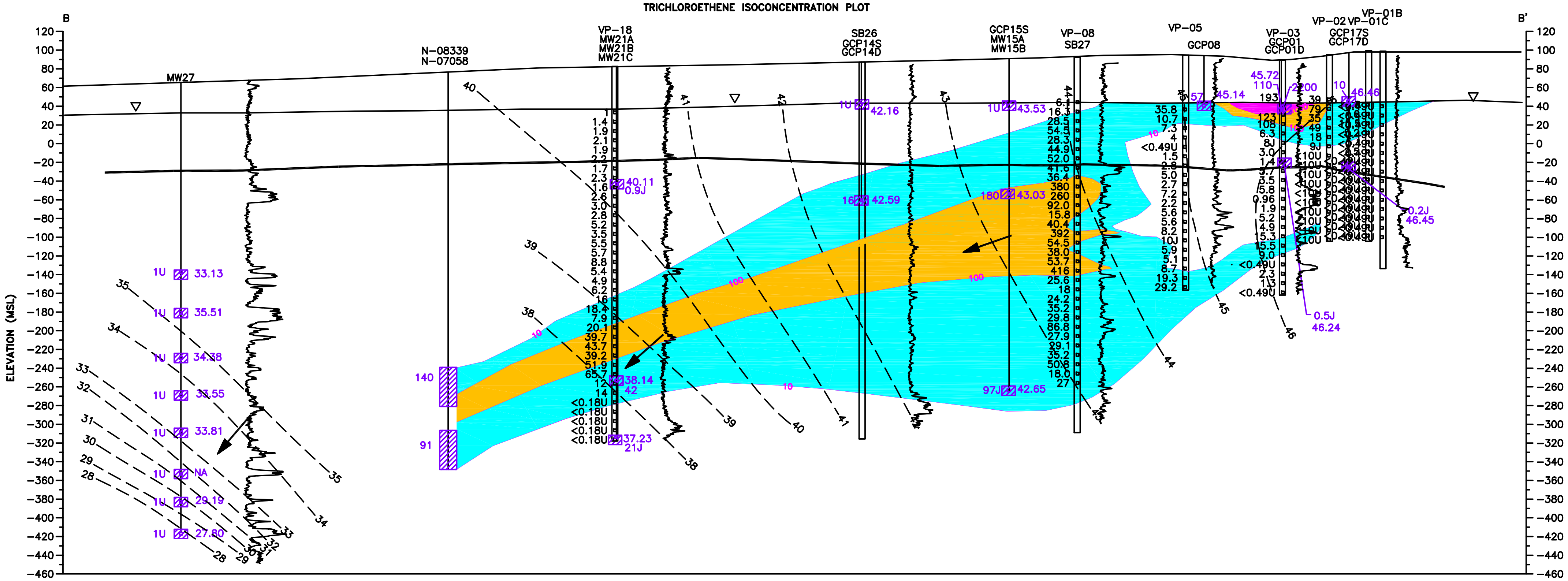
R:\projects\GENESCO\0097881.06-Fulton Ave\0097881-06-003 Areal Extent of CHL VOCs.dwg (01/13/2010 - 12:12pm Melville)

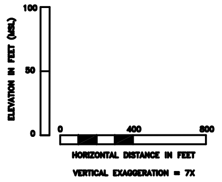


LOCATION OF CROSS-SECTION LINE

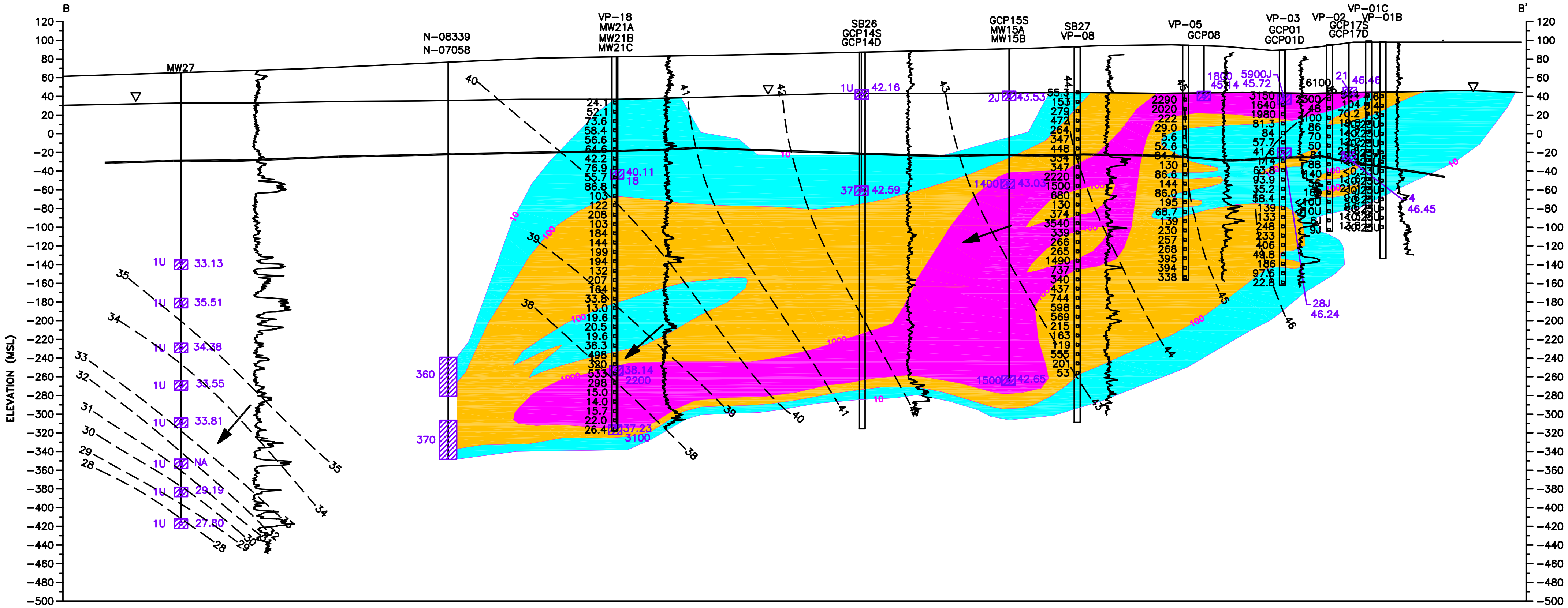


TRICHLOROETHENE ISOCONCENTRATION PLOT





TETRACHLOROETHENE ISOCONCENTRATION PLOT



LEGEND

🟪 COMPOUND>1000 μg/L

🟧 COMPOUND>100 μg/L

🟦 COMPOUND>10 μg/L

CONTACT – UPPER GLACIAL/MAGOTHY AQUIFERS

▽ WATER TABLE – APRIL 4, 2002 & MAY 3, 2004

MONITORING WELL SCREEN ZONE

0.5J ▨ 39.22 – WATER LEVEL ELEVATION (ft MSL)

COMPOUND CONCENTRATION (μg/L)

38 — — — — 38 EQUIPOTENTIAL LINE

→ GENERAL DIRECTION OF GROUND WATER FLOW

NOTE: ISOCONTOURS ARE BASED ON GROUND WATER QUALITY DATA DERIVED FROM VERTICAL PROFILING AND THE PERMANENT GROUND WATER MONITORING WELLS SAMPLED DURING THE RI. FOR EACH GROUND WATER MONITORING WELL LOCATION, THE MAXIMUM DETECTED CONCENTRATIONS OF PCE AND TCE FROM THE 1999–2005 DATA SET WERE USED IN ORDER TO DEPICT THE CURRENT GENERALIZED DISTRIBUTION OF THESE COMPOUNDS IN GROUND WATER.

ALL CONCENTRATIONS IN μg/L.

TITLE

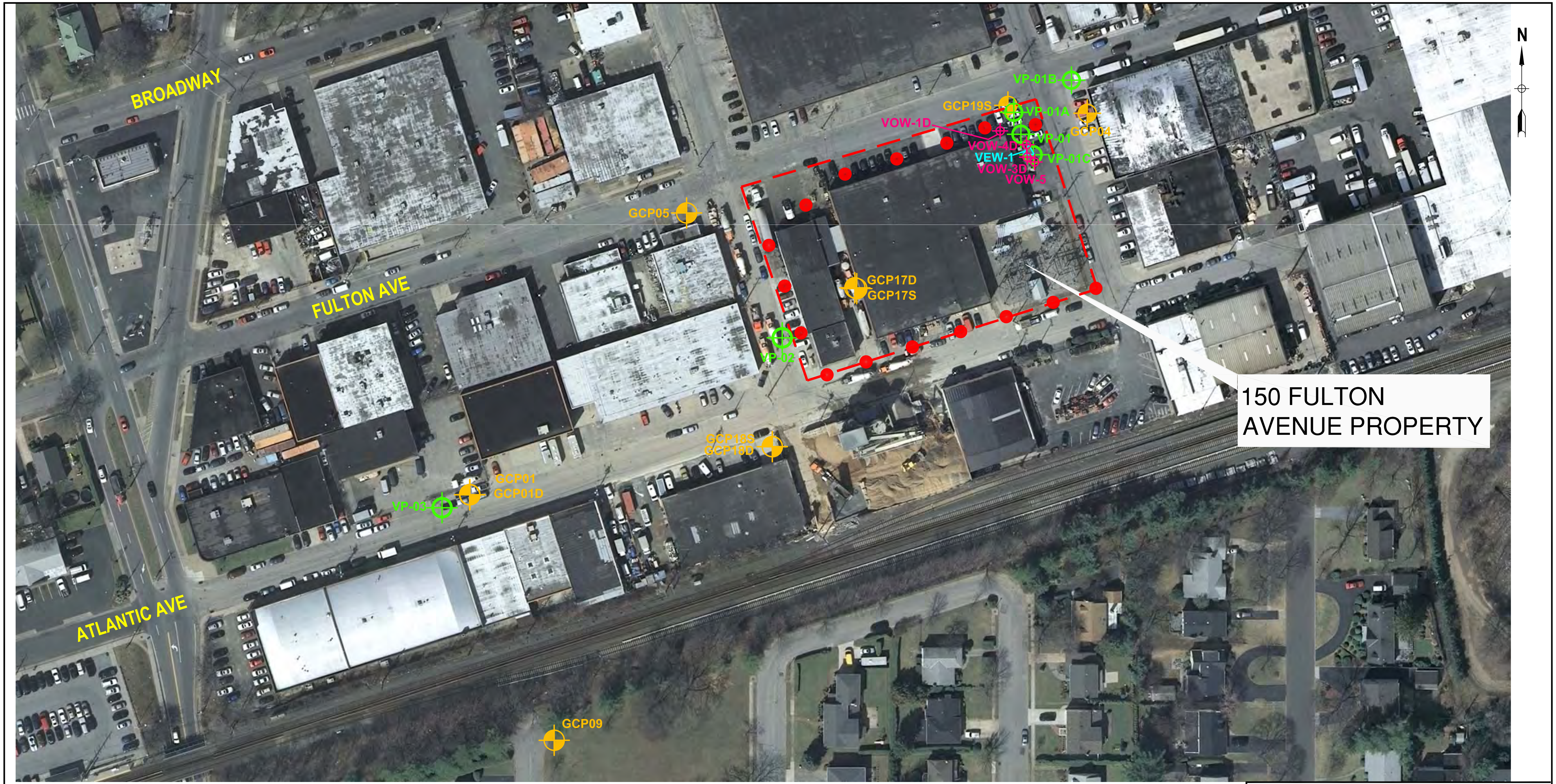
HYDROGEOCHEMICAL
CROSS-SECTION B-B'
150 FULTON AVENUE
GARDEN CITY PARK, NEW YORK

PREPARED FOR

GENESCO INC.

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	FIGURE
MLB/EMF	0097881.06	0097881-06-013	GRAPHIC	3
			DATE 1/11/10	



LEGEND

GCP09 ⊕	EXISTING MONITORING WELL LOCATION
VP-04 ⊕	VERTICAL PROFILE LOCATION
VOW-3D ⌖	AIR SPARGE WELL LOCATION
VEW-1 △	VAPOR EXTRACTION WELL LOCATION
— —	PROPERTY LINE
●	MEMBRANE INTERFACE PROBE (MIP) BORING/ POTENTIAL WATERLOO GROUNDWATER SAMPLING LOCATION

NOTE:
THE AREAL EXTENT OF CHLORINATED VOLATILE ORGANIC COMPOUNDS DEPICTED IN THIS FIGURE IS BASED ON THE MAXIMUM CONCENTRATIONS DETECTED IN GROUND WATER SAMPLES OBTAINED FROM VERTICAL PROFILE TEMPORARY WELLS INSTALLED DURING 1999 – 2000, AND PERMANENT WELLS DURING SEPTEMBER 2001 – MAY 2005.

0 100' 200'

GRAPHIC SCALE

SOURCE: ORTHO IMAGE FROM NYSGIS

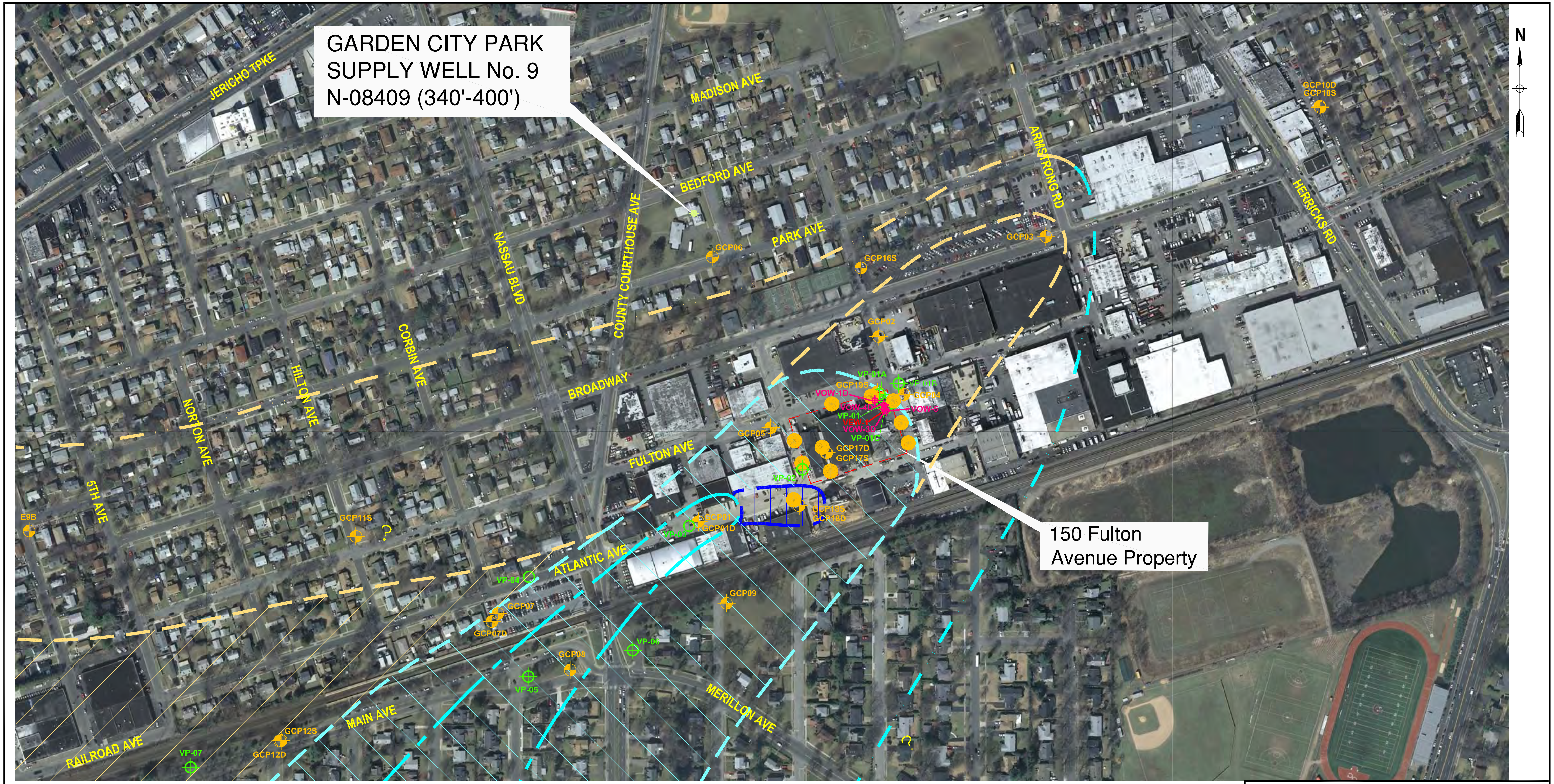
TITLE
PRE-DESIGN SAMPLING LOCATIONS
IN-SITU CHEMICAL OXIDATION
REMEDIAL COMPONENT

PREPARED FOR
GENESCO

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	DATE	FIGURE
CW/EMF	0097881.06	0097881-06-004	GRAPHIC	1/8/10	4

R:\projects\GENESCO\0097881.06-Fulton Ave\0097881-06-004 Pre-Design Samp Locs - No Plume (11x17).dwg (01/11/2010 - 11:26am Melville)



LEGEND

▨	TRICHLOROETHENE (TCE)–DOMINANT PLUME TOTAL VOLATILE ORGANIC CONCENTRATION GREATER THAN 100 ug/l
▨	TETRACHLOROETHENE (PCE)–DOMINANT PLUME TOTAL VOLATILE ORGANIC CONCENTRATION GREATER THAN 100 ug/l
▨	CIS 1, 2 DICHLOROETHENE–DOMINANT PLUME TOTAL VOLATILE ORGANIC CONCENTRATION
GCP10S ⊕	EXISTING MONITORING WELL LOCATION
VP-04 ⊕	VERTICAL PROFILE LOCATION
No.9/N-03881 ●	SUPPLY WELL
(426'–468')=SCREEN INTERVAL	
— — — — —	PROPERTY LINE
▬ ▬	10 ug/l CONTOUR LINE
▬ ▬ ▬	100 ug/l CONTOUR LINE
▬ ▬ ▬	1,000 ug/l CONTOUR LINE
VOW-3D ⊕	AIR SPARGE WELL LOCATION
VEW-1 △	VAPOR EXTRACTION WELL LOCATION
●	ISCO INJECTION POINT

NOTE:
THE AREAL EXTENT OF CHLORINATED VOLATILE ORGANIC COMPOUNDS DEPICTED IN THIS FIGURE IS BASED ON THE MAXIMUM CONCENTRATIONS DETECTED IN GROUND WATER SAMPLES OBTAINED FROM VERTICAL PROFILE TEMPORARY WELLS INSTALLED DURING 1999 – 2000, AND PERMANENT WELLS DURING SEPTEMBER 2001 – MAY 2005.

0 300' 600'
GRAPHIC SCALE

SOURCE: ORTHO IMAGE FROM NYSGIS

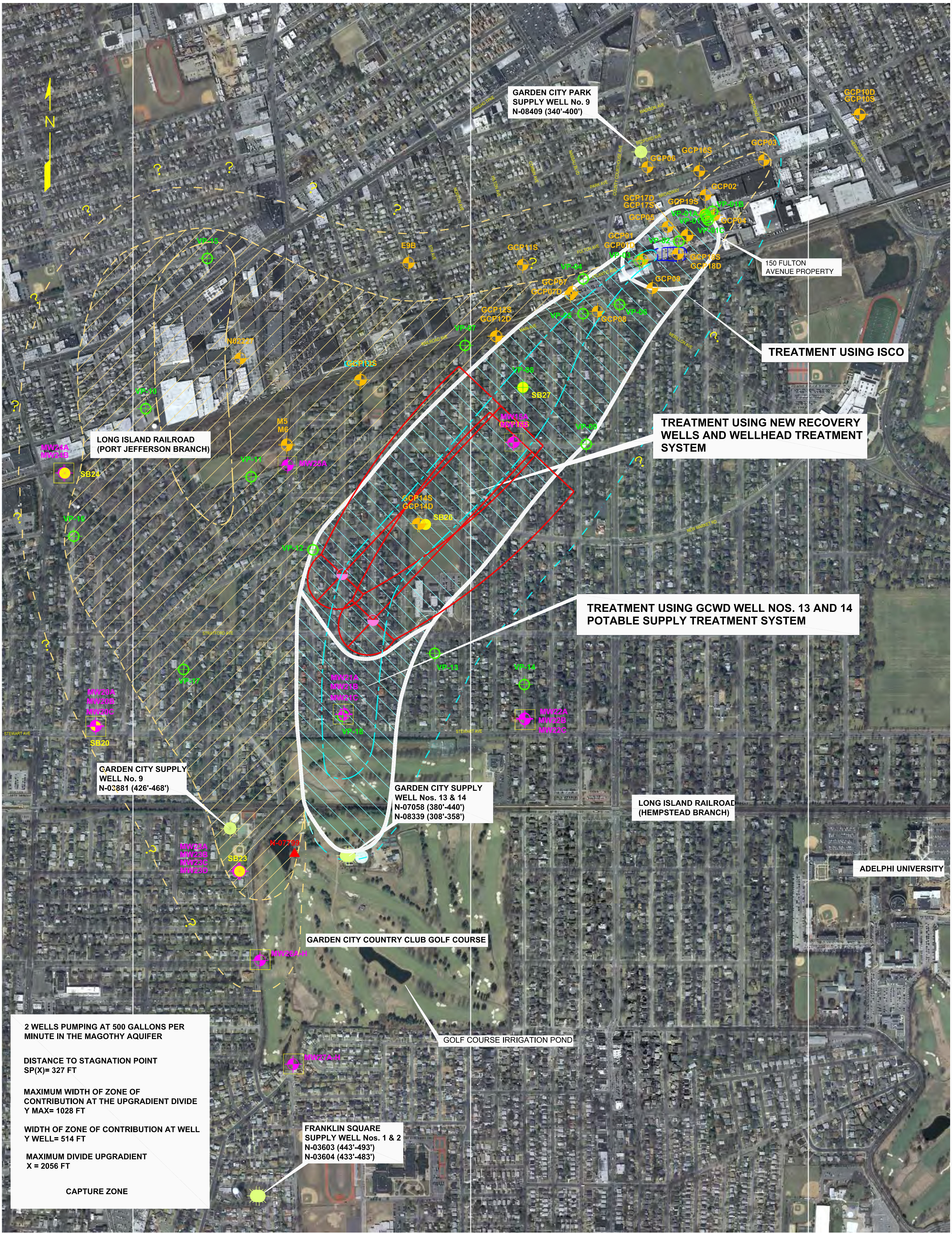
TITLE
TENTATIVE IN-SITU CHEMICAL OXIDATION INJECTION LOCATIONS

PREPARED FOR
GENESCO

ERM Environmental Resources Management

DRAWN: CW/EMF	JOB NO.: 0097881.06	FILE NAME: 0097881-06-002	SCALE: GRAPHIC DATE: 1/11/10	FIGURE 5

R:\projects\GENESCO\0097881.06-Fulton Ave\0097881-06-011 Tentative ISCO Injection Locations (11x17).dwg (01/11/2010 - 2:05pm Melville)



2 WELLS PUMPING AT 500 GALLONS PER MINUTE IN THE MAGOTHY AQUIFER

DISTANCE TO STAGNATION POINT
SP(X)= 327 FT

MAXIMUM WIDTH OF ZONE OF CONTRIBUTION AT THE UPGRADIENT DIVIDE
Y MAX= 1028 FT

WIDTH OF ZONE OF CONTRIBUTION AT WELL
Y WELL= 514 FT

MAXIMUM DIVIDE UPGRADIENT
X = 2056 FT

CAPTURE ZONE

LEGEND

▨	TRICHLOROETHENE (TCE)–DOMINANT PLUME TOTAL VOLATILE ORGANIC CONCENTRATION GREATER THAN 100 ug/l
▨	TETRACHLOROETHENE (PCE)–DOMINANT PLUME TOTAL VOLATILE ORGANIC CONCENTRATION GREATER THAN 100 ug/l
▨	CIS 1, 2 DICHLOROETHENE–DOMINANT PLUME TOTAL VOLATILE ORGANIC CONCENTRATION GREATER THAN 100 ug/l
GCP10S ⊕	EXISTING MONITORING WELL LOCATION
MW-15A ⊕	NEW MONITORING WELL LOCATION (INSTALLED DURING RI)
VP-04 ⊕	VERTICAL PROFILE LOCATION
SB27 ●	SOIL BORING LOCATION
No.9/N-03881 ✺	SUPPLY WELL
(426'–468')=SCREEN INTERVAL	
N-07799 ▲	IRRIGATION WELL
◒	RECOVERY WELL
— · —	10 ug/l CONTOUR LINE
— —	100 ug/l CONTOUR LINE
— ▪ —	1,000 ug/l CONTOUR LINE

0 300' 600'
GRAPHIC SCALE

NOTE:
THE AREAL EXTENT OF CHLORINATED VOLATILE ORGANIC COMPOUNDS DEPICTED IN THIS FIGURE IS BASED ON THE MAXIMUM CONCENTRATIONS DETECTED IN GROUND WATER SAMPLES OBTAINED FROM VERTICAL PROFILE TEMPORARY WELLS INSTALLED DURING 1999 – 2000, AND PERMANENT WELLS DURING SEPTEMBER 2001 – MAY 2005.

TITLE
GROUNDWATER
TREATMENT APPROACH

PREPARED FOR
GENESCO INC.

ERM Environmental Resources Management

DRAWN:	JOB NO.:	FILE NAME:	SCALE	DATE	FIGURE
YS/EMF	0097881.06	0097881-06-006	GRAPHIC	1/11/10	6

R:\projects\GENESCO\0097881.06-Fulton Ave\0097881-06-006 Alternative GW-5.dwg (01/18/2010 - 10:01am Melville)

FIGURE 7
SUMMARY OF HISTORIC GROUND WATER SAMPLING RESULTS
TETRACHLOROETHENE (PCE) CONCENTRATION TRENDS VS. TIME
WELL NOS. MW21A (120'-130'), MW21B (330'-340') & MW21C (390'- 400')

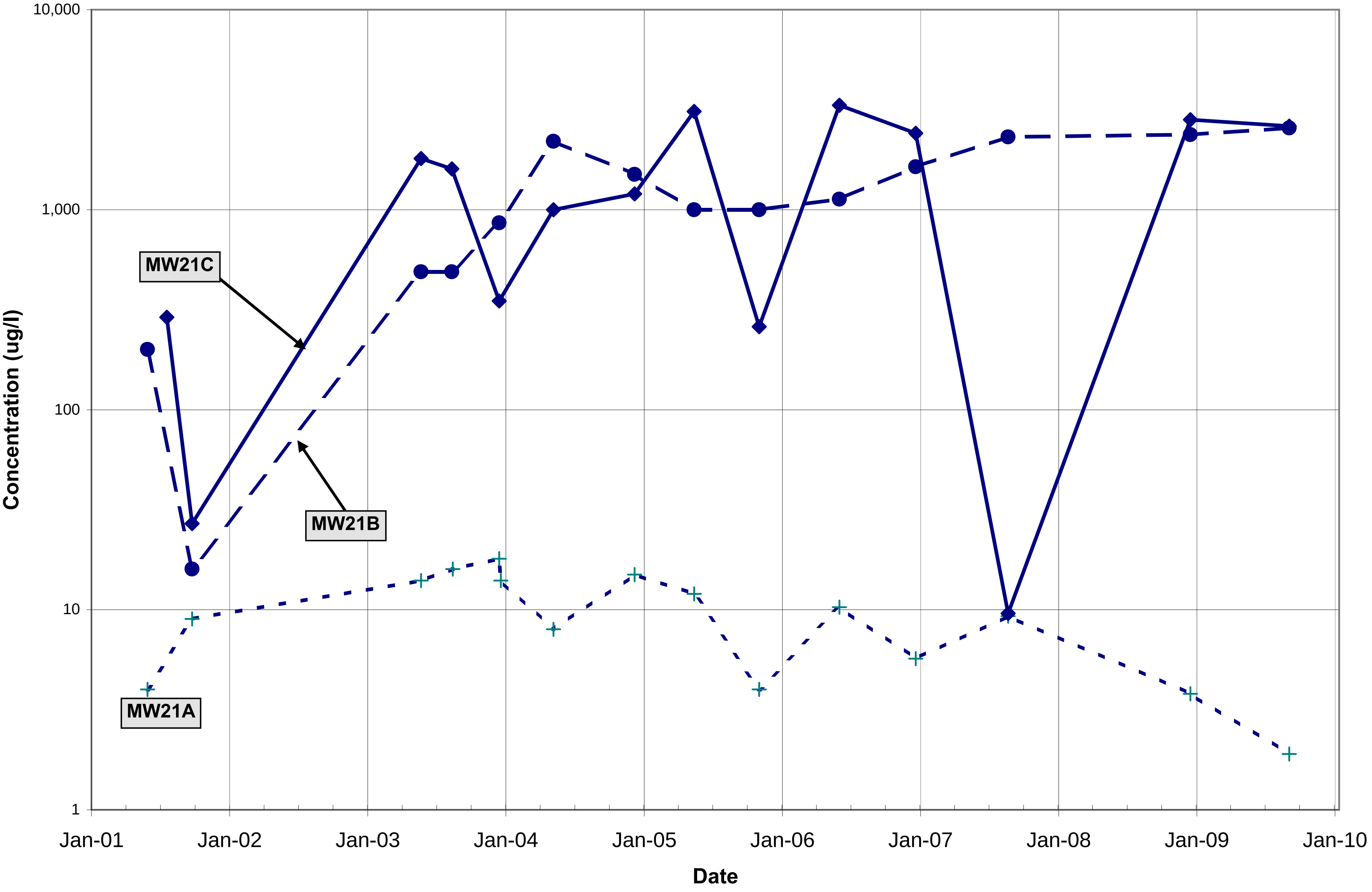
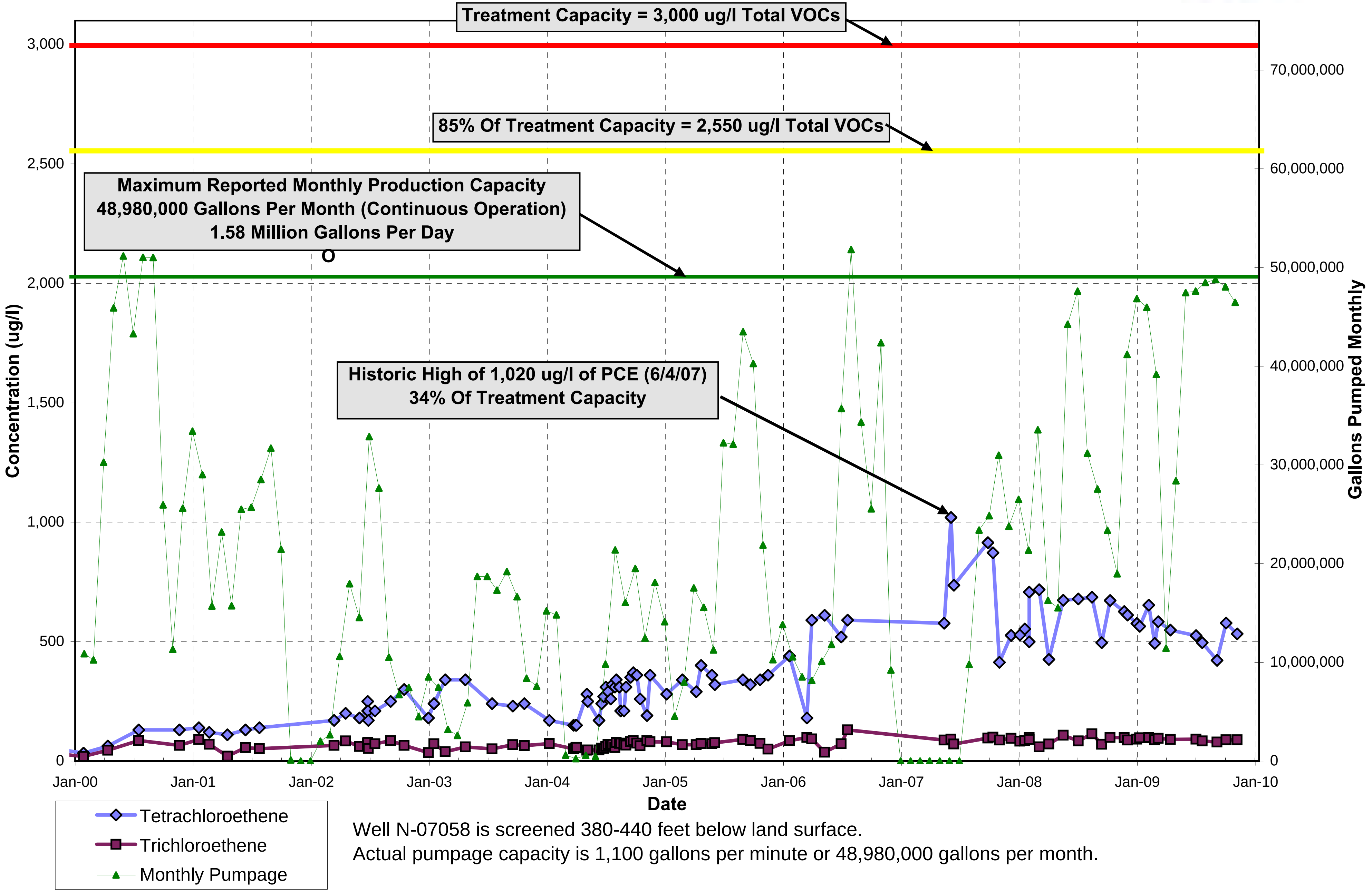


FIGURE 8
HISTORIC TETRACHLOROETHENE, TRICHLOROETHENE CONCENTRATIONS AND PUMPAGE
PUBLIC WATER SUPPLY WELL # N-07058 (GARDEN CITY WELL NO. 13)
GARDEN CITY, NEW YORK



Treatment Capacity = 3,000 ug/l Total VOCs

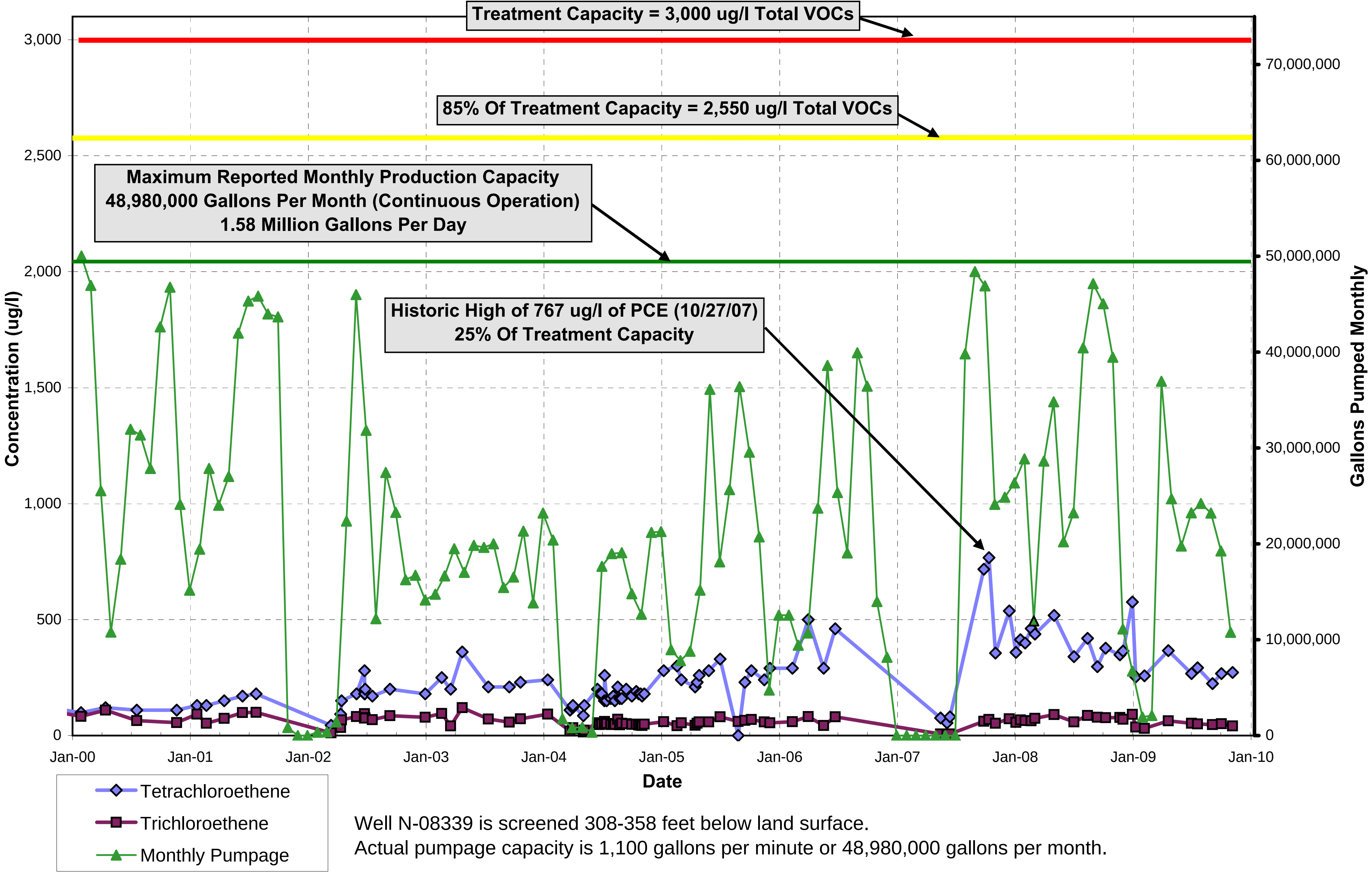
85% Of Treatment Capacity = 2,550 ug/l Total VOCs

Maximum Reported Monthly Production Capacity
48,980,000 Gallons Per Month (Continuous Operation)
1.58 Million Gallons Per Day

Historic High of 1,020 ug/l of PCE (6/4/07)
34% Of Treatment Capacity

Well N-07058 is screened 380-440 feet below land surface.
Actual pumpage capacity is 1,100 gallons per minute or 48,980,000 gallons per month.

FIGURE 9
HISTORIC TETRACHLOROETHENE, TRICHLOROETHENE CONCENTRATIONS AND PUMPAGE
PUBLIC WATER SUPPLY WELL # N-08339 (GARDEN CITY WELL NO. 14)
GARDEN CITY, NEW YORK



Treatment Capacity = 3,000 ug/l Total VOCs

85% Of Treatment Capacity = 2,550 ug/l Total VOCs

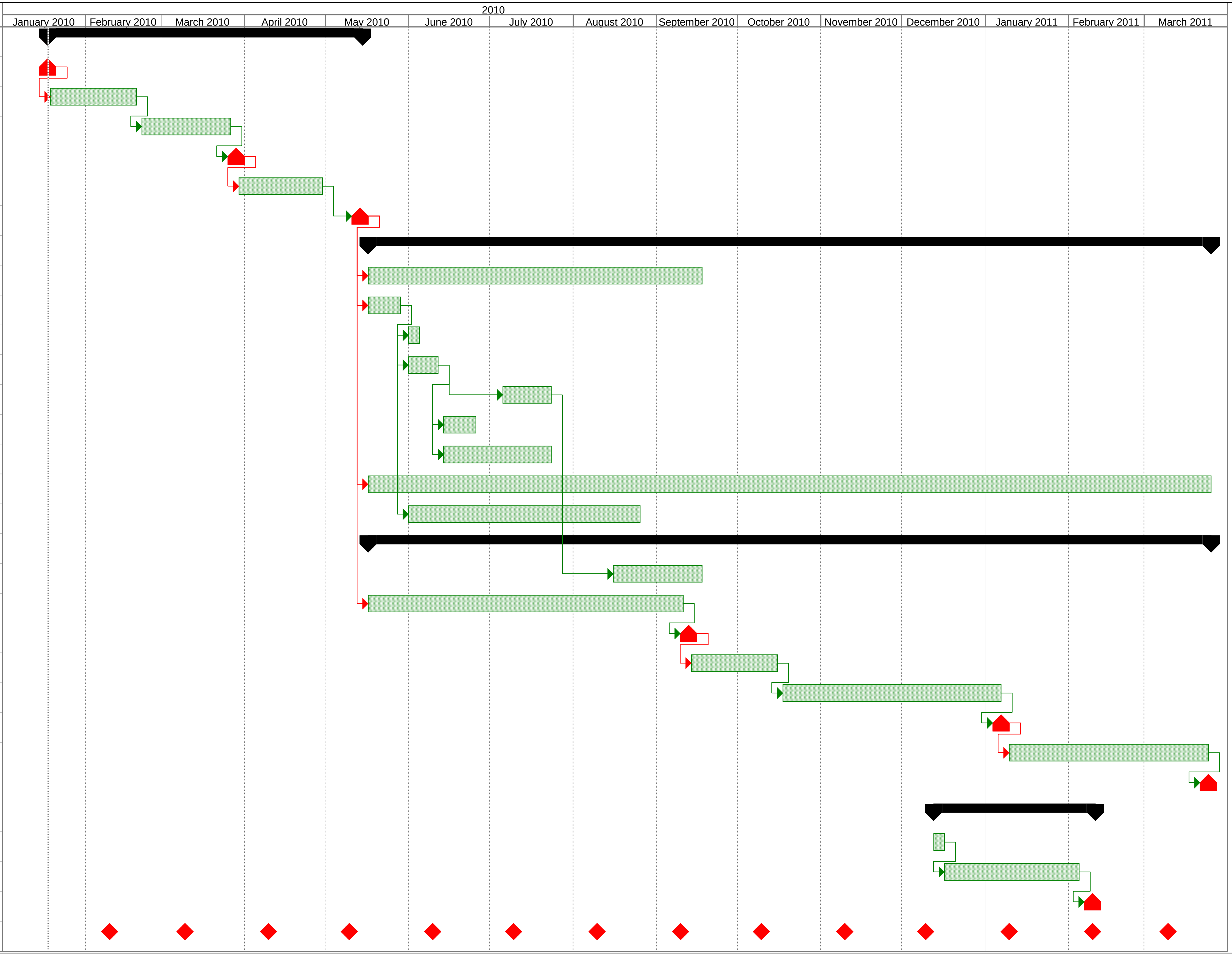
Maximum Reported Monthly Production Capacity
48,980,000 Gallons Per Month (Continuous Operation)
1.58 Million Gallons Per Day

Historic High of 767 ug/l of PCE (10/27/07)
25% Of Treatment Capacity

Well N-08339 is screened 308-358 feet below land surface.
Actual pumpage capacity is 1,100 gallons per minute or 48,980,000 gallons per month.

FIGURE 10
REMEDIAL DESIGN SCHEDULE
FULTON AVENUE SUPERFUND SITE - REMEDIAL OPERABLE UNIT 1

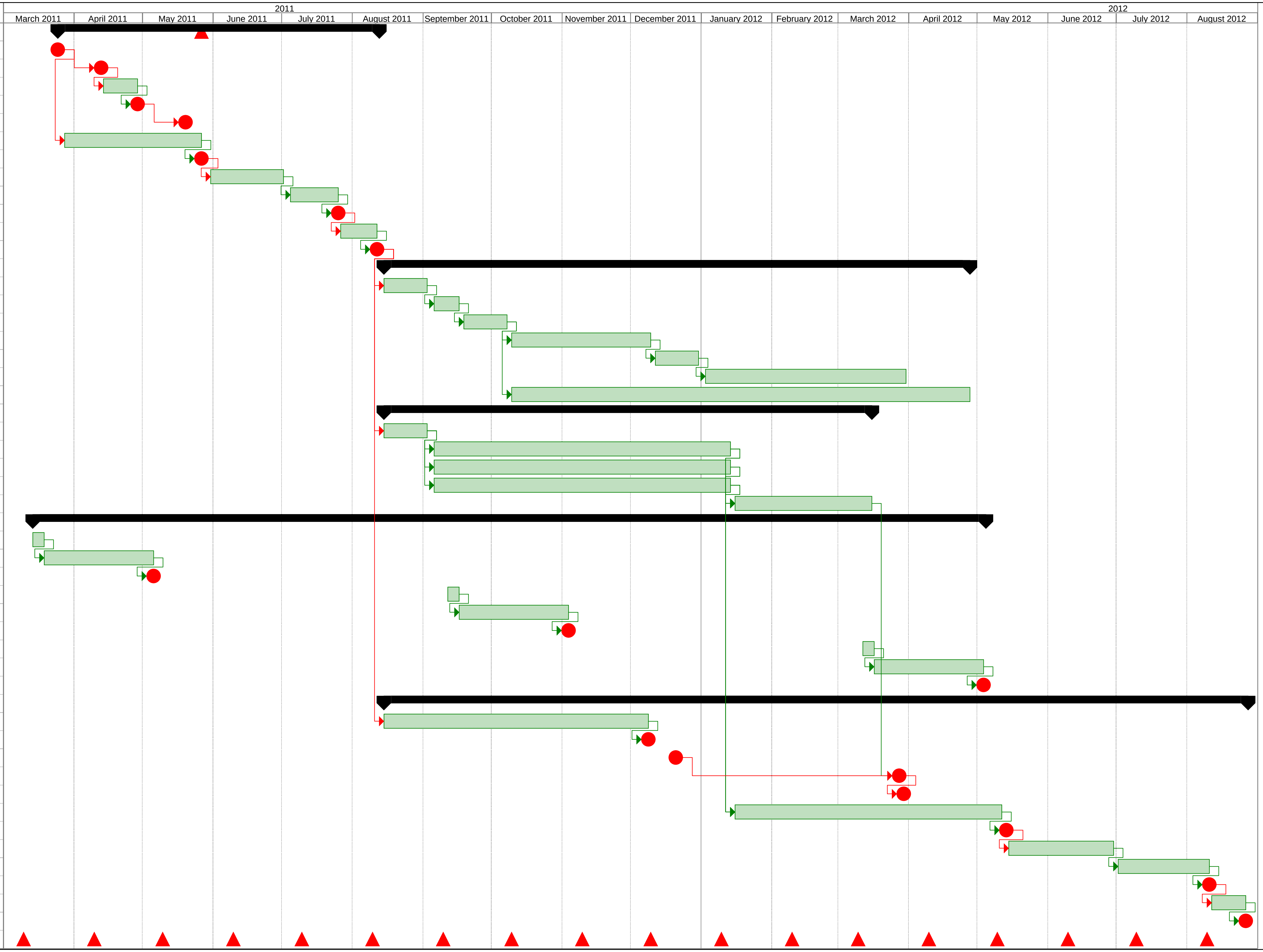
ID	Task Name	Duration	Start	Finish
1	**Remedial Design (RD) Work Plan**	**117 days**	**Mon 1/18/10**	**Fri 5/14/10**
2	Submit Draft RD Work Plan To USEPA	1 day	Mon 1/18/10	Mon 1/18/10
3	USEPA Review of Draft RD Work Plan	32 days	Tue 1/19/10	Fri 2/19/10
4	Finalization of Draft RD Work Plan	33 days	Mon 2/22/10	Fri 3/26/10
5	Submit Revised RD Work Plan To USEPA	1 day	Mon 3/29/10	Mon 3/29/10
6	USEPA Review of Revised RD Work Plan	31 days	Tue 3/30/10	Thu 4/29/10
7	USEPA Approval of Revised RD Work Plan	1 day	Fri 5/14/10	Fri 5/14/10
8	**Pre-Design Studies**	**306 days**	**Mon 5/17/10**	**Fri 3/25/11**
9	Groundwater Modelling	121 days	Mon 5/17/10	Fri 9/17/10
10	Study Planning/Mobilization	12 days	Mon 5/17/10	Fri 5/28/10
11	Well Inspection & Repairs	4 days	Tue 6/1/10	Fri 6/4/10
12	Comprehensive Groundwater Sampling	11 days	Tue 6/1/10	Fri 6/11/10
13	ISCO Sampling	18 days	Tue 7/6/10	Fri 7/23/10
14	Local Hydraulic Evaluation	12 days	Mon 6/14/10	Fri 6/25/10
15	Vertical Profiling	39 days	Mon 6/14/10	Fri 7/23/10
16	Information Gathering/Access	306 days	Mon 5/17/10	Fri 3/25/11
17	Laboratory Analysis, Validation & Reporting	85 days	Tue 6/1/10	Wed 8/25/10
18	**Remedial Design (RD)**	**306 days**	**Mon 5/17/10**	**Fri 3/25/11**
19	ISCO Design Studies	32 days	Mon 8/16/10	Fri 9/17/10
20	Preliminary (30%) RD	114 days	Mon 5/17/10	Fri 9/10/10
21	Submit 30% RD Package To USEPA	1 day	Mon 9/13/10	Mon 9/13/10
22	USEPA Review of 30%RD Package	32 days	Tue 9/14/10	Fri 10/15/10
23	Finalization of RD Package	77 days	Mon 10/18/10	Thu 1/6/11
24	Submit Pre-Final RD Package To USEPA	1 day	Fri 1/7/11	Fri 1/7/11
25	USEPA Review of Pre-Final RD Work Plan	74 days	Mon 1/10/11	Thu 3/24/11
26	USEPA Approval of Revised RD Work Plan	1 day	Fri 3/25/11	Fri 3/25/11
27	**Continued Groundwater Monitoring**	**58 days**	**Mon 12/13/10**	**Thu 2/10/11**
28	Groundwater Sampling	4 days	Mon 12/13/10	Thu 12/16/10
29	Laboratory Analysis, Validation & Reporting	48 days	Fri 12/17/10	Fri 2/4/11
30	Report To USEPA In Progress Report	1 day	Thu 2/10/11	Thu 2/10/11
31	**Progress Reports**	**387 days**	**Wed 2/10/10**	**Thu 3/10/11**



Date: Mon 1/18/10	Task	🟩	Milestone	⬟	Recurring Task ◆	Summary	▬

FIGURE 11
REMEDIAL ACTION SCHEDULE
FULTON AVENUE SUPERFUND SITE - REMEDIAL OPERABLE UNIT 1

ID	Task Name	Duration	Start	Finish
1	**Remedial Action (RA) Work Plan**	**139 days**	**Fri 3/25/11**	**Fri 8/12/11**
2	USEPA Approval of Final Design Package	1 day	Fri 3/25/11	Fri 3/25/11
3	Notify USEPA of Potential Contractors	1 day	Wed 4/13/11	Wed 4/13/11
4	USEPA Review of Potential Contractors	15 days	Thu 4/14/11	Thu 4/28/11
5	USEPA Approval of Potential Contractors	1 day	Fri 4/29/11	Fri 4/29/11
6	Notify USEPA of Selected Contractors	1 day	Fri 5/20/11	Fri 5/20/11
7	Preparation of Draft RA Work Plan	60 days	Mon 3/28/11	Thu 5/26/11
8	Submit Draft RA Work Plan To USEPA	1 day	Fri 5/27/11	Fri 5/27/11
9	USEPA Review of Draft RA Work Plan	32 days	Tue 5/31/11	Fri 7/1/11
10	Finalization of Draft RA Work Plan	21 days	Tue 7/5/11	Mon 7/25/11
11	Submit Revised RA Work Plan To USEPA	1 day	Tue 7/26/11	Tue 7/26/11
12	USEPA Review of Revised RA Work Plan	16 days	Wed 7/27/11	Thu 8/11/11
13	USEPA Approval of Revised RA Work Plan	1 day	Fri 8/12/11	Fri 8/12/11
14	**ISCO Injections**	**252 days**	**Mon 8/15/11**	**Fri 4/27/12**
15	Mobilization	19 days	Mon 8/15/11	Fri 9/2/11
16	Additional Well Installations	11 days	Tue 9/6/11	Fri 9/16/11
17	ISCO Injections - Round 1	19 days	Mon 9/19/11	Fri 10/7/11
18	ISCO Performance Monitoring/Sampling	59 days	Mon 10/10/11	Fri 12/9/11
19	ISCO Injections - Round 2	18 days	Mon 12/12/11	Fri 12/30/11
20	ISCO Performance Monitoring/Sampling	88 days	Tue 1/3/12	Fri 3/30/12
21	Laboratory Analysis & Reporting	197 days	Mon 10/10/11	Fri 4/27/12
22	**Groundwater Extraction System**	**209 days**	**Mon 8/15/11**	**Thu 3/15/12**
23	Mobilization	19 days	Mon 8/15/11	Fri 9/2/11
24	Extraction Well Construction	126 days	Tue 9/6/11	Fri 1/13/12
25	Treatment System Construction	126 days	Tue 9/6/11	Fri 1/13/12
26	Recharge System Construction	126 days	Tue 9/6/11	Fri 1/13/12
27	Systems Start-Up & Adjustments	60 days	Mon 1/16/12	Thu 3/15/12
28	**Groundwater Monitoring**	**411 days**	**Mon 3/14/11**	**Fri 5/4/12**
29	Semi-Annual Groundwater Sampling 1	5 days	Mon 3/14/11	Fri 3/18/11
30	Laboratory Analysis, Validation & Reporting	48 days	Sat 3/19/11	Thu 5/5/11
31	Report To USEPA In Progress Report 1	1 day	Fri 5/6/11	Fri 5/6/11
32	Semi-Annual Groundwater Sampling 2	5 days	Mon 9/12/11	Fri 9/16/11
33	Laboratory Analysis, Validation & Reporting	48 days	Sat 9/17/11	Thu 11/3/11
34	Report To USEPA In Progress Report 2	1 day	Fri 11/4/11	Fri 11/4/11
35	Semi-Annual Groundwater Sampling 3	5 days	Mon 3/12/12	Fri 3/16/12
36	Laboratory Analysis, Validation & Reporting	48 days	Sat 3/17/12	Thu 5/3/12
37	Report To USEPA In Progress Report 3	1 day	Fri 5/4/12	Fri 5/4/12
38	**Inspections and RA Report**	**372 days**	**Mon 8/15/11**	**Mon 8/27/12**
39	Update OM&M Manual	113 days	Mon 8/15/11	Thu 12/8/11
40	Submit OM&M Manual To USEPA	1 day	Fri 12/9/11	Fri 12/9/11
41	Pre-Final Construction Inspection	1 day	Wed 12/21/11	Wed 12/21/11
42	Final Construction Inspection	1 day	Wed 3/28/12	Wed 3/28/12
43	USEPA Approval of Construction	1 day	Fri 3/30/12	Fri 3/30/12
44	Preparation of Draft RA Report	117 days	Mon 1/16/12	Fri 5/11/12
45	Submit Draft RA Report To USEPA	1 day	Mon 5/14/12	Mon 5/14/12
46	USEPA Review of Draft RA Report	45 days	Tue 5/15/12	Fri 6/29/12
47	Finalization of Draft RA Report	39 days	Mon 7/2/12	Fri 8/10/12
48	Submit Revised RA Report To USEPA	1 day	Sat 8/11/12	Sat 8/11/12
49	USEPA Review of Revised RA Report	15 days	Sun 8/12/12	Sun 8/26/12
50	USEPA Approval of Revised RA Report	1 day	Mon 8/27/12	Mon 8/27/12
51	**Progress Reports**	**511 days**	**Thu 3/10/11**	**Fri 8/10/12**



Date: Mon 1/18/10	Task	🟩	Milestone	●	Recurring Task	▲	Summary	▬

LIST OF TABLES

TABLE 1
LISTING OF ARARs AND TBCs
150 FULTON AVENUE
GARDEN CITY PARK, NY

Citation	Description	Type	Potential Applicability to developing Remedial Action Objectives	Potential Applicability to Evaluating Remedial Action Alternatives
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)				
6 NYCRR Part 201	Air Permits and Registrations	Action		Relates to registration and permitting requirements for air emission sources pursuant to the Clean Air Act.
6 NYCRR Part 212	General Emission Sources	Action		Determines whether air emissions permits are needed for new emission sources based on total emission rates. Outlines procedures for sampling and monitoring.
6 NYCRR Part 257	Air Quality Standards	Action		Provide ambient air quality standards for attainment and non-attainment areas.
6 NYCRR Part 287	Air Quality Area Classifications	Location		Assigns standards for the NYC metropolitan area to limit VOCs such that photochemical oxidants levels are not exceeded.
6 NYCRR Part 364	Waste Transporter Permits	Action	Not applicable	This standard would relate to alternatives that involve hazardous waste removal.
6 NYCRR Part 370 through 373	Hazardous Waste Management Regulations	Action, Chemical	This standard relates to identification of hazardous waste. This along with 6 NYCRR Part 375 would be used to determine remedial requirements for hazardous waste.	This standard would relate to the characterization and management of hazardous waste generated by the remedial action.
6 NYCRR Part 375	Inactive Hazardous Waste Disposal Site Remedial Program	Action, Chemical, Location	Guidelines of remediating inactive hazardous waste sites and restoration to pre-disposal conditions; will relate to remedial objectives at the Site.	Guidelines of remediating inactive hazardous waste sites; will relate to remedial activities at the Site.
6 NYCRR Part 376	Land Disposal Restrictions	Action, Chemical	Not applicable.	This standard relates to the management of hazardous waste removed during remedial action.
6 NYCRR Part 598	Handling and Storage of Hazardous Substances	Action	Not applicable.	This standard would relate to any remedial activities that include handling and storage of hazardous substances.
6 NYCRR Parts 700- 706	Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations	Chemical	May relate to ground water quality and remedial objectives for the Site.	May relate to the effectiveness of ground water remediation technologies and the discharge requirements for recharged ground water.
10 NYCRR Part 5	Drinking Water Supplies	Action, Chemical	Provides Maximum Contaminant Levels (MCLs) for contaminants for New York drinking water. Will apply to developing remedial objectives.	May relate to the treatment of water prior to discharge for potable use.
29 CFR (OSHA) Part 1910	Guidelines/Requirements for Workers at Hazardous Waste Sites (Subpart 120) and Standards for Air Contaminants (Subpart 1).	Action		Safety guidelines for construction and maintenance activities.
29 CFR (OSHA) Part 1926	Safety and Health Regulations for Construction			Safety guidelines for construction and maintenance activities.

TABLE 1
LISTING OF ARARs AND TBCs
150 FULTON AVENUE
GARDEN CITY PARK, NY

Citation	**Description**	**Type**	**Potential Applicability to developing Remedial Action Objectives**	**Potential Applicability to Evaluating Remedial Action Alternatives**
40 CFR Part 141	National Primary Drinking Water Regulations (NPDWR)	Chemical	Establishes primary drinking water regulations applicable to public water systems and associated testing requirements. The primary standards include both maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs). MCLs are enforceable standards for specific contaminants based on public health factors as well as the technical and economic feasibility of removing the contaminants from the water supply. MCLGs are non-enforceable standards that do not consider the feasibility of contaminant removal.	May relate to the treatment of water prior to discharge for potable use.
40 CFR Part 144	Underground Injection Control (UIC) Programs	Action		Governs injection of chemicals or substances into the groundwater.
40 CFR 261 (RCRA)	Determination of whether a waste is hazardous	Action, Chemical	This standard relates to identification of hazardous waste and may aid in determining remedial requirements for hazardous wastes.	This standard relates to the characterization and management of hazardous waste generated by the remedial action.
42 U.S.C Chapter 6A, Subchapter XII	Safe Drinking Water Act	Chemical		May relate to the treatment of water prior to discharge for potable use.
33 U.S.C, Chapter 26, Subchapter III	Clean Water Act	Chemical	This act includes ambient water quality standards and Federal Water Quality Criteria (WQC), which are non-enforceable guidelines that may be relevant and appropriate to CERCLA cleanups, and New York State use classifications for ambient water quality. These values may apply to the development of remedial action objectives.	May relate to the treatment of water prior to discharge for potable use. Effluent standards include technology based limitations and State Water Quality Standards.
Village of Garden City Park Ordinance	Zoning Requirements	Action		May relate to buildings construction as part of remedial actions.
TO BE CONSIDERED (TBCs)				
NYSDEC Division of Air Resources -1	Guidelines for the control of Toxic Ambient Air Contaminants	Chemical		Provides guidelines for the control of toxic ambient air contaminants.
NYSDEC *Draft* DER-10	Technical Guidance for Site Investigation and Remediation	Chemical	Draft guidance may relate to development of remedial action objectives.	
NYSDEC TAGM HWR-90-4030	Selection of Remedial Actions at Inactive Hazardous Waste Sites	Chemical	May relate to development of feasibility study.	
NYSDEC TOGS 1.1.1	Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations	Action, Chemical	May be applicable for development of remedial action objectives for Site ground water.	May relate to the effectiveness of ground water remediation technologies and the discharge requirements for recharged ground water.
NYSDOH Community Air Monitoring Plan for Intrusive Activities	CAMP	Action, Chemical	Not applicable.	Requirements for real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust). Would relate to any intrusive remedial activities. May apply to any dust suppression during remedial action.

TABLE 1
LISTING OF ARARs AND TBCs
150 FULTON AVENUE
GARDEN CITY PARK, NY

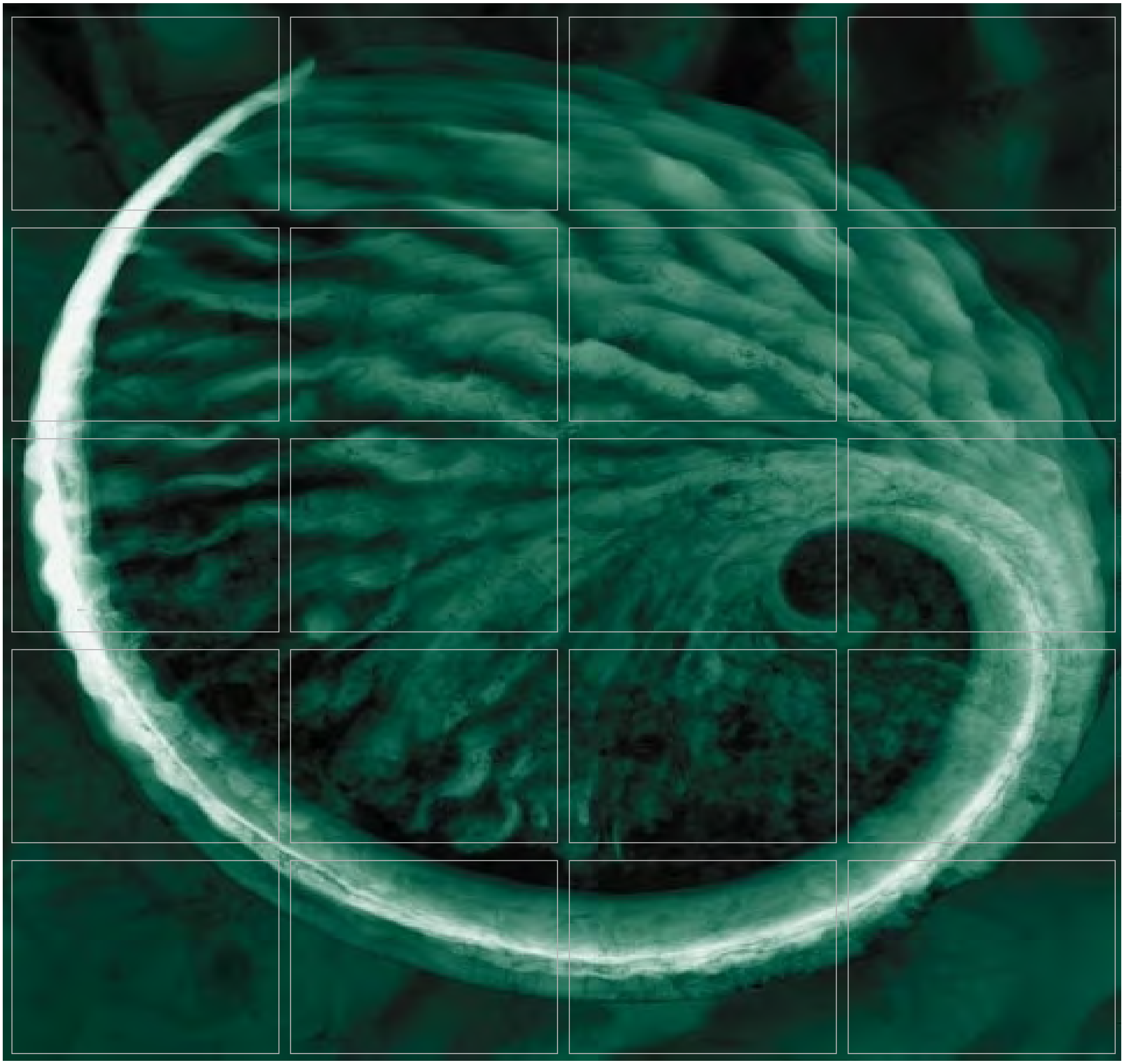
Citation	Description	Type	Potential Applicability to developing Remedial Action Objectives	Potential Applicability to Evaluating Remedial Action Alternatives
USEPA Integrated Risk Information System	USEPA database containing toxicity data for various chemicals.	Action, Chemical	Provides guidance on the human health evaluation activities conducted during the baseline risk assessment, such as data collection and toxicity assessment. May relate to the selection of the final remedial action.	Provides guidance on the human health evaluation activities conducted during the baseline risk assessment, such as data collection and toxicity assessment. May relate to the selection of the final remedial action.
EPA Drinking Water Health Advisories	Non-enforceable guidelines developed by the EPA for chemicals that may be encouraged in drinking water.	Chemical		The drinking water health advisory guidance values may be considered in the demonstration of the remedial actions.
USEPA Risk Assessment Guidance for Superfund Human Health Evaluation Manual		Action		Human health risk assessments.

<u>Acronym Definitions</u>
CAMP: Community Air Monitoring Plan
CFR: Code of Federal Regulations
DER: Division of Environmental Remediation
HWR: Hazardous Waste Remediation
NYSDEC: New York State Department of Environmental Conservation
NYSDOH: New York State Department of Health
NYCRR: New York Environmental Conservation Rules and Regulations
OSHA: Occupational Safety and Health Administration
RCRA: Resource Conservation and Recovery Act
TAGM: Technical and Administrative Guidance Memorandum
TOGS: Technical Operational Guidance Series
USEPA: United States Environmental Protection Agency

LIST OF APPENDICES

A	*Quality Assurance Project Plan*
B	*Health & Safety Contingency Plan*

Appendix A - Quality Assurance Project Plan



DRAFT Operable Unit 1 Quality Assurance Project Plan

Fulton Avenue Superfund Site
150 Fulton Avenue
Garden City Park, Nassau County, New York

January 2010

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LIST OF ATTACHMENTS

ATTACHMENT A - ERM's Proposed Project Management Team
ATTACHMENT B - Professional Profiles
ATTACHMENT C - Standard Operating Procedures (SOPs)
ATTACHMENT D - Laboratory SOPs

Introduction

This Quality Assurance Project Plan (QAPP) presents the policies, organization, objectives, functional activities and specific Quality Assurance (QA) and Quality Control (QC) activities designed to achieve the data quality goals associated with the Operable Unit 1 (OU1) Remedial Design (RD) and Remedial Action (RA) to be conducted at the Fulton Avenue Superfund Site (Site) in Garden City Park, New York.

The purpose and objective of the QAPP is to ensure that the analytical results are accurate and representative of field conditions. The analytical methods and QA/QC procedures presented in this QAPP are referenced from, and shall be consistent with the guidelines established in the *Uniform Federal Policy for Quality Assurance Project Plans* (UFP-QAPP) and Section 6 (Part B) of *Quality Systems for Environmental Data and Technology Programs - Requirements with guidance for use*, ANSI/ASQ E4 (February 2004).

This QAPP is an integral part of the OU1 Remedial Design (RD) Work Plan. This QAPP is a dynamic document that will be subject to revision as the OU1 RD/RA progresses. Revisions will likely be required to address changes in regulatory requirements or field conditions to ensure the scope of the QAPP is aligned with the needs of the OU1 RD and/or RA, and that data goals are met including the accuracy and representativeness of all analytical results.

QAPP Worksheet #1
Title and Approval Page

Site Name/Project Name: Fulton Avenue Superfund Site
Site Location: 150 Fulton Avenue, Garden City Park, New York

Document Title: Quality Assurance Project Plan, 150 Fulton Avenue Site, 150 Fulton Avenue, Garden City Park, New York

Lead Organization: Genesco Inc.

Preparer's Name and Organizational Affiliation: Chris Wenczel & Eugene Gabay Environmental Resources Management, Inc.

Preparer's Address, Telephone Number, and E-mail Address: 40 Marcus Drive, Suite 200, Melville, New York 11747, 631-756-8900, chris.wenczel@erm.com and eugene.gabay@erm.com

Preparation Date (Day/Month/Year): 18 January 2010

Investigative Organization's Project Manager (Sign and Date)
Chris Wenczel, ERM

Investigative Organization's Project QA Officer (Sign and Date)
Andrew Coenen, ERM

Lead Organization's Project Manager (Sign and Date)
Roger Sisson, Senior Vice President, Corporate Secretary and General Counsel, Genesco Inc.

Approval Authority: United States Environmental Protection Agency (USEPA) (Sign and Date)
Kevin Willis, USEPA Remedial Project Manager

Approval Authority: NYS Department of Environmental Conservation (NYSDEC) (Sign and Date)
Steven M. Scharf, P.E., NYSDEC Remedial Project Manager

QAPP Worksheet #2
QAPP Identifying Information

Site Name/Project Name: Fulton Avenue Superfund Site OU1
Site Location: 150 Fulton Avenue, Garden City Park, New York
Site Number/Code: CERCLA Site No.: NY0000110247
Registry of Inactive Hazardous Waste Disposal Sites in New York State
Site Number 130073
Operable Unit: 1 (OU1)
Contractor Name: Environmental Resources Management, Inc. (ERM)
Contractor Number: ERM Project No.: 0097881

Title: Quality Assurance Project Plan
Revision Number: 00
Revision Date: 18 January 2010

Contract Title: N/A
Work Assignment Number: N/A

1. Identify guidance used to prepare QAPP: Uniform Federal Policy for Quality Assurance Project Plans
2. Identify regulatory program: CERCLA
3. Identify approval entity: USEPA Region II
4. The QAPP is (select one): ☐Generic ☒Project Specific
5. List dates of scoping sessions that were held: See Worksheet #9
6. List dates and titles of QAPP documents written for previous site work, if applicable:

Title	Approval Date
Sampling and Analysis Plan, Quality Assurance Project Plan, and Health and Safety Plan	11/16/98

7. List organizational partners (stakeholders) and connection with lead organization:

   Roger Sisson, Senior Vice President, Corporate Secretary and General Counsel
   Genesco Inc.

8. List data users:

   USEPA, NYSDEC, New York State Department of Health (NYSDOH), Nassau County Department of Health (NCDH), Genesco Inc. and ERM.

9. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusions below:

   N/A, See QAPP Identifying Information Matrix Below.

QAPP Worksheet #2
QAPP Identifying Information (continued)

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	QAPP Worksheet # or Crosswalk to Related Document
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QAPP Worksheet #3
Distribution List

QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-mail Address	Document Control Number
Kevin Willis	Remedial Project Manager	USEPA Region II	212-637-4252	212-637-4279	Willis.Kevin@epamail.epa.gov	rev 00-01
Steven M. Scharf, P.E.	Remedial Project Manager	NYSDEC	518-402-9620	518-402-9022	sxscharf@gw.dec.state.ny.us	rev 00-02
John Swartwout	Chief Section C, Remedial Bureau A	NYSDEC	518-402-9620	518-402-9022	jbswarto@gw.dec.state.ny.us	rev 00-03
Douglas Fischer	Assistant Regional Counsel New York/Caribbean Superfund Branch Office of Regional Counsel	USEPA	212-637-3180	212-637-3104	Fischer.Douglas@epamail.epa.gov	rev 00-04
Robert Kambic	Assistant U.S. Attorney U.S. Attorney's Office, EDNY	USDOJ	631-715-7852	631-715-7920	robert.kambic@usdoj.gov	rev 00-05
Paul Alexis, Esq.	Partner	Bradley Arant Boult Cummings LLP	615-252-2385	615-252-6385	palexis@babc.com	rev 00-06
Melissa Alexander, Esq.	Partner	Bradley Arant Boult Cummings LLP	615-252-2326	615-252-6326	malexander@babc.com	rev 00-07
James Periconi, Esq.	Principal	Periconi, LLC	212-213-5500	212-213-5030	jpericoni@periconi.com	rev 00-08
Delight Balducci	Counsel	Periconi, LLC	212-213-5500	212-213-5030	dbalducci@periconi.com	rev 00-09
Roger Sisson, Esq.	Senior Vice President, Corporate Secretary and General Counsel	Genesco Inc.	615-367-7000	615-367-7073	RSISSON@genesco.com	rev 00-010
James Perazzo	Principal Partner	ERM	631-756-8913	631-756-8901	jim.perazzo@erm.com	rev 00-011
Chris Wenczel	Senior Consultant	ERM	631-756-8920	631-756-8901	chris.wenczel@erm.com	rev 00-012
Mr. Andrew Coenen	Project Chemist	ERM	631-756-8959	631-756-8901	andrew.coenen@erm.com	rev 00-013
Mrs. Tammy McCloskey	Laboratory Project Manager	Accutest	732-355-4562	732-329-3499	tammym@accutest.com	rev 00-014

QAPP Worksheet #4
Project Personnel Sign-Off Sheet

Organization: Genesco Inc.

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Roger Sisson	Senior Vice President, Corporate Secretary and General Counsel	615-367-7000		

Organization: ERM

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
James Perazzo	Alternate Project Coordinator/Manager	631-756-8913		
Chris Wenczel	Project Coordinator/Manager	631-756-8920		
Andrew Coenen	Laboratory QA Officer	631-756-8959		
Eugene Gabay	ERM Field Team Leader	631-756-8954		
Justin Bunton	ERM Health and Safety Officer	860 466-8506		

Organization: Accutest Laboratories

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Mrs. Tammy McCloskey	Laboratory Project Manager	732-355-4562		

QAPP Worksheet #5
Project Organizational Chart

See ERM's proposed organizational chart presented as Attachment A.

QAPP Worksheet #6
Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Point of Contact with USEPA Remedial Project Manager and Genesco Inc.	ERM Project Manager	Chris Wenczel	631-756-8920	All documents and information about the project will be forwarded to USEPA by Mr. Wenczel. Mr. Wenczel will have responsibility for all phases of the OU1 Remediation at the site. Mr. Wenczel will delegate project tasks. All materials and information about the project will be forwarded to Genesco by Mr. Wenczel.
General Project Technical Support and QA/QC Review	ERM	James Perazzo Ernest Rossano Andrew Coenen Eugene Gabay	See QAPP Worksheet #3	Project team will provide project support and correspondence through e-mail, telephone and personal communications.
Daily Site Progress	ERM Field Team Leader	Eugene Gabay	631-756-8954	Mr. Gabay will be responsible for providing daily and real-time updates from the site to Mr. Wenczel and the USEPA as requested through e-mail, telephone and personal communications.
Liaison with Analytical Laboratory	ERM	Andrew Coenen	631-756-8959	Mr. Coenen will serve as the point of contact for the analytical laboratory and will be responsible for all laboratory and analytical data QA/QC review. All correspondence with the laboratory will be conducted through e-mail or telephone communications.

QAPP Worksheet #7
Personnel Responsibilities and Qualifications Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
James Perazzo	Principal-In-Charge	ERM	• provide overall corporate project and technical management, • ensures professional services provided by ERM are cost effective and of the highest quality, • ensures all resources of ERM are available on an as-required basis, • conduct technical discussions for key technical issues with the Respondents, • managerial and technical guidance to ERM Site Manager and other staff, • final review of ERM submittals prior to issue • primary technical support in technical discussions with state and / or federal agencies.	See professional profile in Attachment B
Chris Wenczel	Project Manager	ERM	• responsible for all phases of the OU1 Remedial Action at the site. Mr. Wenczel will delegate project tasks.	See professional profile in Attachment B
Andrew Coenen	QA Officer	ERM	• provides managerial and technical assistance to QA/QC personnel during development of the QAPP and associated work plans, • provides expertise support function during Agency negotiations, if required • procurement and contracting f analytical laboratory, • overview of laboratory activities, • decides laboratory data corrective action, • performs analytical data assessment and validation, and • assists in preparation of Final Report.	See professional profile in Attachment B
Eugene Gabay	Field Team Leader	ERM	• coordination and management of all field activities and field QA/QC, • overall technical management of the removal activities, • overall Site Health and Safety performance, • management of project costs and schedules, • technical representation at meetings with the Respondents, • overall preparation and review of work plans, • day-to-day project coordination, facilitation and Site management, • coordination of removal activities, and • progress and Final Report preparation.	See professional profile in Attachment B
Justin Bunton	ERM Health and Safety Officer	ERM	• responsible for overall Site Health and Safety, coordination and management of all field activities and field QA/QC, • overall technical assistance for Health and Safety related issues, and • provides QA/QC review for Health and Safety related documents.	See professional profile in Attachment B

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Mrs. Tammy McCloskey	Laboratory Project Manager	Accutest Laboratories	• coordinate laboratory analyses, • supervise in-house chain-of-custody, • schedule sample analyses, • oversee data review, • oversee preparation of analytical reports, • approve final analytical reports prior to submission to ERM, • oversee QA/QC documentation, and • provide technical representation of laboratory QA procedures.	NA

QAPP Worksheet #8
Special Personnel Training Requirements Table

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Training has been completed on an individual basis to complete the required project specific functions - See note to right and additional information below.						See Professional Profiles provided as Attachment B for specific ERM employee training and certifications. ERM training certificates available upon request

ERM staff and subcontractors who will provide field services at the site will be trained, at a minimum, per the requirements of 29 Code of Federal Regulations (CFR) 1910.120 “Hazardous Waste Operations and Emergency Response” (HAZWOPER), including both the one time 40-hour training and annual 8-hour refreshers. This training includes discussions of potential hazards, exposure limits, and a review of personal protective equipment, emergency procedures, and respRAtor selection and fit testing.

QAPP Worksheet #9

Project Scoping Session Participation Sheet

<table>
<tr><td colspan="3">Project Name:
Projected Date(s) of Sampling:
Project Manager:</td><td colspan="3">Site Name: Fulton Avenue Superfund Site OU1
Site Location: 150 Fulton Avenue
Garden City Park, New York</td></tr>
<tr><td colspan="6">Date of Session:
Scoping Session Purpose:</td></tr>
<tr><th>Name</th><th>Title</th><th>Affiliation</th><th>Phone #</th><th>E-mail Address</th><th>Project Role</th></tr>
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</table>

Comments/Decisions: see below

Action Items: see below

Consensus Decisions: see below

Initial project scoping was completed by ERM in developing the OU Remedial Design Work Plan based on the 28 September 2007 Record of Decision (ROD), the Consent Judgment (USEPA Consent Judgment No. CV–09–3917) and attached SOW lodged with the United States District Court for the Eastern District of New York on 10 September 2009 and noticed in the Federal Register / Vol. 74, No. 179, 17 September 2009.

QAPP Worksheet #10
Problem Definition

The problem to be addressed by the project: The Fulton Avenue Property has been identified as a contributing source of Tetrachloroethene (PCE) contamination of groundwater beneath the Site creating plumes in the Upper Glacial and Magothy aquifers which extend to the southwest, impacting certain public supply wells owned by the Incorporated Village of Garden City (Garden City).
The environmental questions being asked: The OU1 Remedy consists of two key components to actively address groundwater impacts directly attributable to the Avenue Superfund Site: 1) In-situ chemical oxidation (ISCO) treatment of the shallower groundwater at and near the 150 Fulton Avenue Property, and 2) extraction and treatment of PCE-impacted groundwater from the deeper Magothy aquifer at locations upgradient of impacted supply wells operated by the Garden City Water District (Well Nos. 13 & 14) followed by subsequent recharge of the treated groundwater to the Upper Glacial aquifer**.**
Observations from any site reconnaissance reports: The defined extent of areas that require remediation are provided in Section 3 of the RI Report, Sections 1.3 and 2.0 of the FS Report, to be supplemented by the pre-design and design studies outlined in Sections 2.0 and 3.2 of the OU1 RD Work Plan..
A synopsis of secondary data or information from site reports: The secondary data and information has been compiled in the ERM 2005 Remedial Investigation Report.
The possible classes of contaminants and the affected matrices: The investigation identified ground water affected with volatile organic compounds (VOCs), predominantly PCE. The affected matrices will be remediated through ground water extraction, treatment and recharge, and focused in-situ chemical oxidation.
The rationale for inclusion of chemical and non-chemical analyses: The data from groundwater will be used to evaluate the off-site groundwater quality and to track the performance and effectiveness of the remedial components; and groundwater samples will be analyzed as set forth in outlined in Sections 2.1, 2.2, 3.2 & 3.3 of the RD Work Plan to be refined as the OU1 RD progresses. The data from the waste characterization samples will be used to help characterize the investigative/remedial derived waste.
Information concerning various environmental indicators: Remedial objectives, performance standards and specific environmental criteria are set forth in Sections 1.2, 3.2.3 and 3.3.3 of the RD Work Plan.
Project decision conditions ("If..., then..." statements): • To Be Determined during the OU1 RD.

QAPP Worksheet #11

Project Quality Objectives/Systematic Planning Process Statements

Who will use the data? USEPA, and ERM

What will the data be used for?

- The data from groundwater will be used to evaluate the off-site groundwater quality and to track the performance and effectiveness of the remedial components; and
- The data from the waste characterization samples will be used to help characterize the investigative/remedial derived waste.

What type of data are needed? (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques) Groundwater samples will be analyzed as set forth in outlined in Sections 2.1, 2.2, 3.2 & 3.3 of the RD Work Plan to be refined as the OU1 RD progresses. Details regarding specific analytical protocols and collection methods are presented in latter sections of this QAPP. Waste characterization samples may be analyzed for the presence of hazardous material by the Toxic Characteristic Leaching Potential (TCLP) test according to USEPA Methods for PCB's, organics, inorganics and Toxicity Characteristic (TC) criteria (i.e., corrosivity (pH), ignitability (flashpoint), and reactivity). The required criteria will depend upon the media evaluated and the requirements of the TSDF.

How "good" do the data need to be in order to support the environmental decision? The data needs to meet the QA/QC criteria and the target detection limits for compounds listed in Worksheet #12 and #15 of this QAPP.

How much data are needed? (number of samples for each analytical group, matrix, and concentration) The anticipated criteria for the groundwater sampling are outlined in Sections 2.1, 2.2, 3.2 & 3.3 of the RD Work Plan to be refined as the OU1 RD progresses. The number of waster characterization samples will depend on the volume of waste generated and the requirement of the TSDF.

Where, when, and how should the data be collected/generated? The criteria for the groundwater sampling program are outlined in Sections 2.1, 2.2, 3.2 & 3.3 of the RD Work Plan. The anticipated criteria and frequency for the waste characterization samples is also mentioned in these sections but may change based on the specific criteria requested by the TSDF.

Who will collect and generate the data? It is anticipated that samples will be collected by ERM's field personnel.

How will the data be reported? The results of the data will be provided in the final RA report.

How will the data be archived? Data will be archived in ERM's central file. Electronic copies of all data will be provided to USEPA for archival purposes.

QAPP Worksheet #12

Measurement Performance Criteria Table

Matrix	All
Analytical Group	All
Concentration Level	All

Sampling Procedure1	Analytical Method/SOP2	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
All	All	Precision – Lab	RPD 40%	Lab Duplicate	A
		Precision – Field	RPD 50% (aqueous) RPD 100% (soil/air)	Blind Field Duplicate	S & A
		Accuracy/Bias Contamination	No target compounds above QL	Method blank, preparation blank, field blank, trip blank	A
		Sensitivity	In house QC criteria	Lab Check Sample	A
		Completeness	90 % acceptable (non-rejected) [3] data	Data Completeness Check	S & A

1. See Worksheet #21 for detailed information.
2. See Worksheet #23 for detailed information.
3. Only data undergoing validation may be rejected.

QAPP Worksheet #13

Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
Public supply well sampling and pumpage data	Garden City Water Department	ERM	Support the OU1 RD and monitoring the performance and effectiveness of the OU1 RA	N/A
Regional hydrogeologic information	United States Geological Survey			

QAPP Worksheet #14

Summary of Project Tasks

Sampling Tasks: ▪ Collection of waste characterization samples and ▪ Collection of groundwater monitoring samples.
Analysis Tasks: Accutest Laboratories will perform all laboratory analysis. The specific criteria for each project sampling task are detailed in Worksheet #18.
Quality Control Tasks: QA/QC sampling requirements are outlined in Worksheet #26. All project personnel are expected to review and comply with the QA/QC protocol and guidance presented in this document.
Secondary Data: See Worksheet #13.
Data Management Tasks: After appropriate QA/QC review data will be compiled in an electronic database and presented in the RA Report.
Documentation and Records: All documents will be managed and retained by the ERM project manager in the central project file.
Assessment/Audit Tasks: QA/QC audits will be performed by Project Manager, ERM ERM Principal In Charge and ERM QA Officer.
Data Review Tasks: QA/QC review and validation of data will be managed by ERM QA officer.

QAPP Worksheet #15

Analytical Parameters, Project Action Levels and Laboratory Reporting Limits

Sampling Location: Groundwater Monitoring Samples

Matrix: Aqueous **Concentration Level: Low** **Analytical Group: VOCs**

Target Compound List (TCL)[1]	CAS Number[2]	Project Action Limit (µg/l)[3]	Achievable Laboratory Limits[4]	
			QLs[5] (µg/l)	MDLs[6] (µg/l)
Dichlorodifluoromethane	75-71-8	5	1	0.39
Chloromethane	74-87-3	5	1	0.2
Vinyl chloride	75-01-4	2	1	0.77
Bromomethane	74-83-9	5	1	0.39
Chloroethane	75-00-3	5	1	0.65
Trichlorofluoromethane	75-69-4	5	1	0.43
1,1-Dichloroethene	75-35-4	5	1	0.49
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	5	2	0.92
Acetone	67-64-1	50	5	4.6
Carbon disulfide	75-15-0	60	1	0.38
Methyl acetate	79-20-9	5	5	0.54
Methylene chloride	75-09-2	5	2	0.53
trans-1,2-Dichloroethene	156-60-5	5	1	0.18
Methyl tert-butyl ether	1634-04-4	10	1	0.29
1,1-Dichloroethane	75-34-3	5	1	0.089
cis-1,2-Dichloroethene	156-59-2	5	1	0.18
2-Butanone	78-93-3	50	5	1.4
Bromochloromethane	74-97-5	5	1	0.5
Chloroform	67-66-3	7	1	0.18
1,1,1-Trichloroethane	71-55-6	5	1	0.094
Cyclohexane	110-82-7	5	5	0.13
Carbon tetrachloride	56-23-5	5	1	0.53
Benzene	71-43-2	1	1	0.37
1,2-Dichloroethane	107-06-2	0.6	1	0.57
1,4-Dioxane	123-91-1	5	130	18
Trichloroethene	79-01-6	5	1	0.16
Methylcyclohexane	108-87-2	5	1	0.35
1,2-Dichloropropane	78-87-5	1	1	0.5
Bromodichloromethane	75-27-4	50	1	0.14
cis-1,3-Dichloropropene	10061-01-5	0.4	1	0.56
4-Methyl-2-pentanone	108-10-1	5	5	0.5
Toluene	108-88-3	5	1	0.41
trans-1,3-Dichloropropene	10061-02-6	0.4	1	0.15
1,1,2-Trichloroethane	79-00-5	1	1	0.15
Tetrachloroethene	127-18-4	5	1	0.39
2-Hexanone	591-78-6	50	5	0.35
Dibromochloromethane	124-48-1	50	1	0.17
1,2-Dibromoethane	106-93-4	0.0006	1	0.39
Chlorobenzene	108-90-7	5	1	0.74
Ethylbenzene	100-41-4	5	1	0.44
o-Xylene	95-47-6	5	1	0.34
m,p-Xylene	179601-23-1	5	1	0.76

Sampling Location: Groundwater Monitoring Samples

Matrix: Aqueous **Concentration Level: Low** **Analytical Group: VOCs**

Target Compound List (TCL) [1]	CAS Number [2]	Project Action Limit (μg/l) [3]	Achievable Laboratory Limits [4]	
			QLs [5] (μg/l)	MDLs [6] (μg/l)
Styrene	100-42-5	5	1	0.069
Bromoform	75-25-2	50	1	0.52
Isopropylbenzene	98-82-8	5	1	0.64
1,1,2,2-Tetrachloroethane	79-34-5	5	1	0.11
1,3-Dichlorobenzene	541-73-1	3	1	0.32
1,4-Dichlorobenzene	106-46-7	3	1	0.45
1,2-Dichlorobenzene	95-50-1	3	1	0.34
1,2-Dibromo-3-chloropropane	96-12-8	0.04	5	0.62
1,2,4-Trichlorobenzene	120-82-1	5	2	0.13
1,2,3-Trichlorobenzene	87-61-6	5	2	0.14

1. Target Compound List (TCL) from Multi-Media, Multi-Concentration Organics Analysis, SOM01.2, Exhibit C, 1.0.
2. Chemical Abstracts Service (CAS) Registry Number.
3. New York State Ambient Ground Water Quality Standards and Guidance Values (AWGS) as listed in TOGS 1.1.1 (June 1998) and in 6 NYCRR 703.5.
4. As per Accutest Laboratories, 2235 Route 130, Dayton, New Jersey 08810.
5. QL – Quantitation Limit
6. MDL – Method Detection Limit.

Sampling Location: Investigative Derived Waste (IDW)

Matrix: Soil **Concentration Level: Low** **Analytical Group: TCLP**

Compound List [1]	CAS Number [2]	Project Action Limit (mg/l) [3]	Achievable Laboratory Limits [4]	
			QLs [5] (mg/l)	MDLs [6] (mg/l)
Benzene	71-43-2	0.5 (D018)	0.005	0.0012
2-Butanone (MEK)	78-93-3	200 (D035)	0.1	0.0081
Carbon tetrachloride	56-23-5	0.5 (D019)	0.005	0.0013
Chlorobenzene	108-90-7	100 (D021)	0.005	0.0019
Chloroform	67-66-3	6 (D022)	0.005	0.0012
1,4-Dichlorobenzene	106-46-7	7.5 (D027)	0.005	0.0014
1,2-Dichloroethane	107-06-2	0.5 (D028)	0.005	0.0017
1,1-Dichloroethene	75-35-4	0.7 (D029)	0.005	0.002
Tetrachloroethene	127-18-4	0.7 (D039)	0.005	0.0013
Trichloroethene	79-01-6	0.5 (D040)	0.005	0.0012
Vinyl chloride	75-01-4	0.2 (D043)	0.025	0.0022

1. From EPA's Toxicity Characteristic Leaching Procedure (TCLP).
2. Chemical Abstracts Service (CAS) Registry Number.
3. Maximum Concentration of Contaminants for Toxicity Characteristic (Table 1, D List). EPA Hazardous Waste code in parenthesis.
4. As per Accutest Laboratories, 2235 Route 130, Dayton, New Jersey 08810.
5. QL – Quantitation Limit
6. MDL – Method Detection Limit.

QAPP Worksheet #16
Project Schedule

See ERM's proposed OU1 RD and OU1 RA project schedules presented in the OU1 RD Work Plan as Figures 10 & 11.

QAPP Worksheet #17
Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach):

Pre-design Comprehensive Groundwater Sampling Event: A total of 40 groundwater samples will be collected from wells located within the footprint of the PCE-dominant plume to get an updated snapshot of groundwater levels and quality conditions from the Fulton Property to the multi-level wells on the Garden City Country Club Golf Course. The water level and sample analytical data will be used to evaluate current groundwater flow and quality conditions within the footprint of the PCE-dominant plume for design of the ISCO and the groundwater pump and treatment components of the OU1 RA. If necessary, adjustments to the ISCO pre-design investigation will be affected based on the current distribution of VOCs in groundwater in close proximity to the Fulton Avenue Property. The 40 groundwater samples (plus appropriate QA/QC samples) will be collected from multi-level wells MWs 26 & 27 (MWs 26A-H & 27A-H), and the following conventional wells: MWs 15A, 15B, 21A, 21B, 21C, 23A, 23B, 23C, 23D, and GCP 01, 01D, 04, 08, 09, 15S, 17S, 17D, 18S, 18D and 19S plus remaining wells in the vicinity of the Soil IRM Area (wells VOWs 1D, 3D, 4D & VEW-1). All groundwater samples will be analyzed for TCL VOCs using USEPA Method 8260B.

Continued Groundwater Monitoring: The SOW requires a continuation of the groundwater monitoring program currently being performed under the Order at a yet to be determined frequency to onitor groundwater quality immediately upgradient and downgradient of Village of Garden City Public Supply Well Nos. 13 & 14. This continued sampling activity will occur at a frequency yet to be determined but will cover the interim period of time between April 2010 and implementation of the OU1 RA components at which time this monitoring would be replaced by short- term performance monitoring followed by long-term effectiveness monitoring. The results thereof, in conjunction with the existing data set will be used to select and propose the frequency of the continued interim sampling to USEPA. Each continued sampling event will involve the collection 19 groundwater samples (plus appropriate QA/QC samples) will be collected from multi-level wells MWs 26 & 27 (MWs 26A-H & 27A-H), and the following conventional wells: MWs 21A, 21B & 21C. All groundwater samples will be analyzed for TCL VOCs using USEPA Method 8260B.

Short-Term Performance and Long-Term Effectiveness Groundwater Monitoring: Short-term performance and long-term remedial effectiveness monitoring, groundwater monitoring would be conducted for the duration of each OU1 RA component. Those proposed programs have not yet been designed but will be as part of the OU1 RD as part of the Operations, Maintenance & Monitoring Plan (OM&M) Plan. Examples of those programs are presented in Section 3.5.1 of the OU1 RD Work Plan.

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations) [May refer to map or Worksheet #18 for details]: These details are provided in other sections of this document. Please refer to Worksheet #2 for the QAPP Identifying Information and in Worksheet #18.

QAPP Worksheet #18

Sampling Locations and Methods/SOP Requirements Table

Sampling Location	Matrix	Depth (feet)	Analytical Group	Analytical Method	Number of Samples[1]	Sampling SOP Reference[2]	Rationale for Sampling Location
Groundwater Monitoring Samples	Aqueous	Multiple[3]	VOCs	8260B	Number and locations of samples to be determined based on the specific groundwater sampling activity	SOPs 1, 2, 3, 4, 5, 6, 9, 10 & 11	See Worksheet #17
Investigative Derived Waste Samples	Soil	N/A	TCLP VOCs	1311/8260B	1 sample (estimated; may change based on volume of soil generated and specific requirements of TSDF. Collection of QA/QC samples for waste characterization purposes is not anticipated.	SOP-12	See Worksheet #17

1. QA/QC samples collected at the frequency specified on Worksheet #20.
2. See Worksheet #21 for additional information.
3. Each well has a specified depth for sample collection.

QAPP Worksheet #19
Analytical SOP Requirements Table

Sample Location	Matrix	Analytical Group	Preparation and Analytical Method/ SOP Reference [1]	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis) [2]
Groundwater Monitoring Samples	Aqueous	VOCs	EPO5030-03 EMS8260-19	3 – 40 ml glass VOA vials	Cool 4°C, pH<2 (HCl)	NA / 10 days
Investigative Derived Waste Samples	Soil	TCLP VOCs	EPO5030-03 EMS8260-19	1 – 8 oz. glass jar	Cool, 4°C	7 / 10 days

1. See Worksheet #23 for additional information.
2. New York State Analytical Services Protocol (NYS ASP) holding times and are from date of sample receipt.

QAPP Worksheet #20
Field Quality Control Sample Summary Table

Sample Location	Matrix	Analytical Group	Analytical and Preparation SOP Reference1	No. of Sampling Locations	No. of Blind Field Duplicate Samples	No. of MS/MSD pairs	No. of Field Blanks	No. of Trip. Blanks	No. of PT Samples	Total No. of Samples to Lab
Groundwater Monitoring Samples	Aqueous	VOCs	EPO5030-03 EMS8260-19	See Worksheet #18	1 minimum frequency of 1 out of every 20 samples.	1 minimum frequency of 1 out of every 20 samples.	To be determined. Minimum frequency of 1 per each sample collection event	To be determined. Minimum frequency of 1 per each sample collection event	None	To be determined.
Investigative Derived Waste Samples	Soil	TCLP VOCs	EPO5030-03 EMS8260-19	N/A	Collection of a field duplicate is not anticipated.	Collection of a MS/MSD pair is not anticipated	Collection of a field blank is not anticipated	None	None	To be determined.

1. Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

BLIND FIELD DUPLICATES

Blind field duplicate samples are two (or more) field samples taken at the same time in the same location. They are intended to represent the same population and are taken through all steps of the analytical procedure in an identical manner. These samples are used to assess precision of the entire data collection activity, including sampling, analysis, and site heterogeneity. One of the samples is given identification such that the laboratory does not know the true location of the sample. Blind field duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and are treated in an identical manner during storage, transportation, and analysis. The Field Sampling Manager shall assign to the sample containers a unique identification number in the field. Specific locations should be designated for collection of Blind field duplicate samples prior to the beginning of sample collection. A minimum of one Blind field duplicate sample shall be included for every 20 field samples per matrix and evaluated as detailed on Worksheet #28.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

The matrix spike (MS) and matrix spike duplicate (MSD) is an aliquot of sample spiked with known concentrations of all target analytes. The spiking occurs prior to sample preparation and analysis. Each analyte in the MS and MSD shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte. The MS/MSDs are used to document potential matrix effects. A minimum of one MS and one MSD shall be analyzed for every 20 samples. The performance of the MS and MSD is evaluated as detailed on Worksheet #28.

FIELD BLANK

The field blank consists of American Society for Testing and Materials (ASTM) Type II reagent grade or organic-free water poured into appropriate sample containers at the sampling site (in the same vicinity as the associated environmental samples). It is handled like an environmental sample and transported to the laboratory for analysis for all laboratory analytes requested for the environmental samples. Field blanks are used to assess the potential introduction of contaminants from surrounding sources of various COCs to the samples during sample collection. A field blank shall be collected for each sampling event where the potential for introduction of contaminants from surrounding sources exist. The decision whether to collect a field blank will be made by the Field Sampling Manager with the written concurrence of the Quality Assurance Manager. Field blank samples shall be collected downwind of possible sources of COCs. Results associated with a contaminated blank shall be flagged accordingly. Field blanks will be evaluated as detailed on Worksheet #28.

EQUIPMENT BLANK

An equipment blank is a sample of ASTM Type II reagent grade water or organic-free water poured into or over or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis. These may also be called rinse blanks or rinsate blanks. In instances where dedicated sampling equipment is used for sample collection, equipment blanks will not be collected. In these instances, field blanks will be used to assess field QC procedures. Equipment blanks are used to assess the effectiveness of equipment decontamination procedures. Equipment blanks shall be collected immediately after the equipment has been decontaminated after each sampling event, as appropriate, or at a minimum frequency of two per week. The equipment blank samples shall be analyzed for all laboratory analytes requested for the environmental samples collected at the site. Results associated with a contaminated blank shall be qualified accordingly.

TRIP BLANK

The trip blank consists of a VOC sample vial filled in the laboratory by the laboratory with ASTM Type II reagent grade or organic-free water, transported to the sampling site, handled like an environmental sample and returned to the laboratory for analysis. Trip blanks are not opened in the field. Trip blanks are analyzed for VOCs only. Trip blanks are used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures. Each cooler of samples sent to the laboratory for analysis containing VOC samples shall contain a trip blank. Trip blanks will be evaluated as detailed on Worksheet #28.

PROFICIENCY TESTING (PT) SAMPLES

PT samples will not be analyzed for this project.

QAPP Worksheet #21

Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Check if yes)	Comments
SOP-1	Water Level Measurement Procedures	ERM	N/A	☒	
SOP-2	Groundwater sampling Procedures	ERM	N/A	☒	
SOP-3	Field Blanks	ERM	N/A	☒	
SOP-4	Trip Blanks	ERM	N/A	☒	
SOP-5	Membrane Interface Probe (MIP) Procedures	ERM	N/A	☒	Anticipates use of USEPA Low Flow/Low Stress Protocol
SOP-6	Waterloo Vertical Profile Boring with Groundwater Sampling Procedures	ERM	N/A	☒	
SOP--7	Pump Test Procedures	ERM	N/A	☒	
SOP-8	Geologic Boring Drilling Procedures	ERM	N/A	☒	
SOP-9	Temporary Well Installation and Sampling Procedure	ERM	N/A	☒	
SOP-10	Potable Water Blanks	ERM	N/A	☒	
SOP-11	Decontamination Procedures	ERM	N/A	☒	
SOP-12	Investigative Derived Waste	ERM	N/A	☒	

QAPP Worksheet #22

Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Photo Ionization Detector (PID) MinRAe 2000 or equivalent	2 point calibration with isobutylene and zero gas	Cleaning as required and replacement of consumable filters. All maintenance to be performed by equipment rental facility	Test operation of unit comparable to a known calibration standard gas	Condition and operation of unit will be inspected before each use	Daily, before each use	+/- 5 NTU (assumes low range calibration w/ 100 NTU or less standards)	Contact equipment rental firm	Field Team Leader	N/A, reference manufacturer's instructions.
Turbidity Meter Lamotte 2020 or equivalent	2 point calibration or as specified by the manufacturers instructions	All maintenance to be performed by equipment rental facility	Test operation of unit comparable to a known calibration standard	Condition and operation of unit will be inspected before each use	Daily, before each use	+/- 5 NTU (assumes low range calibration w/ 100 NTU or less standards)	Contact equipment rental firm	Field Team Leader	N/A, reference manufacturer's instructions.
Water Quality Instrument dissolved oxygen, temperature, conductivity, pH and oxidation-reduction potential (ORP) YSI Model 600 or equivalent	Calibrate with rental facility supplied standard(s)	All maintenance to be performed by equipment rental facility	Test operation of unit comparable to a known calibration standard	Condition and operation of unit will be inspected before each use	Daily, before each use	+/- 0.03 mg/l for DO, +/- 0.1 pH unit, +/- 0.03% for conductivity, +/- 0.15 C for temp, +/- 1 mv for ORP	Contact equipment rental firm	Field Team Leader	N/A, reference manufacturer's instructions.

[1] Specify the appropriate reference letter or number from the Project Sampling SOP References table (Worksheet #21).

FIELD INSTRUMENT PREVENTATIVE MAINTENANCE

Preventative maintenance of field instruments will include cleaning after each use and replacement of consumable components such as used filters. Field instruments will also be examined prior to each mobilization for field activities to identify maintenance issues. If maintenance issues exist, maintenance will be performed by the equipment rental facility. The equipment rental facility will be responsible for providing a timely replacement for any malfunctioning equipment.

CALIBRATION PROCEDURES AND FREQUENCY

Before a field instrument is used, the calibration will be verified using standard reference materials. The calibration verification may range from a single point to multiple points. The concentration of the standard, reference identification number, instrument response, instrument identification number, date, and time will be recorded on the daily instrument calibration log and referenced in the site field book. The calibration verification will be performed at least daily, or more frequently as warranted by field conditions. Instruments which do not meet minimum requirements for calibration will not be used and will be replaced by a properly calibrated instrument. It is anticipated that all field instruments which will require calibration will be provided by an equipment rental vendor. The specific model of the instrument provided may vary and the manufacturer's calibration and maintenance instructions should be referenced.

QAPP Worksheet #23
Analytical SOP References Table

Analytical Group	Matrix	Analytical SOP Title	Analytical SOP Document Number	Analytical SOP Revision Number	Analytical SOP Revision Date	Organization Performing Analysis	Definitive or Screening Data	Modified for Project Work?
VOCs	Aqueous	Method 5030A: Purge and Trap	EPO5030-03	03	08/06/03	Accutest	Definitive	No
		Analytical Methods for the Analysis of GC/MS Volatile Samples – 8260B	EMS8260-19	19	09/11/09	Accutest	Definitive	No
TCLP VOCs	Soil	Method 5030A: Purge and Trap	EPO5030-03	03	08/06/03	Accutest	Definitive	No
		Analytical Methods for the Analysis of GC/MS Volatile Samples – 8260B	EMS8260-19	19	09/11/09	Accutest	Definitive	No

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA[1]	SOP Reference[2]
GC/MS	Tune	Every 12 Hrs.	Method Specifications	Re-tune	Analyst	EMS8260-19
	Initial Calibration	When CCV Fails	± 30% RSD; R > 0.99 or Grand Mean > 30%	Re-Calibrate	Analyst	
	CCV	12 Hours	± 25% RSD; R >0.99 or Grand Mean > 30%	Re-Calibrate	Analyst	

1. Each instrument has a different analyst.
2. See Worksheet #23 for additional information.

QAPP Worksheet #25
Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person [1]	SOP Reference[2]
HP5973, HP5975 & HP5970	Change Injection Liners		Daily	N/A	Replace or Clean	Analyst	EQA036-02
	Column Ferrules		As Required	N/A	Replace	Analyst	EQA036-02
	Injection Port Disc		As Needed	N/A	Clean as Needed	Analyst	EQA036-02
	Injection Port Wellman Assembly		As Needed	N/A	Replace as Needed	Analyst	EQA036-02
	Columns		As Needed	meets calibration criteria	Trim column or replace	Analyst	EQA036-02
	FID Jet		As Needed	N/A	Clean	Analyst	EQA036-02
	MS Source Parts		As Needed	N/A	Clean	Analyst	EQA036-02
	Purge Tubes		Daily & as Needed	N/A	Rinse	Analyst	EQA036-02
	Traps		Daily & as Needed	N/A	Clean / Replace	Analyst	EQA036-02
	Transfer Lines		As Needed	N/A	Rinse	Analyst	EQA036-02
	Syringe		Daily & as Needed	N/A	Clean	Analyst	EQA036-02
HP 5970 only	Jet Separator		As Needed	N/A	Clean as Needed	Analyst	EQA036-02

1. Each instrument has a different analyst.
2. See Worksheet #23 for additional information.

QAPP Worksheet #26

Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Eugene Gabay / ERM
Sample Packaging (Personnel/Organization): Eugene Gabay / ERM
Coordination of Shipment (Personnel/Organization): Eugene Gabay / ERM
Type of Shipment/Carrier: Priority Overnight / Federal Express
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Custodian / Accutest Laboratories (Dayton, New Jersey)
Sample Custody and Storage (Personnel/Organization): Sample Custodian / Accutest Laboratories (Dayton, New Jersey)
Sample Preparation (Personnel/Organization): Individual Department Heads / Accutest Laboratories (Dayton, New Jersey)
Sample Determinative Analysis (Personnel/Organization): Project Manager – Accutest Laboratories (Dayton, New Jersey)
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Samples collected in the field will be preserved as specified in Worksheet #19 and placed in a chilled cooler for priority overnight shipment to the analytical laboratory. It is the responsibility of the sample collection personnel to maintain appropriate custody of the cooler, ensure samples are packed appropriately to prevent breakage and ensure that the samples are preserved appropriately (e.g., chilled on ice). If special circumstances arise and the samples cannot be shipped the same day of sample collection, it is the sampler's responsibility to maintain appropriate custody and the temperature of the cooler until the samples are shipped the next day. Sample holding times and preservation methods are presented in Table #19.
Sample Extract/Digestate Storage (No. of days from extraction/digestion): See Worksheet #19
Biological Sample Storage (No. of days from sample collection): N/A
SAMPLE DISPOSAL
Personnel/Organization: Sample Custodian / Accutest Laboratories (Dayton, New Jersey)
Number of Days from Analysis: 1 month from submission of the hard copy report to ERM unless otherwise requested.

QAPP Worksheet #27
Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

The following documentation procedures will be used during sampling and analysis to provide custody control during transfer of samples from collection through storage. A sample is defined as being under a person's custody if any of the following conditions exist: 1) it is in their possession, 2) it is in their view, after being in their possession, 3) it was in their possession and they locked it up, or 4) it is in a designated secure area. Recordkeeping documentation will include the use of the following:

- a field logbook (bound, with numbered pages) to document sampling activities in the field,
- labels to identify individual samples,
- and- chain-of-custody forms to document the analyses to be performed

In the field the sampler will record in the field logbook the following information for each sample collected:

- sample identification,
- sample matrix,
- name of the sampler,
- sample location,
- sample time and date,
- additional pertinent data,
- analysis to be conducted,
- sampling method,
- sample appearance (e.g., color, turbidity),
- preservative (if required),
- number of sample bottles an types, and- weather conditions

Samples will be packaged in a manner to prevent breakage of sample containers in a pre-chilled cooler. Custody of the samples and cooler will be the responsibility of the sampling personnel. Samples will be shipped via Federal Express Priority Overnight service to the analytical laboratory the same day samples are collected.

Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal): Each sample or group of samples shipped to the laboratory for analysis will be given a unique identification number. The laboratory sample custodian will record the client name, number of samples and date of receipt of the samples. The remaining sample aliquots not used by the laboratory for analysis will be archived for a period of 30 days. After the archive period has passed the sample will be disposed of by the laboratory unless a request to hold the sample is made by ERM.

Sample Identification Procedures: Each sample collected will be designated by an alpha-numeric code that will identify the type of sampling location and a specific sample designation (identifier). Location types will be identified by a two-letter code. Groundwater samples collected from various existing and future groundwater monitoring wells. Samples collected for waste characterization will begin with “WC”. Samples collected from the treatment system Influent will be labeled “IN”. For example sample nomenclature for monitoring well samples, waste characterization samples and treatment system samples will be assigned as indicated in the following examples:

MW-1A = Monitoring Well Sample-Well ID,
WC-S-01 = Waste Characterization Sample-Soil-Sequential Sample Number (date sample was collected) and
WC-A-01 = Waste Characterization Sample-Aqueous-Sequential Sample Number (date sample was collected).

In the case of QC samples such as field blanks, trip blanks and blind field duplicate samples, six digits will follow FB, TB and DUP respectively to represent the date (e.g., FB (050107) would represent a field blank collected on 01 April 2007). For matrix spike/matrix spike duplicate samples, MS/MSD will be added following the applicable sample identification.

Chain-of-custody Procedures: The sampling crew shall maintain chain-of-custody records for all field and field QC samples.

The following information concerning the sample shall be documented on the chain of custody form:

- Unique sample identification for each container,
- Date and time of sample collection,
- Source of sample (including name, location, and sample type),
- Designation of MS/MSD;
- Preservative used;
- Analyses required;
- Name of collector(s);
- Serial numbers of custody seals and transportation cases (if used);
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories; and
- Bill of lading or transporter tracking number (if applicable).

QAPP Worksheet #28
QC Samples Table – Aqueous VOCs

Matrix **Analytical Group**	Aqueous VOCs		**Sampler's Name**	To Be Determined	
Concentration Level	Low		**Field Sampling Organization**	ERM	
Sampling SOP	SOPs 1, 2, 3, 4, 5, 6, 9, 10 & 11		**Analytical Organization**	Accutest Laboratories	
Analytical Method/ SOP Reference	8260B / EMS8260-19		**No. of Sample Locations**	To Be Determined By Specific Sampling Activity	
QC Sample:	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**
Method Blank	1 / day (12 Hr BFB)	No targets above QL	If no gross detections, qualify with a B. For gross detections reanalyze samples.	Tammy McCloskey (Accutest)	Accuracy/Bias-Contamination
Surrogates	2 per sample	Recovery must fall within in-house QC criteria [1]	Reanalyze sample in order to determine matrix effect.	Tammy McCloskey (Accutest)	Accuracy/Bias
Lab Check Sample	1 / 20 samples	Recovery must fall within in-house QC criteria [1]	Reanalyze if gross exceedances.	Tammy McCloskey (Accutest)	Laboratory Accuracy
Blind field duplicate	1 / 20 samples	Relative percent difference (RPD) 50%	Qualify data during validation process.	Andrew Coenen (ERM)	Precision / Reproducibility
Matrix Spike / Matrix Spike Duplicate Pair	1 / 20 samples	Recovery must fall within in-house QC criteria [1]	Qualify data during validation process.	Andrew Coenen (ERM)	Accuracy/Bias
Field Blank Trip Blank	1 / day 1 / shipment of VOCs	Monitor for targets	Qualify data during validation process.	Andrew Coenen (ERM)	Contamination

1. In house QC criteria subject to change through out the project. Will be monitored during the validation process.

QAPP Worksheet #28
QC Samples Table - Soil TCLP VOCs

Matrix **Analytical Group**	Soil TCLP VOCs
Concentration Level	Low
Sampling SOP	SOPs 3, 4, 11 & 12
Analytical Method/ SOP Reference	88260B / EMS8260-19

Sampler's Name	To Be Determined
Field Sampling Organization	ERM
Analytical Organization	Accutest Laboratories
No. of Sample Locations	To Be Determined By Specific Sampling Activity

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Method Blank	1 / day (12 Hr BFB)	No targets above QL	If no gross detections, qualify with a B. For gross detections reanalyze samples.	Tammy McCloskey (Accutest)	Accuracy/Bias-Contamination
Surrogates	2 per sample	Recovery must fall within in-house QC criteria [1]	Reanalyze sample in order to determine matrix effect.	Tammy McCloskey (Accutest)	Accuracy/Bias
Lab Check Sample	1 / 20 samples	Recovery must fall within in-house QC criteria [1]	Reanalyze if gross exceedances.	Tammy McCloskey (Accutest)	Laboratory Accuracy
Blind field duplicate	None	N/A	N/A	N/A	N/A
Matrix Spike / Matrix Spike Duplicate Pair	None	N/A	N/A	N/A	N/A
Field Blank Trip Blank	None	N/A	N/A	N/A	N/A

1. In house QC criteria subject to change through out the project. Will be monitored during the validation process.

QAPP Worksheet #29

Project Documents and Records Table

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
- Field Notebook, - Monitoring Well Construction Logs, - Well Development Log sheets, - Sampling Equipment Checklists, - Groundwater Sampling Log Sheets, - Chain-of-Custody Forms, - Air Bills, and - Telephone Logs.	- Daily Instrument Calibration Logs, and - Telephone Logs.	- Sample Receipt, Custody and Tracking Records - Telephone Logs, - Laboratory Analytical Reports, and - Raw Data (archived electronically.	- Data Validation Reports, - Field Audit Checklists, and - Data Usability Summary Report.	All documents generated during the project will be recompiled and retained in the central project file. At the conclusion of the project an RA Report will be presented which will include as appendices many of the related project documents and records. Any documents not provided in the report will be presented to USEPA upon request.

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP (s)	Data Package Turnaround [1]	Laboratory/Organization (Name and Address, Contact Person and Telephone Number)	Backup Laboratory/Organization (Name and Address, Contact Person and Telephone Number)
All	All	All	All	All	21 days	Accutest Laboratories 2235 Route 130 Dayton, New Jersey 08810 Tammy McCloskey Laboratory Project Manager 732-355-4562	It is not anticipated that a backup laboratory will be required, however Accutest has an extensive laboratory network, and the Accutest New England facility follows all QA/QC protocol as the Accutest New Jersey facility. 495 Technology Center West Building One Marlborough, Massachusetts 01752 508-481-6200

1. Final laboratory deliverable will be a NYSDEC Category B deliverable.
2. Expedited turnaround for preliminary results may be required and requested.

QAPP Worksheet #31
Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Field Sampling Protocol	Once at a minimum during sampling activities	Internal	ERM	ERM Project Manager ERM Field Team Leader	ERM Principal In Charge ERM Project Manager	ERM Project Manager	ERM Project Manager
Handling and Custody of Samples	Once at a minimum during sampling activities	Internal	ERM	ERM Project Manager ERM Field Team Leader ERM Laboratory QA Officer	ERM Principal In Charge ERM Project Manager ERM Laboratory QA Officer	ERM Project Manager	ERM Project Manager
Analytical Laboratory Performance	The data validation process will satisfy the requirements of this audit	External	ERM	ERM Laboratory QA Officer	ERM Principal In Charge ERM Project Manager ERM Laboratory QA Officer	ERM Project Manager	ERM Project Manager

QAPP Worksheet #32

Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Field Sampling Protocol	Electronic mail which documents the results of the audit will be submitted to the project manager.	Chris Wenczel ERM Project Manager	24 hours after audit	Electronic mail	All ERM project personnel listed on Worksheet #4-2	24 hours after notification
Handling and Custody of Samples	Electronic mail which documents the results of the audit will be submitted to the project manager.	Chris Wenczel ERM Project Manager	24 hours after audit	Electronic mail	All ERM project personnel listed on Worksheet #4-2	24 hours after notification
Analytical Laboratory Performance	Electronic mail which documents the results of the audit will be submitted to the project manager.	Chris Wenczel ERM Project Manager	24 hours after audit	Electronic mail	All ERM project personnel listed on Worksheet #4-2	24 hours after notification

QAPP Worksheet #33
QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Data Validation Reports See Worksheets # 35 & #36	Applicable only to Groundwater Monitoring samples	Three weeks after receipt of the laboratory data deliverable.	Mr. Andrew Coenen Laboratory QA Officer ERM	Mr. Chris Wenczel ERM Project Manager
Data Usability Assessment See Worksheet #37	Once after validated data is reviewed.	End of the Project prior to completion of final project report.	Mr. James Perazzo Mr. Chris Wenczel Mr. Eugene Gabay Mr.Ernie Rossano Mr. Andrew Coenen All ERM Personnel	Mr. Chris Wenczel ERM Project Manager
Final RA Report	Once at the end of the Project.	End of the Project.	Mr. Chris Wenczel ERM Project Manager	Distribution List presented on Worksheet # 3 less Mrs. Tammy McCloskey, Accutest Laboratories

QAPP Worksheet #34

Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Chain of Custody Forms	Chain of Custody (COC) Forms and FedEx shipping papers will be reviewed after the forms have been completed by the ERM sampler but prior to shipping any laboratory samples off-Site. All elements of the COC (requested analysis, bottle qty., project information, etc) will be compared to the analytical criteria specified in the QAPP and to confirm that the labels and qty. of bottles in the cooler match the information specified on the COC. The FedEx shipping form will be reviewed to certify that the address information is correct, all requested information is provided and that the appropriate shipping method (e.g., priority overnight, Saturday delivery) has been marked so that the samples arrive at the lab according to holding time and temperature preservation requirements specified in the QAPP.	Internal	Eugene Gabay ERM Field Team Leader
Audit Reports	The results of the audit reports and project assessments presented in Worksheets #31 through #33 will be retained in the project file. As specified, the results and findings will be reviewed with the appropriate members of the project teem and confirmation that all corrective measures have been completed will be the responsibility of the project manager. Reference Worksheets #31 through #33 for further details.	Internal	Mr. Chris Wenczel ERM Project Manager
Field Notes	It is imperative that detailed field notes are recorded real-time in the field to document project field activities. The field notes will be referenced during preparation of the OU1 RD Package and the Final RA Report and will be retained in the project file. A copy of the field notes will be provided as an Appendix to the final RA Report.	Internal	Eugene Gabay ERM Field Team Leader Mr. Chris Wenczel ERM Project Manager
Laboratory Data	All laboratory data will be reviewed internally by the analytical laboratory prior to reporting analytical results to ERM. All analytical laboratory data packages will comply with the 2005 NYSDEC ASP Category B deliverable guidelines. Data generated from the Groundwater Monitoring samples will be validated according to the procedures specified in Worksheets # 35 and #36. A Data Usability Assessment will be prepared at the end of the project according to the protocol specified in Worksheet #37.	External Internal	Mrs. Tammy McCloskey Accutest Laboratories Project Manager Mr. Andrew Coenen ERM Laboratory QA Officer

QAPP Worksheet #35
Validation (Steps IIa and IIb) Process Table

Step IIa / IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	Review of Chain of Custodies (COCs)	The validator will review each COC as it is received by the laboratory from the field for accuracy of sample nomenclature and requested analysis. Issues will be brought to the attention of the laboratory contact and corrected immediately.	Mr. Andrew Coenen, ERM Laboratory QA Officer
IIb	Field documentation	The Project manager will review all field forms for completeness and adherence to the QAPP.	Mr. Chris Wenczel, ERM Project Manager
IIb	Review of SOPs	The validator will confirm that samples were collected and analyzed in accordance with applicable SOPs.	Mr. Andrew Coenen, ERM Laboratory QA Officer
IIa	Documentation of Method QC Results	The validator will confirm that the appropriate number of QA/QC samples were collected by ERM and analyzed by the laboratory.	Mr. Andrew Coenen, ERM Laboratory QA Officer
IIa	Review Raw Data	The validator will review 10% of the raw laboratory data to confirm the laboratories calculations.	Mr. Andrew Coenen, ERM Laboratory QA Officer
IIa	Project Quantitation Limits	The validator will confirm that the sample results meet the project quantitation limits specified in the QAPP. If they do not, the laboratory will be contacted and possible reanalysis may be required.	Mr. Andrew Coenen, ERM Laboratory QA Officer

Groundwater monitoring samples only will undergo data validation. For each laboratory data deliverable the validator will prepare a Data Usability Report (DUSR). The DUSR will be prepared according to the guidelines established by Division of Environmental Remediation Quality Assurance Group and will review the following:

- Is the data package complete as defined under the requirements for the NYSDEC ASP Category B?
- Have all holding times been met?
- Do all the QC data: blanks, instrument tunings, calibration standards, calibration verifications, surrogate recoveries, spike recoveries, replicate analyses, laboratory controls and sample data fall within the protocol required limits and specifications?
- Have all of the data been generated using established and agreed upon analytical protocols?
- Does an evaluation of the raw data confirm the results provided in the data summary sheets and qualify control verification forms?
- Have the correct data qualifiers been used?

Once the data package has been reviewed and the above questions asked and answered the DUSR will describe the samples and the analytical parameters, data deficiencies, analytical protocol deviations, and quality control problems and their effect on the data. The DUSR shall also include recommendations on resampling/reanalysis if applicable. All data qualifications will be documented following the NYSDEC ASP '05 Rev. Guidelines.

QAPP Worksheet #36

Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria 1, 2, 3	Data Validator (Title and Organizational Affiliation)
IIa	Aqueous	VOCs	Low	National Functional Guidelines for Organic Data Review (October 1999) USEPA Region II Data Review Standard Operating Procedure (SOP) Number HW-24, Revision 1, June 1999: Validating Volatile Organic Compounds by SW-846 Method 8260B	Mr. Andrew Coenen, ERM Laboratory QA Officer

1. The order in which the aforementioned guidance documents and/or criteria are listed does not imply a hierarchy of reliance on a particular document for validation.
2. The reviewer's professional judgment also plays a large role in the validation process.
3. The waste characterization parameters and Treatment Plant Vapor samples will not be validated.

QAPP Worksheet #37
Usability Assessment

The Data Usability Assessment will be performed by Mr. Chris Wenczel and Mr. Andrew Coenen. Mr. Wenczel will be responsible for information in the Usability Assessment. He will also be responsible for assigning task work to the individual task members who will be supporting the Data Usability Assessment. Note that the Data Usability Assessment will be conducted on validated data only. The results of the Data Usability Assessment will be presented in the final report. The following items will be assessed and conclusions drawn based on their results:

Precision – Results of all blind field duplicates will be discussed for each analysis. For each duplicate pair, the relative percent difference (RPD) will be calculated for each analyte whose original and duplicate values are either greater than or equal to the quantitation limit. The RPDs will be checked against the measurement performance criteria presented on Worksheet #12. The RPDs exceeding criteria will be identified. The discussion will summarize the results. Any conclusions about the precision of the analyses will be drawn and any limitations on the use of the data will be described.

Accuracy/Bias Contamination – Results for all laboratory method blanks and instrument blanks will be discussed for each analysis for Confirmatory Post Excavation and Post-Removal Ground water samples only. The results for each analyte will be checked against the measurement performance criteria presented on Worksheet #12. Results for analytes that exceed criteria will be discussed. The discussion will summarize the results of the laboratory accuracy/bias. Any conclusions about the accuracy/bias of the analyses based on contamination will be drawn and any limitations on the use of the data will be described.

Sensitivity – Results for all Lab Check Samples will be presented discussed for each analysis. The results for each analyte will be checked against the measurement performance criteria presented on Worksheet #12 and cross-checked against the quantitation limits presented on Worksheet #15. Results for analytes that exceed criteria will be discussed. The discussion will summarize the results of the laboratory sensitivity. Any conclusions about the sensitivity of the analyses will be drawn and any limitations on the use of the data will be described.

Completeness – A completeness check will be done on all of the data generated by the laboratory. Completeness criteria are presented on Worksheet #12. Completeness will be calculated for each analyte as follows. For each analyte, completeness will be calculated as the number of data points for each analyte that meets the measurement performance criteria for precision, accuracy/bias, and sensitivity, divided by the total number of data points for each analyte. A discussion will follow summarizing the calculation of data completeness. Any conclusions about the completeness of the data for each analyte will be drawn and any limitations on the use of the data will be described.

Reconciliation – Each of the Project Quality Objectives (PQOs) presented on Worksheet #12 will be examined to determine if the objective was met. This examination will include a combined overall assessment of the results of each analysis pertinent to an objective. Each analysis will first be evaluated separately in terms of the major impacts observed from the Data Validation, Data Quality Indicators, and measurement performance criteria assessments. Based on the results of these assessments, the quality of the data will be determined. Based on the quality determined, the usability of the data for each analysis will be determined. Based on the combined usability of the data from all analyses for an objective, it will be determined if the PQO was met and whether project action limits were exceeded. The final report will include a summary of all the points that went into the reconciliation of each objective. As part of the reconciliation of each objective, conclusions will be drawn and any limitations on the usability of any of the data will be described.

LIST OF ATTACHMENTS

ATTACHMENT A - ERM's Proposed Project Management Team

ATTACHMENT B - Professional Profiles

ATTACHMENT C - Standard Operating Procedures (SOPs)

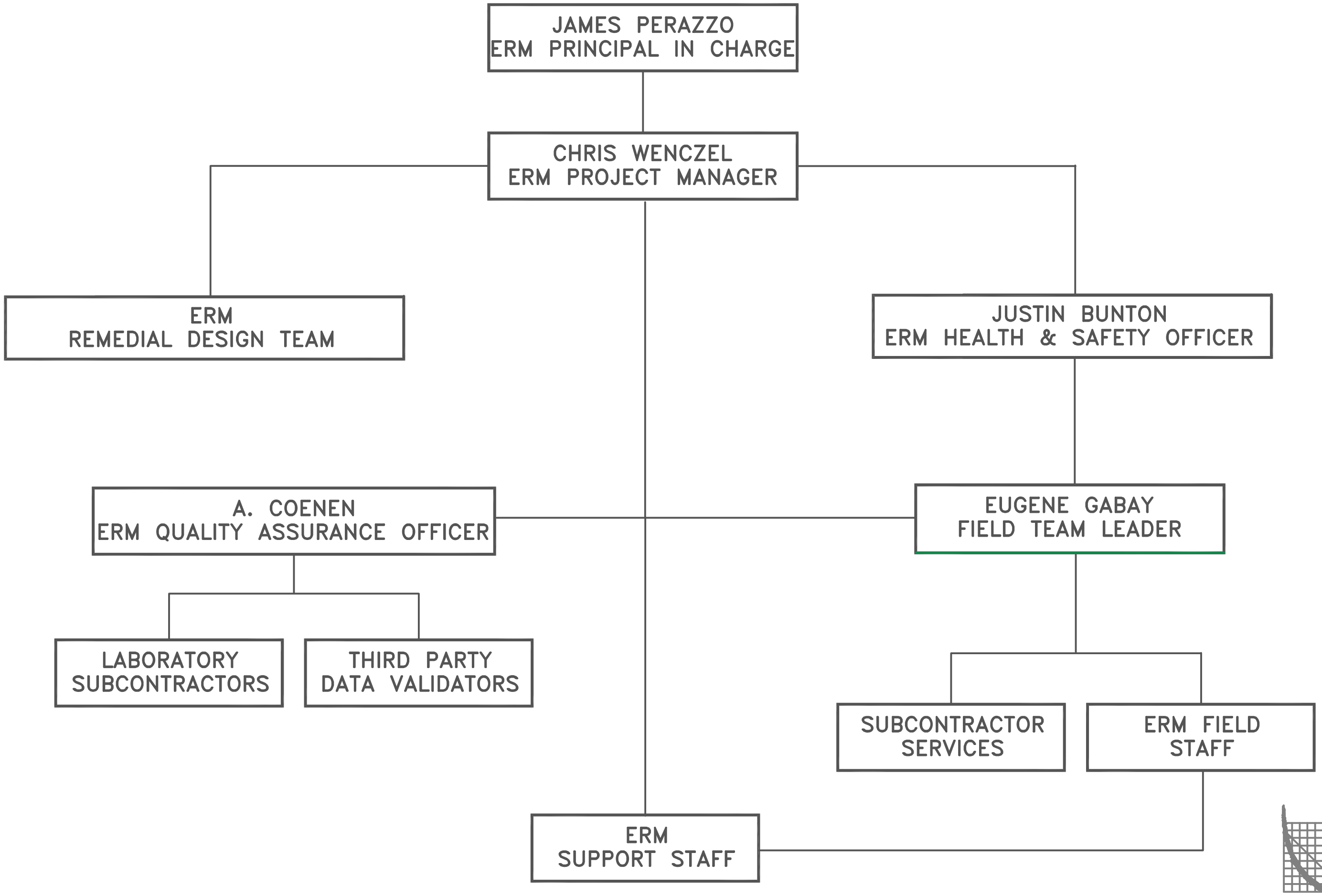
ATTACHMENT D - Laboratory SOPs

ATTACHMENT A - ERM's Proposed Project Management Team

ATTACHMENT A

ERM PROJECT ORGANIZATION CHART

FULTON AVENUE SUPERFUND SITE OPERABLE UNIT 1 REMEDIAL DESIGN/REMEDIAL ACTION



STAFFINGCHART

ATTACHMENT B - Professional Profiles

James A. Perazzo, P.G.

Principal-In-Charge

Mr. Perazzo has 26 years of experience in the environmental field. His experience in formulating strategies to investigate legacy environmental problems, analyze data, and develop solutions to impaired assets enables client to manage environment risks and comply with disclosure obligations. He has directed projects to address CERCLA, RCRA, and TSCA and other federal and state obligations while evaluating environmental liability costs to assist sellers and purchasers in making business decisions. Mr. Perazzo brings a broad understanding of legacy problems to projects, which consider regulatory burdens, project life cycle, concept and engineering remedial estimates and operating cash flows. He has worked with clients to determine realistic cash flows as projects have matured into the remedial implementation phase enabling client's to establish proper reserves for legacy problems in conformance with financial reporting guidelines. Mr. Perazzo works with regulators and stakeholders to accurately communicate information and assist clients in meeting business goals. He routinely provides strategic guidance, conducts negotiations, and serves as an expert, giving testimony in private litigations and mediations.

Registrations & Professional Affiliations

- Professional Geologist in Pennsylvania
- New York State Council of Professional Geologists

Fields of Competence

- CERCLA RI/FS and removal actions
- RCRA (RFA, RFI CMS and CMI)
- UST assessment and hydrocarbon remediation
- Indirect/direct investigative techniques
- Soil and ground water investigations
- Hydrogeological assessments
- Regulatory negotiation and strategic guidance
- Expert witness

Education

- M.B.A. , Long Island University (C.W. Post), New York, 2006
- M.S. Earth Science, Adelphi University, New York, 1981
- B.S. Geology, The State University of New York at Stony Brook, 1978

Publications

"CERCLA - The Technical Perspective," Environmental Regulations Course, Executive Enterprises, Inc., June '95, October '95, and February '96.

"Remedial Investigation and Feasibility Study Process," New York Hazardous Regulation Course, Executive Enterprises, Inc., November 16-17, 1990.

"Groundwater Remediation; Performance Goals," Haztech International, Cleveland, Ohio, September 20-22, 1988.

"Remedial Design Needs to Consider in Planning Hazardous Waste Site Investigations," with J. Iannone and J. Mack; Haztech International, St. Louis, Missouri, August 26-27, 1987.

"Long Term Confidence in Ground Water Monitoring Systems," Groundwater Monitoring Review, Vol. 4, No. 4, all 1984.

Key Projects

Project Manager for large Superfund site containing lead. Project responsibilities included work plan preparation, RI implementation, coordination of human health risk and ecological assessments, a feasibility study, and remedial design and construction of the remediation action.

Provide expert testimony in toxic tort action involving alleged contribution of inorganic constituents from a former recycling operation to off-site parcels.

Provided expert testimony in matter involving the origin and subsequent migration of petroleum contamination as it related to on-site and off-site impacts.

Developed a tank management program for 36 locations in New York and Connecticut. Planned site assessments and remedial programs. Formulated monitoring programs for early warning of potential environmental problems. Negotiated financial estimates and justification for outstanding environmental liability allowing owner to divest with protection against future liabilities.

Provided expert testimony regarding waste characterization at a former septic disposal area and the alleged impacts to certain public and private supply wells.

Project Director for three removal actions pursuant to an ACO under 106 provisions at two separate Superfund sites that were in receivership. Performed removal of anhydrous ammonia vessel, ASTs, laboratory chemicals, drums, PCB oils, transformers, and closure of USTs. Also directed a radiological survey with a health physicist to locate and remove materials exhibiting anomalous levels of radiation. These efforts were done on behalf of a savings and loan in receivership.

Project Director for development and implementation of remedial system to extract VOCs from soil and ground water at State Superfund site. Coordinated program involving dewatering and vacuum extraction. Established basis for performance analysis and effectiveness evaluation to determine proper time for system termination.

Assessed alleged environmental liabilities at a commercial resort built on a former shipyard to facilitate a Chapter 11 bankruptcy work-out on Long Island, NY.

Conducted reviews and critiques of RI and RODs, the latter in support of petitions to amend. These efforts resulted in modifications to remedies that were consistent with the NCP and reduced client’s financial exposure.

Assisted clients in securing approval for reimbursement of response costs from the Superfund

Negotiated with NYS DOL on behalf of two commercial financial institutions to secure the environmental conditions at three manufacturing facilities to allow assets to be removed as part of a Chapter 7 bankruptcy.

Developed technical approach to ongoing cases for the New York Sate Environmental Protection Bureau of the Attorney General's office. Prepared scientific reports and represented the Attorney General in adversarial discussions, public meetings, and court hearings.

As part of a multi-disciplined technical team, developed a comprehensive remedial program at a dioxin-contaminated landfill in western New York. The program involved collection and treatment of dissolved and non-aqueous phase liquids (NAPLs) in overburden and bedrock.

Technical representative for the government in developing a comprehensive soil and aquifer remediation project in Nassau County, New York. The project involved a soil and ground water remediation program including installation of a slurry wall via the vibrating beam technique, soil flushing system and staged ground water recovery from a shallow and deep aquifer. Maintained a key role in establishing performance criteria for cleanup and effectiveness monitoring.

Christopher W. Wenczel

Mr. Wenczel has more than 23 years of diversified experience in the environmental consulting field specializing in hydrogeology, hazardous waste management/remediation, and water supply. His diverse project experience includes work under CERCLA, RCRA, TSCA, NJDEP Site Remediation Program, NJPDES, NYSDEC Voluntary Cleanup Program, NYSDEC State Superfund Program, and NYSDEC Oil Spill Program.

Mr. Wenczel has experience in the development and implementation of complex remedial investigation and feasibility study (RI/FS) plans for USEPA and NYSDEC Superfund sites in both New York and New Jersey, which include 12 National Priority List (NPL) sites. He also has extensive experience in planning and performance of other compliance site investigations such as RCRA Corrective Action and property transfer due diligence environmental quality site assessments.

Mr. Wenczel's experience includes activities such as preparation of MOAs, preliminary site assessments, site investigations, remedial actions, and long-term monitoring programs at former landfills and manufacturing facilities.

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Registrations & Professional Affiliations

- State of New Jersey Certified Underground Storage Tank Investigator, License No. 0012475

Fields of Competence

- Site Investigation/Remediation Strategy & Implementation
- Ground Water Resource Development
- Multi-Media Sampling & Remediation
- Hydrogeologic Testing, Analyses and Interpretation
- Analysis of Surface & Ground Water Flow Systems
- Surface & Ground Water Quality Monitoring
- Applied Geophysics
- UST Assessment, Removal & Remediation
- Soil Vapor Extraction/Air Sparging

Education

- M.S. Earth Sciences/Hydrogeology, Adelphi University, New York, 1990
- B.S. Geology, State University of New York at Oneonta, 1985
- NJDEP UST License Renewal Course, New Jersey Society of Professional Engineers, 10 September 1998, 11 September 2001 & 9 September 2004
- State of New Jersey Certified Cleanup Star Program Participant, 2004
- 40-Hour OSHA 1910.120 Health and Safety Training, 1987, and 8-Hour OSHA Annual Refresher Training, 1987 – 2004
- 8-Hour OSHA Supervisory Training For Level B Activities, 1989

- International Symposium on Environmental Geotechnology, Lehigh University and the International Committee on Environmental Geotechnology, Allentown, PA, 21 -23 April 1986
- Theory and Application of Vadose Zone Monitoring, Sampling and Remediation, NGWA, Somerville, MA, 7-9 April 1992
- Assessment, Control and Remediation of LNAPL Contaminated Sites, API/USEPA, East Brunswick, NJ, 20 October 1994
- Environmental Horizontal Well Symposium, NGWA, Indianapolis, IA, 28-30 October 1995,
- Petroleum Hydrocarbons & Organic Chemicals in Ground Water: Prevention, Detection and Remediation, NGWA, Houston, TX, 13-15 November 1996
- NJDEP Technical Requirements For Site Remediation Seminar, Cook College @ Rutgers, 27 May 1998
- DNAPLs in Fractured Geologic Media: Monitoring, Remediation & Natural Attenuation, Univ. of Waterloo, San Francisco, CA, 8-10 December 1999
- Hydrogeology of Fractured Rock: Characterization, Monitoring, Assessment & Remediation, Fractured Rock Educational Services, Princeton, NJ, 19-22 May 2003

Key Projects

Project Manager responsible for execution of multiple projects at a major aeronautical systems manufacturing facility in Utica, New York. These projects include a NYSDEC RCRA Corrective Action program, facility relocation support and permitting, and implementation of multiple Interim Remedial Measures (IRM). The RCRA Corrective Action included the regulatory negotiation, development, and implementation of key program documents including the RCRA Facility Assessment and the RCRA Facility Investigation Work Plan. Both on-site and off-site investigations were required to characterize impacted media including soils, ground water, storm water, surface water, and building materials such as concrete and metals. Contaminants of concern at the facility included volatile organic compounds, semi-volatile organic compounds, polychlorinated biphenyls (PCBs), metals, and cyanide. IRMs included removal and disposal of structures, vent stacks, stormwater conveyance systems, soil, and concrete. Facility relocation support included procurement of permits/registrations for sanitary wastewater discharges, air discharges, petroleum bulk storage tanks, waste management, development of a spill control, containment and countermeasures plan (SPCC), and revisions to both waste management and emergency control procedure plans.

Project Manager responsible for execution of multiple projects at Brookhaven National Laboratory, Upton, NY, with revenues in excess of $2.8 million. These projects include extensive ground water delineation projects for volatile organic compounds, metals, and radionuclides. These ground water surveys include the High Flux Beam Reactor emergency response tritium delineation project conducted in March 1997. In a six-week period, ERM's team installed and sampled a total of 72 temporary ground water vertical profile wells to depths ranging between 200 and 300 feet below grade. In addition, these projects have included walk-over radiation surveys across the site, and geotechnical studies for BNL's sewage treatment plant.

Project Manager responsible for the implementation of an extensive RI/FS and Soil IRM at the Fulton Avenue Superfund site located in Garden City Park, NY. The Fulton Avenue site is listed on both the NYSDEC Registry of Inactive Hazardous Waste Sites and the USEPA NPL. Past discharges of chlorinated solvents (tetrachloroethene) have caused extensive ground water contamination in the Upper Glacial and Magothy aquifers. The ground water contaminant plume has allegedly migrated a distance of 2 miles from the site to depths of up to 500 feet to affect up to 5 public supply wells encompassing an area of approximately 5 square miles within Nassau County. The RI/FS focuses on a ground water vertical profiling task using temporary wells to further define the extent of ground water contamination within the upper glacial aquifer and the Magothy aquifer, and to select permanent ground water monitoring well locations and screen settings; installation of permanent conventional and multi-level ground water monitoring wells to act as permanent monitoring and/or compliance points within the upper glacial aquifer and the Magothy aquifer; collection of ground water samples from over 60 ground water monitoring wells; collection of several rounds of synoptic ground water level data; a three-dimensional ground water flow computer model; a risk assessment for ground water; and a feasibility study for ground water. The soil IRM is comprised of a source area soil removal action, and the installation of a soil vapor extraction (SVE) and air sparging (AS) to remove contaminants from the vadose zone soils and the shallow ground water table. Since the SVE/as system went online in October 1998, approximately 10,000 pounds of tetrachloroethene has been removed from the ground. The post-IRM Site closure included indoor air sampling and installation of a sub-slab venting system beneath the building at the Site.

Project Manager/Senior Hydrogeologist responsible for the coordination and performance of a major off-site hydrogeologic investigation for a manufacturing facility and ISRA site (NJDEP Site Remediation) in South Brunswick, NJ. Conducted an extensive volatile organic compound plume delineation task in a dual aquifer ground water system which utilized the terrain conductivity, resistivity and VLF geophysical mapping techniques and the Hydropunch ground water sampling technique. Other site investigative activities have included: the phased installation of an extensive ground water monitoring well network, performance of multiple aquifer tests, characterization of the subsurface geologic and hydrogeologic regime, test pitting, soil sampling, an UST investigation, ground water sampling, performance of a soil vapor extraction pilot study, design/installation/testing of a ground water recovery well, data analyses/interpretation, and preparation of an Site Assessment Report, an extensive Pump Test Report, Soil and Ground Water Remedial Action Work Plans, a Comprehensive Hydrogeologic Report, a SVE Pilot Study Report. Remedial Action Work Plans proposed the use of SVE, biosparging, and pump and treat technologies. All three systems are currently in operation and effectively remediating soil and ground water contamination at the site.

Management and supervision of hydrogeologic investigation at an Ashland Drum Landfill Site, Fords, New Jersey (NJDEP Site Remediation). The investigation included: the installation of a ground water monitoring well network, characterization of the subsurface geologic and hydrogeologic regime, a study of tidal influence on ground water flow, test pitting, soil sampling, ground water sampling, drum sampling, data analyses and preparation of an RI Report.
Under the USEPA Superfund program, participated in RI/FS and Remedial Design (RD) programs at the following NPL Sites: the Lipari Landfill, the Port Washington Landfill, the Lone Pine Landfill, the Vestal Well Field RI and RD, the Sinclair Refinery site, Swope Oil Company site, the Metaltech/Robintech/National Pipe site, the Sarney Farm site, the Montclair/West Orange Radium site, and 150 Fulton Avenue.

Senior Hydrogeologist responsible for the coordination and supervision of a comprehensive RI at the Pfohl Brothers NYSDEC State Superfund site (120 acres) located in Williamsville, NY. The site investigation of Pfohl Brothers Landfill included: preparation of a RI work plan, Health and Safety Plan (HASP), a Quality Assurance Plan (QAPP), geophysical surveys using terrain conductivity, magnetometry and ground penetrating radar, soil borings, ground water monitoring well installation in both bedrock and overburden aquifers, soil sampling, sludge sampling, hydrologic monitoring of surface water bodies, surface water sampling, ground water sampling, landfill leachate sampling, test pitting and drum sampling. In addition to the overall site characterization, evaluated the presence of low-level radionuclide contamination on the site, delineated, and mapped over 450 radioactive "hot- spots" using scintillometers. Radionuclides found at the site included radium-226, thorium-232, cesium-132 and uranium-238 in the form of discarded machine parts, radioluminescent badges, and ore rocks.
Installation of ground water and landfill gas monitoring wells as part of an RI for the Port Washington Municipal Landfill NPL site, Port Washington, New York. Additionally, participated in the development and implementation of a landfill gas sampling program using flux boxes, landfill gas monitoring wells and summa canisters.

Senior Hydrogeologist responsible for the coordination and performance of a comprehensive environmental assessment at the former ESSO petroleum refinery, San Nicholas, Aruba, N.V. The investigation included: the installation of a ground water monitoring well network, characterization of the subsurface geologic and hydrogeologic regime, test pitting, soil sampling, an above ground storage tank investigation, ground water sampling, mapping of extensive LNAPL bodies, data analyses/interpretation, and preparation of an Site Assessment Report.
Participated in two NPL site RD programs, Vestal Well 1-1, Vestal, New York and the Lipari Landfill, Pitman, New Jersey. Activities for the Vestal Well 1-1 site included the preparation of a Remedial Design work plan, HASP and QAPP, performance of a soil boring program and design of a 1,000-gpm air stripper. Activities for the Lipari Landfill included the design of an automated extraction/injection well network and a 300-gpm production well.

Project Manager responsible for execution several major environmental investigative/cleanup tasks at the former Brooklyn Navy Yard (Brooklyn Navy Yard Industrial Park {BNYIP}), that have included:
Phase I & II Site Assessment/Investigation Services Related To a NYSDEC Voluntary Cleanup Agreement, Implementation of Interim Remedial Measures, and Investigation/Closure of Underground Storage Tanks

ERM performed a Phase I Preliminary Site Assessment data gathering and evaluation process in conjunction with a Phase II Site Investigation to address key data gaps for potential area and activity-specific sources of hazardous substances. The Phase I Preliminary Site Assessment included site inspections, review of all historic data/records, previous investigations performed at the BNYIP to date, inspection of BNYIP facilities, interviews of facility personnel regarding current and past operations.

The Phase II investigation included the sampling and characterization of environmental conditions at electrical substations/transformer areas, drum storage areas, dry docks, and facility-wide ground water characterization. The Phase II Investigative findings were then integrated with the Phase I Site Assessment information to prepare a Comprehensive Environmental Assessment Report (CEAR) for the BNYIP.

ERM provided complete turnkey services for investigation and closure of 10 underground petroleum storage tanks located in seven separate areas at the BNYIP. These services included pre-closure site investigations at each tank locations, preparation of all regulatory required work plan documents, notification of interested regulatory agencies (NYSDEC, NYCFD), procurement of necessary permits, closure by excavation and removal of the USTs and effected soils, complete restoration of each former tank location, and preparation of a final comprehensive UST Closure Report for submittal to NYSDEC.

ERM performed an Interim Remedial Measure (IRM) at former electrical substation to mitigate PCB contamination resulting from releases of electrical transformer dielectric fluids. The IRM included characterizing the extent of PCB contamination on concrete surfaces and soils/sediments associated with the former transformers. The IRM included the removal, containment and disposal of soils/sediments containing high levels of PCBs from a subsurface vault, cleaning, scarification, and final encapsulation of all effected concrete surfaces within the vault and other concrete surfaces associated with the former transformers. A Final Remediation Report was prepared and submitted to NYSDEC for review and official acknowledgment that "no further action" is required at this electrical substation.

Project Manager responsible for the implementation of an RI/FS at the NYSDEC Utility Manufacturing State Superfund site located in New Cassel, NY. The Utility Manufacturing site is listed on the NYSDEC Registry of Inactive Hazardous Waste Sites. Past discharges of chlorinated solvents have caused extensive ground water contamination in the Upper Glacial and Magothy aquifers affecting several deep public supply wells in the Bowling Green Water District. The RI features the off-site installation of soil borings to collect both lithologic samples to characterize off-site stratigraphic conditions, and groundwater samples using a Hydropunch to characterize off-site groundwater quality/impacts (i.e. determine if site-related contaminants have migrated off-site); installation of groundwater monitoring wells to confirm the results of the Hydropunch sampling; and the collection of soil gas samples to evaluate potential risks from soil vapor migration.

Project Manager responsible for third-party oversight on behalf of ERM's client to ensure responsible parties (former owners) comply with all applicable NJDEP soil and ground water remediation standards and the NJDEP-approved Remedial Action Plan for an NJDEP ISRA site in Paramus, New Jersey. Additional activities include oversight of an asbestos removal action at the same site.

Eugene T. Gabay

Mr. Gabay has more than 6 years of diversified experience in the environmental consulting field specializing in hydrogeology, hazardous waste management andremediation. His diverse project experience includes work under CERCLA, RCRA, NJDEP Site Remediation Program, NJPDES, NYSDEC Voluntary Cleanup Program, NYSDEC State Superfund Program, and NYSDEC Oil Spill Program. Mr. Gabay is currently managing several New York State Department of Environmental Conservation projects, and has logged well over 5,000 hours organizing and performing various field activities. Mr. Gabay's field experience includes ground water and soil sampling, field parameter measurement, monitoring well installation and horizontal drilling activities, installation of vertical profile wells, logging of soil and bedrock, oversight of underground storage tank removals, subsurface and indoor air sampling, oversight of unexploded ordinance investigations and oversight of remediation activities at several manufactured gas plants in the State of New York.

Registrations & Professional Affiliations

- 40-hour Health and Safety Certification
- ExxonMobil Loss Prevention System-Certified

Fields of Competence

- Geologic and Hydrogeologic Correlation, Analysis, Interpretation and Assessments
- Soil and Ground Water Investigations
- Air Quality Investigations and Monitoring
- Multi-Media Sampling
- Underground Storage Tank Assessments, Removals, In-Place Closures and Hydrocarbon Remediation
- Applied Geophysics
- Aquifer Testing, Tidal Studies and Analysis
- Project Management and Client Liaison
- Project Planning and Scoping
- Project Budgeting and Scheduling
- Regulatory Agency Interaction
- Health and Safety Officer Of Site Investigations
- Field Management

Education

- M.S. Environmental Studies, C.W. Post University, New York, Currently Enrolled
- B.A. Environmental Planning and Resource Management, Plattsburgh State University, New York, 2000
- Associates Liberal Arts, Nassau Community College, New York, 1997

Key Projects

Mr. Gabay has logged over 5,000 hours as a Field Team leader for performance of investigative and remedial activities, and tasks associated with field activities.

Project Manager of New York State Department of Environmental Conservation (NYSDEC) Candlewood Road Superfund Site Investigation. Responsibilities included work plan design and implementation, oversight of field work, interpretation of laboratory data and report writing. Both on-site and off-site investigations were required to characterize impacted media including soils, soil vapor and groundwater. Contaminants of concern at the facility included chlorinated volatile organic compounds (VOCs). Investigative activities included sampling of soil, soil vapor and groundwater through the installation of Geoprobe soil borings, Geoprobe groundwater vertical profiling, and soil vapor sampling probes.

Project Manager of New York State Department of Environmental Conservation Levey Property Site. Responsibilities included work plan design and implementation, oversight of field work, interpretation of laboratory data and report writing. Both on-site and off-site investigations were required to characterize impacted media including soils, soil vapor and groundwater. Contaminants of concern at the facility included VOCs, semi-VOCs and metals. Investigative activities included sampling of soil, soil vapor and groundwater through the installation of Geoprobe soil borings, Geoprobe groundwater vertical profiling, and soil vapor sampling probes.

Project Manager of New York State Department of Environmental Conservation (NYSDEC) Pride Solvent Superfund Site. Contaminants of concern at the Site included VOCs, semi-VOCs and metals. Investigative activities included sampling of soil, soil vapor and groundwater through the installation of Geoprobe soil borings, Geoprobe groundwater vertical profiling, and soil vapor sampling probes.

Responsible for the coordination and implementation of a complex groundwater monitoring program at major petrochemical facility in Linden New Jersey since 2003. These responsilbilities include compliance with facility-specific health and safety programs, and receipt, review, evaluation and reporting of the monitoring data.

Managed and assisted in the selection and installation of multilevel groundwater monitoring systems such as the Solinst Waterloo, Westbay and the FLUTe multilevel sampling systems.

Field Manager and site health and safety officer at cable manufacturer in Yonkers, New York. Included soil sampling program, monitoring well installation, and ground water sampling.

Performed quarterly and annual water sampling rounds at a major petroleum storage and distribution terminal in Holtsville, New York.

Field Manager and site health and safety officer at a residence in Water Mill, NY. Project consisted of a vapor/fluid recovery system, and frequent groundwater monitoring and reporting.

Performed the duties of Field Manager and site health and safety officer at a NYSDEC site in West Babylon, New York. Responsibilities included ground water sampling, soil sampling, and leach field and septic system excavation and sampling.

Performed quarterly and annual groundwater monitoring activities several industrial manufacturing facilities in New Jersey.

Performed quarterly and annual water level and water sampling rounds at a cable-manufacturing site in New Brunswick, New Jersey.

Performed the duties of air sampling technician on numerous asbestos abatement projects in New York City, and Long Island.

Performed the duties of Asbestos Inspector in several buildings in Long Island. Responsibilities included sampling all suspect asbestos containing materials.

Flute installation

Andrew Coenen

Mr. Coenen has 13 years of general analytical chemistry experience, 6 years of analytical laboratory experience, and 7 years of environmental consulting experience, including analytical data validation, sampling and analysis programs, quality assurance programs, technical support, and QA oversight for fixed laboratory and field analysis. Mr. Coenen has knowledge of numerous analytical methodologies and experience in data validation of analytical data package deliverables for adherence to USEPA CLP and non-CLP, NYSDEC ASP, and NJDEP protocols. He is proficient with GIS/Key environmental management software and has operated a mobile gas chromatograph laboratory used to test soil and water samples for quick-turn volatile analysis.

Fields of Competence

- Analytical data review and validation
- Environmental database management (GIS/Key)
- Laboratory Subcontractor Management
- Analytical protocols for pollutants by USEPA methodologies
- Methods of analysis of organic and inorganic parameters
- Review and preparation of QA/QC plans
- Field analytical techniques
- Multi-Media Sampling

Education

- 8-Hour OSHA Annual Refresher Training, 1999 - current
- Rutgers University / Cook College - NJDEP Using GIS for Environmental Evaluations, October 1999
- 40-Hour OSHA [29 CFR 1910.120 (e) (2)] Health and Safety Training, 1998
- Computer Aided Drafting, 50-Hour Course, Island Drafting and Technical Institute, 1998
- Immunoassay Testing Training Program, Strategic Diagnostics Inc., 1998
- B.S. Chemistry, University of Michigan, 1991

Key Projects

Data validation for numerous projects located in New York, New Jersey, Pennsylvania, Illinois, Massachusetts, Indiana, and Wisconsin, involving evaluation of aqueous, soil, sediment, leachate and air samples analyzed by USEPA Contract Laboratory Protocols, New York State DEC Contract Laboratory and Analytical Services Protocols and SW-846 methodologies for organic, inorganic, wet chemistry parameters, TPH and various other analyses.

Reviewed sampling and laboratory chemical data for adherence to New Jersey Department of Environmental Protection protocols on numerous projects. Also constructed electronic deliverables for submission to NJDEP in required haz-deliverable format.

Database construction & management for numerous investigations utilizing GIS/Key software. Compiled field and laboratory data and generated result summary tables, contours, isopleths, contaminant plume maps, cross-sections and boring logs.

Prepared numerous Sampling and Analysis Plans (SAPs) and Quality Assurance Project Plans (QAPPs) for adherence to state and federal guidelines.

Project management and technical support for Special Analytical Services required to delineate low-level PAH contamination at a Superfund Site. This included method development and validation of a Selected Ion Monitoring (SIM) GC/MS technique.

Utilized Immunoassay test kits for field measurement of PCB contamination at the former Brooklyn Navy Yard, Brooklyn, New York. Performed data validation of all field analytical samples and off-site laboratory samples and compared off-site results to test kits.

Conducted subsurface investigations with a Geoprobe. Performed various field tests.

Supervision of tank removal and subsequent soils evaluation for contamination.

Justin M. Bunton, ASP

Mr. Bunton is a Staff Scientist within ERM, based in Hartford, CT. Justin is a degreed safety professional with experience in implementing and managing safety & health programs in warehousing operations. Prior to joining ERM in December 2007, Mr. Bunton worked as a Health & Safety Manager for a large grocery distributor. As an H&S manager, Justin has developed, implemented and managed a number of programs on a wide variety of topics, including:

- H&S Audits and Inspections
- Development/Implementation of H&S Programs, Policies and Procedures
- Job Hazard Analysis/Safe Work Practices
- H&S Training
- Accident/Incident Investigation & Recordkeeping
- First Aid/Injury Management
- Control of Hazardous Energy (Lockout/Tagout)
- Bloodborne Pathogens Exposure Control
- Emergency Action Plans
- Hazard Communication
- Personal Protective Equipment
- Industrial Hygiene
- Hearing Conservation
- Behavior-Based Safety
- Powered Industrial Trucks
- Ergonomics
- Machine Guarding
- Walking and Working Surfaces/Fall Protection
- Worker's Compensation

Education

- B.S. Occupational Safety Studies, Keene State College, 2006
- OSHA 511 General Industry Outreach Training
- OSHA 2250 Ergonomics Training
- OSHA HAZWOPER
- FEMA IS-00235 Emergency Planning Training
- American Red Cross CPR, First Aid, and AED Trained

Registrations & Professional Affiliations

- Associate Safety Professional (ASP)- Board of Certified Safety Professionals
- American Society of Safety Engineers (ASSE)

Fields of Competence

- Organization and administration of H&S programs
- H&S compliance
- H&S auditing
- Hazard analysis and control
- Safety management systems
- Competence & training
- Construction Management

Key Projects

Project Scientist for Industrial Hygiene Sampling Program for Confidential Natural Gas Utility– Conducted multiple rounds of employee exposure monitoring for a wide variety of constituents (such as cadmium, carbon black, asbestos, particulates and noise) associated with the processes at several facilities, to ensure compliance with applicable regulatory standards.

Compliance Audit, Confidential Food Distributor - Performed a two-day audit of production operations in multiple facilities to identify key health and safety issues, potential regulatory compliance issues and share best management practices (BMPs).

Industrial Hygiene Sampling, Confidential Plastic Color Concentrate Manufacturer– Performed industrial hygiene sampling to assess potential employee exposures to pigment dust and various metals associated with the facility's mixing operation to ensure compliance with applicable OSHA standards.

Compliance Audit for Confidential Locomotive Engine Manufacturer - Performed a comprehensive compliance audit of a major locomotive engine manufacturing facility to identify key health and safety issues, identify potential OSHA violations and assist with making recommendations for corrective measures.

On-Site Health and Safety Compliance Support for Large Food Manufacturing Company- Performed oversight of construction contractors to ensure compliance with OSHA CFR 1926 regulations during flood relief and recovery operations. Duties included: site walkthroughs, meeting with contractors to address and advise on H&S concerns, site safety training for new workers, reporting and correcting possible hazards, and ensuring the implementation of corrective actions.

General Facility Safety Assessment for Confidential Medical Solvent Laboratory- Performed a Safety and Health assessment of the laboratory's facility to identify any possible safety issues, OSHA violations and make recommendations for improvement or corrective measures.

Regulatory Applicability Review for Confidential Aerospace Component Manufacturer- Performed a review of the companies operations and written programs to determine applicable health and safety regulatory/legal requirements.

Industrial Hygiene Sampling, Confidential Plastic Food and Beverage Waste Processor– Performed industrial hygiene sampling to assess potential employee exposures to dust and various particles associated with the facility's grinding operation to ensure compliance with applicable OSHA standards.

Compliance Audit for Confidential Specialty Metal Alloy Manufacturer - Performed a comprehensive compliance audit of a specialty brass and stainless steel alloy manufacturing facility to identify key health and safety issues, identify potential OSHA violations and assist with making recommendations for corrective measures.

On Site Construction Manager for a 29,000 square foot replacement- Provided Health and Safety as well as project oversight at the facility for the removal and replacement of the roof. The project involved the removal and disposal of approximately 15,000 square feet of asbestos containing roofing materials before the new roof could be installed.

On Site Construction Manager for large excavation and UST removal- Provided Health and Safety as well as project oversight for the excavation of 800 tons of contaminated soil, backfill of the excavated area, removal of the existing UST, installation of a new AST, the construction of an enclosure around the AST, and was responsible for obtaining necessary construction and occupancy permits from the town.

ATTACHMENT C - Standard Operating Procedures (SOPs)

ATTACHMENT C

STANDARD OPERATING PROCEDURES (SOPS)

Section	**Standard Operating Procedure**
C.1	SOP 1 Water Level Measurement Procedures
C.2	SOP 2 Groundwater Sampling Procedures
C.3	SOP 3 Field Blanks
C.4	SOP 4 Trip Blanks
C.5	SOP 5 Membrane Interface Probe Procedures
C.6	SOP 6 Waterloo Vertical Profile Borings with Groundwater Sampling Procedures
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C.0 STANDARD OPERATING PROCEDURES

C.1 WATER LEVEL MEASUREMENT PROCEDURES

The following procedure shall be used for water level measurements:

- Clean all water-level measuring equipment using appropriate decontamination procedures.

- Wear appropriate health and safety equipment as outlined in the Health and Safety Plan. In addition, samplers shall don new sampling gloves at each individual well prior to sampling.

- Visually examine the exterior of the monitoring well for signs of damage or tampering and record in the field logbook.

- Unlock well cap.

- Take and record in field logbook PID and/or OVA readings.

- Measure the static water level in the well with an electronic water level indicator. The water level indicator shall be rinsed with deionized water in between individual wells to prevent cross-contamination. Synoptic round of water level measurements shall all be completed on the same day.

- For wells located within the GCPIA, an interface probe will be used to check the bottom well sump for the presence of DNAPL. If it appears that DNAPL is present, an attempt will be made to collect a sample of the DNAPL using a discrete depth-sampling device such as a Bacon Bomb sampler. Groundwater samples will not be collected from any well containing DNAPL. Attach a pre-cleaned decontaminated discrete depth-sampling device to a new, dedicated length of polypropylene string. Set the sampler in the open position, and slowly lower the device to the bottom of the well. Upon reaching the well bottom, close the sampler using the wire-line or bottom actuated release mechanism to collect a sample. Slowly retrieve the sampler from the well, and collect a sample of the fluids into a sample jar for analysis and characterization.

- If DNAPL is not detected in the well, continue with the procedures described below.

C.2 SOP 2: GROUNDWATER SAMPLING PROCEDURES

Groundwater sampling will be performed using USEPA low-flow well purging/sample collection techniques. The following subsections present general preliminary well sampling procedures common to both techniques followed by low-flow sampling procedures, and if for some reason it is not possible to perform low-flow sampling, conventional procedures are also presented for reference.

The low-flow groundwater purging/sampling technique employs the use of a flow-through cell equipped with probes and a meter for measuring groundwater quality parameters such as pH, temperature, specific conductivity, dissolved oxygen and oxidation/reduction potential. One example of this equipment is the Horiba U-22 Flow-Through Cell and the specific manufacturer's calibration and operation instructions should be followed.

C.2.1 General Procedures

The following procedure will be used for all monitoring well groundwater sampling:

- Clean all water-level measuring equipment using appropriate decontamination procedures.
- Wear appropriate health and safety equipment as outlined in the HASP. In addition, samplers will don new sampling gloves at each individual well prior to sampling.
- Visually examine the exterior of the monitoring well for signs of damage or tampering and record in the field logbook.
- Unlock well cap.
- Take and record in field logbook PID and/or Organic Vapor Analyzer (OVA) readings.
- Measure the static water level in the well with a decontaminated steel tape or electronic water level indicator. The tape or water level indicator will be rinsed with deionized water in between individual wells to prevent cross-contamination. Synoptic round of water level measurements will all be completed on the same day.
- All wells will also be checked for the presence and thickness of Light or Dense Non Aqueous Phase Liquids (LNAPL/DNAPL).

- If LNAPL or DNAPL is encountered on the top of the water table at the time of sampling, a sample of the LNAPL or DNAPL will be collected for analysis if accumulations are sufficient. Measurement of the thickness of this layer will be taken using an interface probe. A sample of the LNAPL or DNAPL may be obtained using a dedicated bottom-loading bailer. The sample will be sent to the laboratory for analysis of its chemical composition and physical properties (e.g., specific gravity, and gas chromatograph (GC) fingerprint). Initially, no groundwater sample will be collected from wells that contain LNAPL or DNAPL.
- If LNAPL or DNAPL is not detected in the well, continue with the low-flow sampling procedures described below.

C.2.2 Low-Flow Sampling

The low-flow sampling procedure is intended to reduce the amount of purge water generated during groundwater monitoring well sampling.

Sample Equipment

- Adjustable-rate, positive displacement pumps (e.g., centrifugal or bladder pumps constructed of stainless-steel or Teflon®). The selected pump must be specifically designed for low-flow rates (i.e., use of a high volume pump that is adjusted down to a low flow setting is not permitted).
- Tubing used in purging and sampling each well must be dedicated to that well. Once properly located, moving the pump in the well should be avoided. Consequently, the same tubing should be used for purging and sampling. Teflon® and Teflon®-lined polyethylene tubing must be used to collect samples for organic analysis.
- Electronic water level measuring device, 0.01-foot accuracy.
- Flow measurement supplies (e.g., graduated cylinder and stop watch).
- Interface probe.
- Power or air source (generator, compressed air tank, etc.).
- In-line purge criteria parameter monitoring instruments - pH, turbidity, specific conductance, temperature, ORP, and dissolved oxygen.
- Decontamination supplies.
- Logbook and field forms.

- Sample bottles.
- Sample preservation supplies (as specified by the analytical methods).
- Sample tags or labels, chain of custody forms.
- Well construction data, location map, field data from last sampling event.

Sample Procedure

1) Lower pump, safety cable, tubing, and electrical lines very slowly into the well to a depth corresponding to the center of the saturated screen section of the well. The pump intake must be kept at least two feet above the bottom of the well to prevent mobilization of any sediment. Lowering the pump quickly, or even at a moderate rate, will result in disturbing sediment in the well. This is one of the most important steps in low flow sampling at the Site.

2) Measure the water level again with the pump in well before starting the pump. Start pumping the well at 100 to 500 milliliters per minute. Ideally, the pump rate should cause little or no water level drawdown in the well (less than 0.3 foot and the water level should stabilize).

- Measure and record the depth to water and pumping rate every 3 to 5 minutes (or as appropriate) during pumping. If purging continues for more than 30 minutes, readings will be recorded at approximately 10-minute intervals. However, once stabilization is indicated, a minimum of 3 consecutive readings at 3 to 5 minute intervals will be recorded prior to sample collection.
- Care should be taken not to cause pump suction to be broken or entrainment of air in the sample. Do not allow the groundwater level to go below the pump intake.
- Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to minimize drawdown and/or to ensure stabilization of indicator parameters.

3) During purging, measure and record the field indicator parameters using the in-line meter (turbidity, temperature, specific conductance, pH, Eh, and dissolved oxygen) every 3 to 5 minutes (or as appropriate). If purging continues for more than 30 minutes, readings will be recorded at approximately 10-minute intervals. However, once stabilization is indicated, a minimum of 3 consecutive readings at 3 to 5 minute intervals will be recorded prior to sample collection.

- The well is considered stabilized and ready for sample collection once all the field indicator parameter values remain within 10 percent for 3 consecutive readings.
- If drawdown in the well is measured at 1 foot or more, continue to low flow purge until a minimum of the equivalent volume of 1 well casing volume is removed. Using the flow equation to calculate the volume of purge water. Then collect the ground water sample.

4) Before sampling, either disconnect the in-line cell or use a by pass assembly to collect groundwater samples before the in-line cell. All sample containers should be filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.
5) Label the samples using waterproof labels, or apply clear tape over the paper labels. Place all samples in a cooler as described in the QAPP with bagged ice or frozen cold packs and maintain at 4°C for delivery to the laboratory.
6) Do not use ice for packing material; melting will cause bottle contact and possible breakage.
7) Measure and record well depth. Take final water quality reading using low flow cell.
8) Secure the well.

C.2.3 Standard Purging and Sampling Procedure

1) Calculate the volume of water in the well as follows:

$$\text{Volume (in gallons)} = 3.14r^2(h) \times 7.48\ \text{gal/ft}^3$$

Where

h - well depth (feet) - static water level (feet)

r = well radius (feet)

2) Lower the decontaminated submersible pump with new, dedicated lengths of polyethylene tubing into the well so the pump is set at the screen interval. Purge 3 to 5 volumes of water from the well, using the submersible pump.
3) Measure and record time, temperature, pH, turbidity, and specific conductance as each volume of well water is purged. Once the temperature, pH, and specific conductance have stabilized to within 10% for two successive well volumes and the turbidity is less than 50

4) After purging, allow static water level to recover to approximate original level.

5) Place polyethylene sheeting around well casing to prevent contamination of sampling equipment in the event equipment is dropped.

6) Obtain sample from well with a dedicated, factory pre-cleaned polyethylene Voss ™ bailer. The bailer will be suspended on a new, dedicated length of polypropylene string. The maximum time between purging and sampling will be three (3) hours. All the bailers for one day of sampling will be pre-cleaned and dedicated to each individual wells.

   Sample for VOCs first by lowering the bailer slowly to avoid degassing, then collect any other organic and inorganic samples by pouring directly into sample bottles from bailers.

   The sample preservation procedure will be to immediately place analytical samples in the cooler and chill to 4°C. Samples will be delivered to the appropriate laboratory within 24 hours. Samples will be maintained at 4°C until time of analysis.

7) Decontaminate the submersible pump and discard the pump discharge line.

8) Re-lock well cap.

Fill out field notebook, Well Sample Log Sheet, labels, Custody Seals and Chain-of-Custody forms.

C.3 SOP 3: FIELD BLANKS

Field blanks shall be taken to evaluate the cleanliness of groundwater sampling equipment, sample bottles and the potential for cross-contamination of samples due to airborne contaminants present in the air at the site and handling of equipment and sample bottles. Field blank samples shall be performed on the groundwater sample bailers and any filtering equipment. The frequency of field blanks taken shall be one per decontamination event for each type of sampling equipment, and each media being sampled (e.g., a groundwater bailer for groundwater, and a hand auger for soil sampling), at a minimum of one per equipment type and/or media per day.

Where required, field blanks shall be obtained prior to the occurrence of any analytical field sampling event by pouring deionized or potable water over a particular piece of sampling equipment and into a sample container. The analytical laboratory shall provide field blank water and sample jars with preservatives for the collection of all field blanks. Glass jars shall be used for organic blanks. The field blanks as well as the trip blanks shall accompany field personnel to the sampling location. The field blanks shall be analyzed for the same analytes as the environmental samples being collected that day and shall be shipped with the samples taken subsequently that day.

Field blanks shall be taken in accordance with the procedure described below:

(1) Decontaminate sampler using the procedures specified in this plan.

(2) Pour distilled/deionized water over the sampling equipment and collect the rinsate water in the appropriate sample bottles.

(3) The sample shall be immediately placed in a sample cooler and maintained at a temperature of 4°C until receipt by the laboratory.

(4) Fill out sample log, labels and chain-of-custody forms, and record in field notebook.

C.4 SOP 4: TRIP BLANKS

A laboratory supplied trip blank shall be an aliquot of distilled, deionized water which shall be sealed in a sample bottle prior to initiation of each day of field work. The trip blank shall be used to determine if any cross-contamination occurs between aqueous samples during shipment. Trip blanks are analyzed for aqueous VOCs only. Glass vials (40 ml) with teflon-lined lids shall be used for VOC blanks. A trip blank shall be prepared by the laboratory prior to each day of field sampling for aqueous volatiles. The sealed trip blank bottles shall be placed in a cooler with the empty sample bottles and shall be brought to the site by the laboratory personnel. If multiple coolers are required to store and transport aqueous VOC samples, then each cooler must contain an individual trip blank.

C.5 SOP 5: MEMBRANE INTERFACE PROBE (MIP) PROCEDURES

Vertical profile borings utilizing a Membrane Interface Probe (MIP) will be installed at sixteen (16) locations outside the Fulton property to a depth of approximately 130 feet. All boreholes will be advanced using direct push technologies. Specifically, a track mounted Geoprobe Model 6610DT. Continuous readings will be collected from ground surface to the completion depth. The objective is to create a real-time plan view and cross-sectional diagram of the VOC distribution in the subsurface.

C.5.1 Sample Collection

The profiler head screws into conventional AW drill rods and will be driven into the subsurface using direct push technology. The membrane interface probe head consists of a semi-permeable membrane comprised of a thin film polymer impregnated into a stainless steel screen for support. The membrane is approximately 6.35mm in diameter. The membrane is placed in a heated block attached to the probe. This block is heated to approximately 100-120 degrees C and is raised at the leading edge to protect the membrane. Heating the block accelerates diffusion of the contaminant through the membrane. A clean carrier gas sweeps behind the membrane and carries the contaminants to the gas phase detectors at the surface. Travel time from the membrane interface to the detector(s) is approximately 30-45sec (depending on the length of trunkline and flow rate). Teflon® tubing will be attached to the internal fitting using couplings.

At the surface the detectors will measure total VOCs in the carrier gas and provide this information in real-time as an instrument response. The detectors do not provide a quantitative concentration of VOCs in the groundwater or soil. However, the response level from the detector corresponds to the amount of VOCs present in the carrier gas, which is proportional to the amount of VOCs in the soil or groundwater at the MIP location. A greater response from the detector indicates greater VOC concentrations in the subsurface.

C.5.2 Source of Water

All water used during steam cleaning operations shall be from a potable source and so designated in writing. ERM's drilling subcontractor will be solely responsible for obtaining all permits from the local water purveyor and any other concerned authorities, and provision of any required back-flow prevention devices.

C.5.3 Borehole Abandonment

The borings will be properly abandoned to prevent an artificial conduit for vertical groundwater flow through any confining layers. After sampling, the borehole beneath the water table will be sealed by pumping a high-solids grout down the inside of the rods and out the bottom by displacing a disposable steel point. The grout is pumped down the rods while the rod assembly is withdrawn from the hole in a process known as retraction grouting. The rod assembly will then be removed from the borehole and the excess drill cuttings and the tailings from the unused portion of the samples will be placed back down the borehole. The remaining two feet will be filled with cement/bentonite grout, consisting of 5.0 pounds of high grade bentonite for each 94 pounds of Type I or Type II Portland cement mixed with 8.3 gallons of water for a target density of 13.9 pounds/gallon with an acceptable range of 13.4 to 14.5 pounds/gallon. Boreholes constructed in paved areas will then be repaired with an asphalt patch.

C.5.4 Work Site Restoration

Upon completion of the work, the drilling subcontractor shall restore all work areas/drilling locations to a pre-drilling condition. The drilling subcontractor shall remove and dispose of all debris, remove all equipment and materials from the each work site promptly and leave the location in a neat and orderly fashion to the satisfaction of ERM's representative. The restoration shall include repair of any holes, trenches, tire ruts, damage to pavement, etc. caused by the movement or operation of the drilling subcontractor's equipment.

C.6 SOP 6: WATERLOO VERTICAL PROFILE BORINGS WITH GROUNDWATER SAMPLING PROCEDURES

Vertical profile borings with groundwater sampling utilizing the Waterloo Groundwater profiler will be installed at eight (8) locations to characterize groundwater quality/impacts. The Vertical Profile, groundwater samples will be collected from up to 10 intervals per boring. The sampling intervals will be selected based on a combination of MIP data and relative permeability data generated using the Waterloo^{APS}. This technique will refine the understanding of the plume configuration.

All boreholes will be advanced using direct push technologies. Specifically, a track mounted Geoprobe Model 6610DT. The Profiler will be driven to the water table where continuous relative permeability data collection will begin. Up to ten (10) groundwater samples will be collected at each borehole at interval chosen based on a combination of MIP data and relative permeability data generated using the Waterloo^{APS}.

C.6.1 Sample Collection

ERM's drilling subcontractor will be responsible for provision of the Waterloo sampling tool and all necessary accessory items (reusable and disposable) to collect groundwater samples.

The effectiveness of the Waterloo Profiler is based on the premise that the device causes minimal drag down of contamination as it is driven through high contaminant zones into zones of little or no contamination.

The Profiler head consists of a stainless steel drive point with six 5/32-inch diameter circular ports fitted with stainless steel screens. Screen mesh sizes may be selected based on the grain size of the aquifer materials. The ports convey water into a common internal fitting tip. Teflon® tubing is attached to the internal fitting using couplings. The Teflon® tubing is used in a disposable continuous length. The small storage volume in the profiler and conduit tubing provides rapid transmission of the water sample to the surface. Sample bottles are fitted into stainless steel sampling caps in which an airtight seal is obtained. Because of the depth of the water table, groundwater samples will be collected using a nitrogen airlift pump. Purging of the sample containers prior to sampling ensures that formation water exists in the vials at the time of collection. The sampling tubing is protected in the AW drill rod used to drive the tip.

While the Profiler is being driven, contaminant free water, such as distilled water, is pumped down the tubing and out the small ports to purge the Profiler of formation water from the previous sampling interval and to prevent clogging of the ports. As the Profiler reaches sampling depth, the pump is reversed to begin pumping water to the surface, minimizing the introduction of foreign water to the zone to be sampled. Prior to collection, the ports are developed and the system is purged. The amount of water introduced into the formation is monitored during drilling. Samples are collected after the water introduced into the formation is recovered and field parameters such as oxidation-reduction potential, temperature, pH, dissolved oxygen and specific conductance stabilize.

Initially the continuous point sampler will be advanced to just above the designated sample depth starting with the upper most sample in the profile. The Profiler will be used to collect groundwater samples at multiple depths without tripping out the tool. The Profiler will be advanced in ten-foot intervals to collect the groundwater samples using the procedures presented above. Waterloo groundwater sample collection will continue to the borehole termination depth to be determined in the field. Once the desired numbers of sample have been obtained, the Profiler will be tripped out of the boring. If necessary, the Profiler will be properly decontaminated and re-introduced into the borehole to collect additional samples.

A New York State Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP) -certified laboratory will analyze the groundwater samples obtained from these locations for USEPA SW-846 Method 8260.

C.6.2 Borehole Abandonment

The borings will be properly abandoned to prevent an artificial conduit for vertical groundwater flow through any confining layers. After sampling, the borehole beneath the water table will be sealed by pumping a high-solids grout down the inside of the rods and out the bottom by displacing a disposable steel point. The grout is pumped down the rods while the rod assembly is withdrawn from the hole in a process known as retraction grouting. The rod assembly will then be removed from the borehole and the excess drill cuttings and the tailings from the unused portion of the samples will be placed back down the borehole. The remaining two feet will be filled with cement/bentonite grout, consisting of 5.0 pounds of high grade bentonite for each 94 pounds of Type I or Type II Portland cement mixed with 8.3 gallons of water for a target density of 13.9 pounds/gallon with an acceptable range of 13.4 to 14.5 pounds/gallon. Boreholes constructed in paved areas will then be repaired with an asphalt patch.

C.6.3 Work Site Restoration

Upon completion of the work, the drilling subcontractor shall restore all work areas/drilling locations to a pre-drilling condition. The drilling subcontractor shall remove and dispose of all debris, remove all equipment and materials from the each work site promptly and leave the location in a neat and orderly fashion to the satisfaction of ERM's representative. The restoration shall include repair of any holes, trenches, tire ruts, damage to pavement, etc. caused by the movement or operation of the drilling subcontractor's equipment.

C.7 SOP 7: PUMP TEST PROCEDURES

A pre-design hydraulic evaluation of groundwater flow dynamics within the capture field of Village of Garden City Public Supply Well Nos. 9, 13 & 14 will be preformed during the RD. These data will be used as a basis to better understand local groundwater response to pumping of the wells in constructing a preliminary groundwater flow model, identify data gaps, potential new monitoring well locations, and the design of the recovery wells.

Groundwater monitoring wells MWs 20A, 20B, 20C, 21A, 21B, 21C, 22A, 22B, 22C, 23A, 23B, 23C, GCP 14S, GCP-14D, and GCWD Well Nos. 9, 13 & 14 will be outfitted with water level data loggers. Presuming cooperation with the GCWD, the pumping of the three public supply wells during the time these aforementioned monitoring wells are recording water levels will be documented. Preferably, the Village of Garden City Water Department will coordinate pumping of GCWD Well Nos. 9, 13 and 14 during certain times to ensure the three public supply wells are pumped in various combinations as well as simultaneously for specified periods of time to optimize the quality of the data set obtained from this activity. The various pumping scenario combinations will, to the extent practicable, represent potential operating scenarios, e.g., 9 on/13 off/14 on, 9 on/13 on/14 off, etc. Again, the cooperation of the Village of Garden City Water Department will be required to effectively implement this pre-design task.

C.7.1 Transducer/Datalogger Installation

Pressure-sensitive transducer/datalogger, including one barometric pressure transducer/datalogger, that are compatible with both water quality and anticipated pressure-sensitivity range in a given well will be installed in the above mentioned monitoring wells during each pump test, and will record measurements at a frequency of one per minute.

The transducer/datalogger shall be installed by the geologist/environmental engineer in accordance with the manufacturer's instructions. The transducer/datalogger will be suspended inside the well casing by a length of polyethylene string and secured with plastic tie strips to the riser casing or protective well casing. The plastic tie strip shall be positioned such that it does not interfere with closing and locking of the wells protective casing.

C.7.2 Decontamination Procedures

Prior to installation and upon removal from the well each logger will be decontaminated in accordance with SOP 12A.

C.8 SOP 8: GEOLOGIC BORING DRILLING PROCEDURES

C.8.1 Borehole Construction

All temporary well boreholes will be constructed using 4.25 inch ID hollow stem augers. In order to reduce the potential for "running sands", a hydraulic head of potable water will be applied within the augers when the water table is encountered to maintain a positive hydrostatic head on subsurface materials. Each borehole will be advanced to the prescribed completion depth below grade. Cuttings generated from the construction of the boreholes will be contained in New York State Department of Transportation (NYSDOT) approved 55-gallon ring-top drums. The drums will be labeled according to the borehole/temporary well number. All drums will be staged within the fenced storage area along the southern boundary of the Fulton Avenue site.

C.8.2 Borehole Sampling

During the construction of each temporary well borehole, split-spoon samples will be obtained at 10-foot intervals beginning at the water table to the prescribed completion depth for geologic description to characterize the subsurface lithology beneath and downgradient of the Fulton Avenue site. Augers shall be advanced to the sample collection depth and a split-spoon sampler shall be deployed ahead of the lead auger following ASTM Method D1586. Split-spoons shall be advanced by either the wire-line method (downhole cable hammer) or with a cathead and standard 140 pound hammer simulating a free-fall of 30 inches. The soil samples shall be collected using a 2-foot by 2-inch carbon steel split-spoon sampler driven by a 140 lb. hammer dropped 30 inches repeatedly. An ERM Hydrogeologist shall examine and identify the sample immediately upon collection. The sample shall also be screened for volatile organic compound contamination using a hand-held PID total organic vapor analyzer.

C.8.3 Borehole Logging

The hydrogeologist, who shall use visual and field test criteria to classify the soils, shall examine each split-spoon sample. The cuttings brought to the surface during the drilling shall also be:

- screened for volatile organic compound contamination using a hand-held PID total organic vapor analyzer, and
- examined for any physical soil characteristics that may have varied between samples.

A standard "Geologic Log" shall be maintained for each boring that shall include all of the geological information gathered in the field, including the following:

- The structure of the soils sampled, including layering stratification features, and the dominant soil types.
- The color of soils, using Munsell Soil Color Charts.
- The moisture content of soils.
- Soil grain features, including grain sizes, degree of sorting or grading, angularity, and mineralogy. The soils shall be classified using the American Society for Testing and Materials (ASTM) Method D2488-84, a visual manual procedure.
- Identification of any rock fragments, organic material or other components.

The consistency of clay-dominated soils.

All of the soils information collected shall be recorded as a designation under the Unified Soil Classification System (USCS) along with additional observations for each distinctive soil type within each sample. All soil samples shall be stored in glass or plastic jars supplied by the drilling subcontractor. The hydrogeologist shall label the jars with well number, sample interval and date. In addition to the visual logging of the soils, a natural gamma geophysical log will be run inside of the augers upon completion of the boring. The results will be plotted on a linear graph in the field to confirm the geologic structure of subsurface soil.

C.9 SOP 9: TEMPORARY WELL INSTALLATION AND SAMPLING PROCEDURES

C.9.1 Temporary Well Construction

After the borehole has been completed it will be measured with a tape measure to ensure that no "running sands" have entered the augers and that the borehole is clear. Following this procedure a 5-foot, steam cleaned reusable stainless steel well screen attached to black steel riser pipe shall be lowered into the borehole and set at the prescribed completion depth. The augers shall then be withdrawn to allow the formation to collapse and create a seal around the well screen.

C.9.2 Temporary Well Sampling

Prior to purging and sampling, the static water level in the temporary well shall be measured and the volume of standing water in the well shall be calculated. A small diameter stainless steel submersible pump (variable speed Grundfos submersible pump) and dedicated lengths of new polyethylene tubing shall be lowered into the well casing and placed just above the well screen for purging and sampling the well. The submersible pump shall be decontaminated between each well location and each sampling interval utilizing an Alconox wash and potable water rinse followed by a deionized water rinse. At least three well casing volumes shall be purged until the pH, temperature, and specific conductance have stabilized to within 10% for two (2) successive well volumes before a groundwater sample is to be collected. Dissolved oxygen (DO) will also be measured at the conclusion of purging. The pump rate for sampling VOCs shall be less than or equal to 100 ml/minute. These samples shall be preserved by chilling to 4°C and held at this temperature until analyzed by the laboratory.

Following sample collection, the temporary well screen and riser pipe shall be withdrawn 10 feet to the next ground water sampling interval. The submersible pump will be lowered back into the well casing and another sample collected. All sampling measurements shall be recorded on a Field Sampling Log.

This procedure shall continue sequentially until all ground water quality screening samples (up to and including the water table) are collected. All of the samples will be analyzed for volatile organic compounds by USEPA Method 8260B. Duplicate samples will be collected at a frequency of one per twenty samples and will be analyzed for volatile organic compounds by NYSDEC ASP CLP Method 95-4 or 95-1 as described in Section 2.16.1.

Purge water will be collected in a tanker truck, transported to the Fulton Avenue site and pumped into a temporary frac tank. Analytical results from groundwater sampling and samples collected from the frac tank will determine the ultimate disposition of the purge water.

C.9.3 Temporary Well Borehole Abandonment

Once the temporary well has been sampled back to the water table, the remaining steel casing and screen will be withdrawn from the borehole. The borehole shall be allowed to collapse and will be backfilled with cuttings removed during construction of the borehole or clean sand. Grouting of the boreholes will not be required. Boreholes constructed in paved areas will then be repaired with an asphalt patch.

C.10 SOP 10: POTABLE WATER BLANKS

Quality Assurance samples of the potable water used for drilling operations shall be sent for analysis at the start of field activities and at least once every two weeks thereafter to demonstrate the water is analyte-free. If analytical results indicate the presence of a contaminant of concern in a quality assurance sample, then the analytical results of samples collected from those wells installed using the corresponding potable water shall be suspect. These samples shall be analyzed for the same compounds as the groundwater environmental samples.

The following procedure shall be used to collect potable water blanks:

- Pour potable water into an extra vial. The sample shall be immediately placed in a sample cooler and maintained at a temperature of 4°C until receipt by the laboratory.

- Complete sample log, labels, custody seals and Chain-of-Custody forms. Record in field notebook.

C.11 SOP 11: DECONTAMINATION PROCEDURES

As presented below, all drilling and field sampling equipment shall be decontaminated prior to use and/or sampling.

C.11.1 Decontamination of Sampling Equipment

Split-spoons shall be decontaminated between sampling intervals as follows:

- Potable water rinse.
- Alconox and water detergent and potable water scrub.
- Potable water rinse.
- Lay on or wrap equipment in clean polyethylene sheeting until use.

The submersible sampling pumps that are placed in the borehole shall be decontaminated with an Alconox detergent rinse and by pumping approximately 20 gallons of potable water through the pump. Since dedicated new lengths of polyethylene tubing shall be used for sampling each well, the tubing shall not be decontaminated. Unless otherwise specified, the submersible pumps shall be decontaminated prior to the sampling the first well and between each subsequent well as follows:

- Potable water rinse.
- Alconox detergent and potable water scrub.
- Potable water rinse.
- Distilled/deionized water rinse.
- Wrap in aluminum foil, shiny side facing out.

Unless otherwise specified, all non-detect sampling equipment utilized to obtain groundwater environmental samples for chemical analyses (e.g., stainless steel bailers) shall be decontaminated between sampling points as follows:

- Potable water rinse.
- Alconox and water detergent and potable water scrub.
- Potable water rinse.
- Methanol (at least pesticide grade) rinse: Light spray to minimize material used. Segregate and store rinsate separately.
- Distilled/deionized water rinse.
- Air dry.
- Wrap or cover in aluminum foil shiny side facing out.

C.11.2 Driller's/Heavy Equipment Decontamination

All drilling equipment and the back of the drilling rig shall be decontaminated by steam cleaning prior to performance of the first boring/well installation and between all subsequent borings/well installations. This shall include all hand tools, casing, augers, drill rods and bits, tremie pipe and other related tools and equipment. The steam cleaning equipment shall be capable of generating live-steam with a minimum temperature of 212°F.

All water used during drilling and/or steam cleaning operations shall be from a potable source and so designated in writing. The drilling contractor is responsible for obtaining all permits from the local potable water purveyor and any other concerned authorities, and provision of any required back-flow prevention devices. The equipment shall be cleaned to the satisfaction of the ERM Hydrogeologist.

All well casing and screen shall be steam cleaned, wrapped in clean polyethylene sheeting and stored until the time of well construction.

Extraneous contamination and cross-contamination shall be controlled by wrapping the sampling equipment with aluminum foil when not in use and changing and disposing of the sampler's gloves between samples. Decontamination of sampling equipment shall be kept to a minimum in the field, and wherever possible, dedicated sampling equipment shall be used. Personnel directly involved in equipment decontamination shall wear appropriate protective equipment.

C.12 SOP 12: WASTE MANAGEMENT AND DISPOSAL

The following section describes the handling and ultimate disposal of solid and liquid wastes generated during the field activities. Waste generated is expected to consist of trash (boxes, paper, etc.), auger cuttings, decontamination wash water, purge water, and used protective clothing.

The PCE in soil and ground water at the Fulton Avenue site is a listed hazardous waste. Accordingly, its derived-from solid and liquid wastes are considered hazardous for handling and disposal purposes. In regards to disposal, disposal options for generated wastes will depend on contaminant levels in the waste. The following standards and regulations have been identified as being applicable, relevant and appropriate to any removal, management, and off-site or on-site disposal of Fulton Avenue site RI generated waste materials:

NYSDEC's RCRA TAGM #3028 on "Contained-In Criteria for Environmental Media" {November 30, 1992};

- 40 C. F.R. Part 262 (Standards Applicable to Generators of Hazardous Waste);
- 40 C. F. R. Part 263 (Standards Applicable to Transporters of Hazardous Waste;
- 40 C. F. R. Part 264 (Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities); and
- 40 C. F. R. Part 268 (Land Disposal Restrictions)

Accordingly, handling and disposal will be as follows:

- Non-contaminated trash and debris will be placed in a trash dumpster and disposed of by a local garbage hauler.
- Non-contaminated protective clothing will be packed in plastic bags and placed in a trash dumpster for disposal by a local garbage hauler.
- Cuttings from soil borings and monitoring well installations will be collected on plastic sheeting and stored in a roll-off container or drums staged in the secure, fenced area along the southern boarder of the Fulton Avenue site established for that purpose. Subsequent

sampling of the material will be conducted to determine its classification for disposal purposes. The soils will then be disposed of in accordance with any applicable federal and state regulation in addition to those referenced above by a waste subcontractor.

- Liquids generated from equipment decontamination, temporary well purging and permanent ground water monitoring well development will be collected in a tanker truck at the point of generation, transported to the Fulton Avenue site, and stored in a temporary frac tank. Purge water from sampling the permanent ground water wells will be collected in 55-gallon drums or a tanker truck, hauled to the Fulton Avenue site for transfer into the frac tank at the Fulton Avenue site. Subsequent sampling of the material will be conducted to determine its classification for disposal purposes. It is intended that these liquids will not be stored in the frac tank for more than 90 days in order to comply with applicable RCRA storage regulations.

- Used protective clothing and equipment that is suspected to be contaminated with hazardous waste will be placed in plastic bags, packed in 55-gallon ring-top drums, and disposed of in accordance with any applicable federal and state regulation in addition to those referenced above by a waste subcontractor.

ATTACHMENT D - Laboratory SOPs

Accutest Laboratories
Standard Operating Procedure

FN: EOP5030-03
Pub Date: 08/27/98
Rev Date: 08/06/03
Page 1 of 9

Lab Manager______________

QA Manager______________

Effective Date:_________________

TITLE: **PURGE-AND-TRAP EXTRACTION FOR AQUEOUS SAMPLES**

REFERENCES: **SW-846 5030B (Revision 2, December 1996)**

***Revised Sections**: Added 6.2, 7.6, 7.7, 8.2, 10.2.5.1.1, 10.2.7.2, 10.2.8 & 12.0; Modified 1.0, 3.0, 4.0, 5.3, 6.0, 7.5, 8.0, 10.0 & 11.0*

1.0 SCOPE AND APPLICATION

1.1 This method describes a purge-and-trap procedure for the analysis of volatile organic compounds (VOCs) in aqueous samples, water miscible liquid, and high-level soil and waste sample extracts prepared in Method 5035. This method is used in conjunction with gas chromatographic determinative methods SW8015, SW8021, and SW 8260.

1.2 Method 5030 can be used for most volatile organic compounds that have boiling points below 200 °C and are insoluble or slightly soluble in water. Volatile water-soluble compounds can be included in this analytical technique; however, quantitation limits (by GC or GC/MS) are approximately ten times higher because of poor purging efficiency.

1.3 Water samples can be analyzed directly for volatile organic compounds by purge-and-trap extraction and gas chromatography. Higher concentrations of these analytes in water can be determined by direct injection of the sample into the chromatographic system or by dilution of the sample prior to the purge-and-trap process.

2.0 SUMMARY OF METHOD

2.1 Aqueous Samples: An inert gas is bubbled through a portion of the aqueous sample at ambient temperature, and the volatile components are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the volatile components are adsorbed. After purging is completed, the sorbent column is heated and backflushed with inert gas to desorb the components onto a gas chromatographic column.

2.2 High Concentration Extracts from Method 5035: An aliquot of the extract prepared in Method 5035 is combined with organic free reagent water in the purging chamber. It is then analyzed by purge-and-trap GC or GC/MS following the normal aqueous method.

3.0 REPORTING LIMIT AND METHOD DETECTION LIMIT

3.1 Not applicable. See determinative method.

4.0 DEFINITIONS

BATCH - a group of samples which are similar with respect to matrix and testing procedures being employed and which are processed as a unit. A sample batch is a maximum of 20 samples which can be prepared and analyzed over a period of one day.

BLANK - an analytical sample designed to assess specific sources of laboratory contamination. See individual types of Blanks: Method Blank; Instrument Blank, Storage Blank, and Sulfur Blank.

MATRIX - the predominant material of which the sample to be analyzed is composed. For the purpose of this SOP, a sample matrix is either water or soil/sediment. Matrix is <u>not</u> synonymous with phase (liquid or solid).

MATRIX SPIKE - aliquot of a matrix (water or soil) fortified (spiked) with known quantities of specific compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery.

MATRIX SPIKE DUPLICATE - a second aliquot of the same matrix as the matrix spike (above) that is spiked in order to determine the precision of the method.

METHOD BLANK - an analytical control consisting of all reagents, internal standards and surrogate standards, that is carried throughout the entire analytical procedure. The method blank is used to define the level of laboratory, background and reagent contamination.

REAGENT WATER - water in which an interferant is not observed at or above the minimum detection limit of the parameters of interest.

TRIP BLANK - a sample of analyte free matrix taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures.

5.0 HEALTH & SAFETY

5.1 The analyst should follow normal safety procedures as outlined in the Accutest Health and Safety Plan and Personal Protection Policy, which includes the use of safety glasses and lab coats. In addition, all acids are corrosive and should be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact the supervisor/Health and Safety Officer.

5.2 The toxicity or carcinogenicity of each reagent used in this method has not been precisely determined; however, each chemical should be treated as a potential health hazard. Exposure to these reagents should be reduced to the lowest possible level. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of data handling sheets should be made available to all personnel involved in these analyses.

5.3 Primary standards of the toxic compounds should be prepared in a hood. A NIOSH/Mass approved toxic gas respirator should be worn when the analyst handles high concentrations of these toxic compounds.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 Collect samples in 40 ml glass screw-cap VOA vials with Teflon-faced silicone septum. The vials and septum should be washed and rinsed with distilled deionized water, then baked in oven at 105 °C for approximately one hour. Do not heat the septum for more than one hour, because the silicone begins to slowly degrade at 105 °C.

6.2 Test all samples for residual chlorine using test paper for free and total chlorine. If samples contain residual chlorine, three milligrams of sodium thiosulfate should be added for each 40 ml of water sample.

6.3 Preserve samples with HCl to pH ≤ 2. Samples received unpreserved must be so noted on the chain of custody. The sample manager must notify the project manager of the non-conformance, who in turn notifies the client for additional instructions. The non-conformance is documented in the report narrative.

6.4 Store samples with minimum headspace, at 4 ^{o}C or less in an area free of solvent fumes. The size of any bubble caused by degassing upon cooling the sample should not exceed 5 - 6 mm. When a bubble is present, also observe the cap and septum to ensure that a proper seal was made at time of sampling. If the sample was improperly sealed, the sample should be discarded.

6.5 Samples must be analyzed within 14 days of collection.

7.0 APPARATUS AND MATERIALS

7.1 Microsyringes - 10-µL, 25-µL, 100-µL, 250-µL, 500-µL, and 1,000-µL.

7.2 Syringe valve - Two-way, with Luer ends.

7.3 5-mL glass hypodermic syringes with Luer-Lok tip.

7.4 Volumetric flasks, Class A - 10-mL and 100-mL, with ground-glass stoppers.

7.5 Purge-and-trap device.

7.5.1 The following autosampler models are used for purging, trapping, and desorbing the sample into GC column.

- O.I. Model 4560 sample concentrator with 4551 vial multi-sampler.
- O.I. Model 4560 sample concentrator with 4552 Water/Soil multi-sampler.

7.5.2 The sample purge chamber accepts 5 ml samples with a water column at least 3 cm deep.

7.5.3 The Archon auto sampler is equipped with a heater capable of maintaining the purge chamber at 40 °C (± 1°C) is to be used for low level soil/sediment analysis, but <u>not</u> for water or medium level soil/sediment analyses.

7.5.4 The trap is 25 cm long with an inside diameter of 0.105 inch, which is purchased from a commercial vendor. It contains Tenax, silica gel, and a carbon molecular sieve. Before initial use, the trap should be conditioned at 180°C for 30 minutes by backflushing with at least 20 ml/minute flow of helium.

7.5.4.1 A variety of traps and trapping materials may be employed with this method. The choice of trapping material may depend on the analyte of interest. Whichever trap is employed, it must demonstrate sufficient adsorption and desorption characteristics to meet the quantitation limits of all the target analytes for a given project and the QC requirements in this method.

7.5.5 The desorber should be capable of rapidly heating the trap to 180 °C. The polymer section of the trap should not be heated higher than 180 °C and the remaining sections should not exceed 210 °C during bakeout mode.

7.6 Vials - 40 ml with Teflon lined septa.

7.7 pH papers.

8.0 REAGENTS

8.1 Reagent Water

8.1.1 Reagent water is defined as water in which an interferant is not observed at the method detection limit of the parameters of interest.

8.1.2 Reagent water is generated by using a multi-element deionizing system consisting of a particulate filter, twin mixed bed ion exchange resin columns, and a carbon-polishing column.

8.2 Methanol - purge-and-trap grade or equivalent.

8.3 Refer to the determinative method SOP for specifications on internal and surrogate standards.

9.0 INTERFERENCES

9.1 The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running laboratory reagent blanks. The use of non-polytetrafluoroethylene (non-PTFE) plastic coating, non-PTFE thread sealants, or flow controllers with rubber components in the purging device must be avoided, since such materials out-gas organic compounds which will be concentrated in the trap during the purge operation. These compounds will result in interferences or false positives in the determinative step.

9.2 Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) through the septum seal of the sample vial during shipment and storage. A trip blank prepared from organic-free reagent water and carried through sampling and handling protocols serves as a check on such contamination.

9.3 Contamination by carryover can occur whenever high-concentration and low-concentration samples are analyzed sequentially. Whenever an unusually concentrated sample is analyzed, it should be followed by an analysis of organic-free reagent water to check for cross-contamination. The trap and other parts of the system are subject to cross contamination from highly concentrated samples. Frequently bake-out and purge the entire system on a routine basis.

9.4 Special precautions must be taken to control methylene chloride sources. All GC carrier gas lines and purge gas plumbing should be constructed of stainless steel or copper tubing. Organics prep staff whose clothing is routinely exposed to methylene chloride and other solvent vapors during sample preparation are banned from wearing their lab coat in the GC/MS laboratory.

10.0 PROCEDURE

10.1 The purge-and-trap technique for aqueous samples is found in Sec. 10.2 and guidance for analysis of solvent extracts from the High Concentration Method in Method 5035 is found in Sec. 10.3. The samples prepared by this method may be analyzed by Methods 8015, 8021, and 8260. Refer to these methods for appropriate analysis conditions.

10.2 This section provides guidance on the analysis of aqueous samples and samples that are water miscible, by purge-and-trap analysis.

10.2.1 Condition the trap according to manufacturer’s instructions upon installation. Routine Daily maintenance must be performed before any tuning, calibration or sample analysis activities are initiated. These include checks of the following items:

- Clean & bake purge tube.
- Bake trap and transfer lines.
- Check or refill internal/surrogate spike solution on SIM/SAM vials.
- Clean/replace syringe (if necessary).
- Change and refill rinse bottle.
- Empty and rinse waste bottle.

10.2.2 Prior to using this introduction technique, the GC system must be calibrated. The procedures for the determinative methods give details on preparation of standards for initial and daily calibrations. The GC/MS methods require instrument tuning prior to proceeding with calibration.

10.2.2.1 Transfer and fill up (no air space) each standard to labeled 40 ml vial and cap with Teflon septum, then place the vial into O.I. sample tray.

10.2.2.2 Program the autosampler to add surrogate and internal standard spiking solution to each standard.

10.2.2.3 Follow the purge-and-trap analysis as outlined in Sec. 10.2.4.

10.2.2.4 Calculate response factors (RF) or calibration factors (CF) for each analyte of interest. Follow the specific calibration requirements as described in the determinative method SOP.

10.2.3 Sample Screening

10.2.3.1 Screening of the sample prior to purge-and-trap analysis may provide guidance on whether sample dilution is necessary and may prevent contamination of the purge-and-trap system.

10.2.3.2 The Tekmar 7000/7050 headspace autosampler is utilized by Accutest for screening. The system functions by direct sampling of the heated sample headspace by direct injection onto the GC column equipped with a flame ionization detector (Method 3810).

10.2.4 Sample Introduction and Purging

10.2.4.1 All samples and standard solutions must be allowed to warm to ambient temperature before analysis.

10.2.4.2 Adjust the purge gas flow rate to 25-40 mL/min on the purge-and-trap device. Once the flow is optimized, it is not necessary to set the flow daily, although periodic checking is recommended.

10.2.4.3 Using <u>O.I.Model 4560 sample concentrator with 4551 or 4552 vial multisampler,</u>

- Place the 40 ml vial in the tray, or
- Load 5ml sample into purge tube if sample volume limited.

10.2.4.4 Program the autosampler to inject the internal standard (if applicable) and surrogate solution into the robotic syringe used to withdraw sample from the 40 ml vial.

10.2.4.5 Purge the sample for the time and at the temperature specified in the determinative method SOP.

10.2.5 Sample Desorption

10.2.5.1 Place the purge-and-trap system in the desorb mode, and rapidly heat the trap to the temperature specified in the determinative method SOP while backflushing with helium for the method specific time. Simultaneously begin the temperature program of the gas chromatograph and start the data acquisition.

10.2.5.1.1 Desorb time may require performance optimization between 2.0 and 4.0 minutes as dictated by trap manufacturer's specifications or instrument characteristics.

10.2.5.2 Program the purge and trap system to automatically rinse purge tube at least twice with heated reagent water between analyses to avoid carryover of target compounds. For samples containing large amounts of water-soluble materials, suspended solids, high-boiling compounds, or high purgeable levels, it may be necessary to wash out the purging device with methanol solution between analyses, rinse it with distilled water.

10.2.6 Trap Reconditioning

10.2.6.1 Recondition the trap by returning the purge-and-trap device to the purge mode. Maintain the trap temperature and bake time as specified in the method SOP.

10.2.7 Sample Dilution

10.2.7.1 If the concentration of any target compound in any sample exceeds the initial calibration range, a new aliquot of that sample must be diluted and reanalyzed.

10.2.7.2 Establish the dilution of sample in order to fall within the calibration range:

- Use FID screen data.
- Employ data from undiluted sample analysis.
- Use historical site data.
- Use sample characteristics (i.e. appearance, odor) as initial guidance.

10.2.7.3 The following procedure is appropriate for diluting purgeable samples. Until the dilute sample is in a sealed sample vial, all steps in the dilution procedure must be performed without delay.

10.2.7.3.1 Dilutions may be made in volumetric flasks (10-mL to 100- mL). Intermediate dilutions may be necessary for extremely large dilutions.

10.2.7.3.2 Calculate the approximate volume of reagent water to be added to the volumetric flask selected and add slightly less than this quantity of organic-free reagent water to the flask.

10.2.7.3.3 Inject the proper aliquot of samples from the syringe into the flask. Aliquots of less than 1 mL are not recommended. Dilute the sample to the mark with organic-free reagent water. Cap the flask, invert, and shake three times.

10.2.7.3.4 Fill a 40 ml sample vial and seal with a Teflon baked silicon septa, load the diluted sample into the autosampler and analyze.

10.2.8 pH Verification.

10.2.8.1 Once the sample analysis is completed or before preparing sample dilution, the pH of the sample must be determined to ensure that all VOA samples were properly preserved in the field. Put one or two drops of sample directly on a piece of pH paper. Check the pH. Any sample with a pH greater than 2 will be recorded accordingly on the instrument run log and will be reported with a footnote indicating the sample preservation deficiency.

10.2.9 Analysis of water-miscible liquids

10.2.9.1 Water-miscible liquids are analyzed as water samples after first diluting them at least 50-fold with organic-free reagent water.

10.3 This section provides guidance on the analysis of solvent extracts from High Concentration Samples prepared by Method 5035.

10.3.1 Low-level soil method.

10.3.1.1 Weigh out 5 g of each sample into a labeled vial. Add 5 ml of reagent water and cap the vial quickly. Transfer the 40 ml vial to the autosampler tray. Stir and heat the sample at the time of analysis.

10.3.2 Medium-level soil method.

10.3.2.1 Select the volume of methanol extract to add to the 50 ml of reagent water for analysis. If a screening procedure was followed, use the estimated concentration to determine the appropriate volume. Otherwise, estimate the concentration range of the sample from the low-concentration analysis to determine the appropriate volume.

10.3.2.2 Aliquot 5ml of the solution into the 40 ml vial and cap with Teflon septum, then place the vial onto the autosampler.

10.3.3 Proceed with the analysis as outlined in the specific determinative method. Analyze all reagent blanks on the same instrument as that used for the samples. The standards and blanks should also contain the same amount of methanol to simulate the sample conditions.

11.0 QUALITY CONTROL

11.1 Analyze a method blank and blank spike at a rate of one per day or every twenty samples, whichever is more frequent.

11.2 A matrix spike/matrix spike duplicate is required for every 20 samples. Client specific requirements may specify a MS/MSD per day.

12.0 DOCUMENTATION

12.1 The Analytical Logbook records the analysis sequence; the logbook must be completed daily. Each instrument will have a separate logbook.

12.1.1 If samples require reanalysis, a brief explanation of the reason must be documented in the Comments section.

12.2 Standards Preparation Logbook must be completed for all standard preparations. All information must be completed; the page must be signed and dated by the appropriate person.

12.2.1 The Accutest lot number must be cross-referenced on the standard vial.

12.3 Instrument Maintenance Logbook must be completed when any type of maintenance is performed on the instrument. Each instrument has a separate log.

12.4 Any corrections to laboratory data must be done using a single line through the error. The initials of the person and date of correction must appear next to the correction.

12.5 Unused blocks of any form must be X'ed and Z'ed by the analyst before submitting the data for review.

12.6 Supervisory (or peer) personnel must routinely review (at least once per month) all laboratory logbooks to ensure that information is being recorded properly. Additionally, the maintenance of the logbooks and the accuracy of the recorded information should also be verified during this review.

13.0 POLLUTION PREVENTION & WASTE MANAGEMENT

13.1 Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents, and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids to the environment must be followed. All method users must be familiar with the waste management practices described in section 13.2.

13.2 Waste Management. Individuals performing this method must follow established waste management procedures as described in the waste management SOP, ESM003. This document describes the proper disposal of all waste materials generated during the testing of samples as follows:

13.2.1 Non hazardous aqueous wastes.

13.2.2 Hazardous aqueous wastes

13.2.3 Chlorinated organic solvents

13.2.4 Non-chlorinated organic solvents

13.2.5 Hazardous solid wastes

13.2.6 Non-hazardous solid wastes

ACCUTEST LABORATORIES
STANDARD OPERATING PROCEDURE

FN: EGN142-10
Pub. Date: 1/15/98
Rev. Date: 10/3/09
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Lab Manager:____________________

QA Manager:_____________________

Effective Date:

TITLE: TCLP - VOLATILES EXTRACTION

METHOD REFERENCES: SW846 1311

Revised Sections: 13.2

1.0 SCOPE AND APPLICATION

1.1 The Toxicity Characteristic Leaching Procedure (TCLP) utilizes a zero-headspace extraction device to evaluate the presence and mobility of volatile organics for waste characterization.

2.0 SUMMARY OF METHOD

2.1 For liquid wastes containing less than 0.5 % solids, the sample is filtered through a 0.6 to 0.8 um filter and the filtrate is defined as the TCLP leachate. All filtrations are done in a zero headspace extractor/filtration device to minimize exposure of the sample to the air.

2.2 For solid samples, the solid portion of the sample is extracted by adding extraction fluid equal 20 times the weight of the sample and rotating the sample for 18 ± 2 hours at 30 rpm. All filtrations are done in a zero headspace extractor/filtration device to minimize exposure of the sample to the air. After leaching, the sample is filtered through 0.6 to 0.8 um filter paper and the filtrate is analyzed for volatile organics.

3.0 REPORTING LIMIT AND METHOD DETECTION LIMIT

3.1 Not applicable for this method. Refer to determinative methods for reporting limit and method detection limit information.

4.0 DEFINITIONS

BATCH: A group of samples which behave similarly with respect to the sampling or the testing procedures being employed and which are processed as a unit. For QC purposes, if the number of samples in a group is greater than 20, then each group of 20 samples or less will all be handled as a separate batch.

MATRIX: The component or substrate (e.g., water, soil) which contains the analyte of interest.

MATRIX DUPLICATE: A duplicate sample is digested at a minimum of 1 in 20 samples. The relative percent difference (RPD) between the duplicate and the sample should be assessed. The duplicate RPD is calculated as shown below. Assess laboratory performance against the control limits that are specified in the SOP. In house limits are generated once sufficient duplicate data is available to generate limits (usually a minimum of 20 to 30 analyses). If a duplicate is out of control, flag the results with the appropriate footnote. If the sample and the duplicate are less than 5 times the reporting limits and are within a range of ± the reporting limit, then the duplicate is considered to be in control. Note: If control limits are not specified in the SOP, use default limits of ± 20% RPD.

$$\frac{(|\text{Sample Result - Duplicate Result}|) \times 100}{(\text{Sample Result + Duplicate Result})/2} = \text{Duplicate RPD}$$

MATRIX SPIKE: The laboratory must add a known amount of each analyte to a minimum of 1 in 20 samples. The matrix spike recovery is calculated as shown below. Assess laboratory performance against the control limits that are specified in the SOP. In house limits are generated once sufficient matrix spike data is available to generate limits (usually a minimum of 20 to 30 analyses). If a matrix spike is out of control, then the results should be flagged with the appropriate footnote. If the matrix spike amount is less than one fourth of the sample amount, then the sample cannot be assessed against the control limits and should be footnoted to that effect. Note: If control limits are not specified in the SOP, then default limits of 75 to 125 percent should be used.

$$\frac{(\text{Spiked Sample Result - Sample Result}) \times 100}{(\text{Amount Spiked})} = \text{Matrix Spike Recovery}$$

MATRIX SPIKE DUPLICATES: Intralaboratory split samples spiked with identical concentrations of target analyte(s). The spiking occurs prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix.

METHOD BLANK. The laboratory must digest and analyze a method blank with each set of samples. A minimum of one method blank is required for every 20 samples. For a running batch, a new method blank is required for each different digestion day. If no digestion step is required, then the method blank is equivalent to the reagent blank. The method blank must contain the parameter of interest at levels of less that the reporting limit for that parameter. If the method blank contains levels over the reporting limits, the samples must be redigested or redistilled and reanalyzed. The exception to this rule is when the samples to be reported contain greater than 10 times the method blank level. In addition, if all the samples are less than a client required limit and the method blank is also less than that limit, then the results can be reported as less than that limit.

ORGANIC-FREE REAGENT WATER: For semivolatiles and nonvolatiles, all references to water in the methods refer to water in which an interferant is not observed at the method detection limit of the compounds of interest. Organic-free reagent water can be generated by passing tap water through a carbon filter bed containing about 1 pound of activated carbon. A water purification system may be used to generate organic-free deionized water.

REAGENT BLANK: The reagent blank is a blank that has the same matrix as the samples, i.e., all added reagents, but did not go through sample preparation procedures. The reagent blank is an indicator for contamination introduced during the analytical procedure. (Note: for methods requiring no preparation step, the reagent blank is equivalent to the method blank.) Either a reagent blank or a method blank must be analyzed with each batch of 20 samples or less. The concentration of the analyte of interest in the reagent blank must be less than the reporting limit for that analyte. If the reagent blank contains levels over the reporting limits, the samples must be reanalyzed. The exception to this rule is when the samples to be reported contain greater than 10 times the reagent blank level. In addition, if all the samples are less than a client required limit and the reagent blank is also less than that limit, then the results can be reported as less than that limit.

REAGENT GRADE: Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents which conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.

REAGENT WATER: Water that has been generated by any method which would achieve the performance specifications for ASTM Type II water. For organic analyses, see the definition of organic-free reagent water.

REFERENCE MATERIAL: A material containing known quantities of target analytes in solution or in a homogeneous matrix. It is used to document the bias of the analytical process.

5.0 HEALTH & SAFETY

5.1 The analyst must follow normal safety procedures as outlined in the Accutest Laboratory Safety Manual which includes the use of safety glasses and lab coats. In addition, all acids are corrosive and must be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact the supervisor.

5.2 The toxicity or carcinogenicity of each reagent used in this method has not been precisely determined; however, each chemical must be treated as a potential health hazard. Exposure to these reagents should be reduced to the lowest possible level. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of data handling sheets must be made available to all personnel involved in these analyses.

6.0 COLLECTION, PRESERVATION, AND HOLDING TIME

6.1 The samples are stored at 4°C prior to extraction. The samples should be collected with no headspace. No preservatives should be added to the samples for TCLP volatile extraction. The TCLP extract should be stored at 4°C after filtration and prior to analysis.

6.2 All volatiles must be leached within 14 days of the date of collection.

7.0 INTERFERENCES

7.1 Refer to the individual methods for the analytes of interest for discussion of interferences.

8.0 APPARATUS

Below is a summary of the apparatus to be used for extraction of samples for volatile analyses.

8.1 Zero Headspace Extractor (ZHE)- Analytical Testing and Consulting Services, or equivalent. A pump is normally required to add the extraction fluid to the vessel. This vessel should have an internal volume of 500 to 600 ml and be able to accommodate a 90-110 mm filter. The vessel must be gas tight and free of organic contaminants. It is strongly recommended that all ZHE's be fitted with a pressure valve to check for leaks. The o-rings must be checked and replaced on a regular basis.

8.1.1 ZHE extractors must be leak tested before first being placed into use and whenever a loss of pressure during an extraction is observed. To leak test an extractor, pressurize the ZHE to 50 psi and allow it to stand unattended for one hour, and recheck the pressure.

8.1.1.1 If pressure is lost, check all fittings and inspect and replace o-rings and repeat the leak test process.

8.1.1.2 If the pressure still does not hold in a range from 45 to 50 psi, then pressurize the extractor to 10 psi and allow it to stand unattended for one hour and recheck the pressure. If it does not hold at 10 psi, the ZHE must be removed from all service until the problem is resolved.

8.1.1.2.1 Any pressure of < 45 psi is considered failing the 50 psi check and must be also checked at the 10 psi level.

8.1.1.2.2 Any pressure of < 10 psi is considered failing the 10 psi check and must be taken out of service until it is repaired.

8.1.1.3 If the ZHE will hold pressure at 10 psi and can maintain a filtering pressure of 50 psi when gas pressure is applied, then it can be used for extractions. Notify a team leader or supervisor that further maintenance is required on this extractor.

8.2 Rotary Agitation Device - Analytical Testing and Consulting Services or equivalent. Must be capable of rotating the extraction vessel in an end-over-end fashion at 30 ± 2 rpm. The rotation rate should be checked and recorded at least once per week on the analysis worksheets.

8.3 Filters - Whatman GF/F; 90-110 mm, or equivalent. The filters should be borosilicate glass fiber filters with an effective pore size of 0.6 to 0.8 um. Pre-filters should not be used.

8.4 pH meter - capable of reading ± 0.05 pH units

8.5 Balance - capable of weighing ± 0.01 g and with a range up to approximately 150 g or higher.

8.6 Glass, gas-tight syringes.

8.7 40 ml volatile vials

8.8 Filtration device - Millipore Corp., YT 3014214w; 142 mm, or equivalent. For use in the determination of the solids content of the sample. This device must have a minimum internal volume of 300 ml and be equipped to handle a 142 mm diameter filter. It must be made of inert materials which will not leach or absorb waste components.

8.9 Filters - Whatman GF/F; 142 mm, or equivalent. For use in the determination of the solids content of the sample. The filters should be borosilicate glass fiber filters with an effective pore size of 0.6 to 0.8 um. Pre-filters should <u>not</u> be used.

8.10 Thermometer, calibrated against an NIST traceable thermometer. To record room temperature.

8.11 Variable speed mechanical pump - Environmental Express Model TP1200, or equivalent.

9.0 REAGENTS

All reagents should be prepared from reagent grade chemicals unless otherwise specified.

9.1 Organic Free Water: ASTM Type II or equivalent. Use DI water from the taps in the GC lab for all volatile extractions.

9.2 Sodium Hydroxide, 1N; Dissolve 40.0 grams of NaOH in 500 ml DI water in a 1 liter flask. Dilute to volume and mix. CAUTION: The solution will become warm.

9.3 Glacial Acetic Acid, CH_3CH_2OOH, Reagent Grade

9.4 Extraction Fluid #1: Add 5.7 ml of glacial acetic acid to 500 ml of DI water in a 1 liter flask. Add 64.3 ml of 1N sodium hydroxide, and dilute to 1 liter. The pH of this solution must be within the range of 4.93 ± 0.05 to be used. The expiration date for this extraction fluid is 2 weeks from the date of preparation.

10.0 PROCEDURE

Below is the procedure to be followed for the TCLP extraction of volatile analytes.

10.1 If the waste will obviously yield no liquid when subjected to pressure filtration, proceed to Section 10.3. For example, for samples that are solids with no free liquids, proceed to Section 10.3.

10.2 If the waste is a liquid or multiphasic, proceed as follows, using the pressure filtration device.

10.2.1 Pre-weigh the filter and the container that will hold the sample. Document all weights on the leachate form.

10.2.2 Assemble the filtering apparatus as per the manufacturer's instructions.

10.2.3 Weigh a 100 gram subsample of the waste and record the weight. Note: There may be limited sample volume available for the volatile extraction and analysis. In that case, the aliquot used to determine the solids content of the sample should be taken from one of the bottles intended for non-volatile analysis.

10.2.3.1 If there is insufficient volume to do this characterization with 100 g, then proceed with a smaller sample aliquot and note on the extraction log that a smaller aliquot was used for percent solids characterization.

10.2.4 Quantitatively transfer the subsample to the filtering apparatus. Slurries may be allowed to settle and the liquid portion filtered prior to transferring the solid portion of the waste. NOTE: If waste material has adhered to the sample container, obtain the weight of this residue and subtract from the total weight of the waste.

10.2.5 Complete the assembly of the filtration device, and gradually apply pressure until fluid is expelled. If no fluid is expelled, gradually increase the pressure in 10 psi increments to a maximum of 50 psi. If no fluid is expelled in a 2 minute period, stop the filtration. Shut off the pressurizing gas and vent the filtration system using the side port. If the pressure is taken too high and the filter breaks, start the procedure again will a new sample aliquot. Never use more than one filter for a sample aliquot. CAUTION: Do not remove flange clamps while system is pressurized! Serious injury may result!

10.2.6 The material in the filtration apparatus is defined as the solid phase. This material may either be a solid or a high viscosity liquid such as an oil or paint.

10.2.7 Remove the solid portion of the waste sample and the filter from the filtration apparatus. Then dry the filter and solids at 100^0 C $\underline{+}$ 20 to a constant weight (2 successive weights within 1%). Determine the percent solids as shown below. (This drying is only required when there is filtrate entrained in the filter, but it is recommended for all wet samples.)

$$\%\ \text{solids} = \frac{(W - F) \times 100}{T}$$

where W = weight of sample remaining on filter
F = weight of filter
T = initial weight of sample used

10.2.8 If the sample contains <0.5% dry solids, the filtrate is defined as the sample leachate.

10.3 Zero Headspace Extraction

10.3.1 If the waste contains <0.5% dry solids, charge the zero headspace extractor (ZHE) with 200 ml of the sample, insert the filter and supports, and seal the vessel. Raise the piston to remove any headspace present. Attach a 50 ml glass gas tight syringe to the ZHE, and raise the piston to expel approximately 45 ml of filtrate. Transfer the filtrate to a 40 ml VOA vial with a minimum of agitation, and seal the vial. Make sure that there is no headspace in the vial. Repeat the sampling to obtain three vials of filtrate. Store at 4^{o}C until analysis.

10.3.2 If the waste is 100% solid, weigh a 10 to 25 gram subsample and quickly transfer to the ZHE. (Before weighing and loading the sample, make sure that the base of the ZHE has been adjusted upwards so that the volume open on sealing the vessel will be no more than the volume needed for the sample and the extraction fluid.) Install the filter and supports, and seal the vessel. Check the pH of the extraction fluid to ensure that it is within the proper range (4.93 ± 0.05). Then add 20 times the sample weight of extraction fluid into a class A graduated cylinder, and attach the pump and the transfer line to the ZHE. Open the value to the transfer line and then turn on the pump and pump in the appropriate volume of extraction fluid. When the fluid has been transferred, remove the transfer line and close the valve. Pressurize the ZHE to 5 to 10 psi and then rotate the ZHE 2-3 times. Open the valve and expel any residual headspace. Stop at the first sign of liquid expulsion. Check the ZHE carefully for leaks and make sure that the pressure is holding to within 2 psi of the initial pressure. If not, discard the sample and set up a new aliquot in a different ZHE. Make sure to record the initial pressure on the extraction sheet. Proceed to section 10.3.4.

10.3.3 If the waste is biphasic, charge the ZHE with enough sample to obtain 10-25 grams of solid using the formula shown below. Install the filter and supports, and seal the unit. Pressurize the ZHE by raising the piston and expelling any headspace. Attach a 50 ml syringe to the ZHE and continue to raise the piston to expel the liquid phase. Transfer the liquid to 40 ml VOA vials for storage at 4^{o}C until analysis. Check the pH of the extraction fluid to ensure that it is within the proper range (4.93 ± 0.05). Charge the ZHE with extraction fluid equivalent to 20 times the sample dry weight, (as described in 10.3.2 above) and pressurize the ZHE at 5 to 10 psi. Check the ZHE carefully for leaks. Record the initial pressure on the extraction sheet.

$$\text{final g of sample (10 to 25)} = \frac{\text{x g of sample}}{\text{\% solids/100}}$$

10.3.4 Turn on the rotary agitator and allow the extraction to proceed 18 ± 2 hrs at a rotation rate of 30 ± 2 rpm and a temperature of 23 ± 2°C.

10.3.5 At the end of the extraction period, check the pressure reading on each ZHE. If the pressure has decreased by more than 2 psi from the initial pressure reading of 5 to 10 psi, then the sample must be discarded and releached using a different ZHE. (The leaking ZHE must be successfully leak tested as outlined in Section 8.1.1 before reuse with another sample.)

10.3.5.1 Note: an increase in pressure is not a problem.

10.3.6 If the pressure has held over the course of the extraction, then attach a 50 ml syringe to the ZHE on the three-way valve, open the valve, and remove three 50 ml aliquots of the leachate. Transfer the aliquots to 40 ml VOA vials and store with no headspace at 4°C until analysis.

10.3.6.1 For biphasic samples, if a compatible liquid was obtained in Section 10.3.3, then the extract must be combined with this liquid proportionally before analysis. For example, if there was 50 ml of original filtrate and 300 ml of extract, then a 40 ml aliquot of sample to be analyzed should contain 5.7 ml of the original filtrate and 34.3 ml of the filtered extract. Check with the area supervisor or manager for further assistance when 2 extracts are obtained.

10.3.6.2 For biphasic samples, if a non-compatible liquid was obtained in Section 10.3.3, then each separate aliquot must be analyzed. The results should be combined mathematically after analysis according to the following formula:

$$\text{Concentration} = \frac{V_1C_1 + V_2C_2}{V_1 + V_2}$$

Where: V_1 = Volume of first phase (liters)
C_1 = Concentration of analyte, ug/l, in first phase.
V_2 = Volume of second phase (liters)
C_2 = Concentration of analyte, ug/l, in second phase.

10.3.7 Open the ZHE and remove the remaining leachate and sample. Remove the piston and clean the vessel with hot soapy water, rinse with deionized water, and dry in an oven at 110°C. If the ZHE contained a sample with high levels of organics (i.e. oily appearance or strong smell), then Contrad soap (available in the organic extractions area) should be used to clean the vessel. After approximately 10 extractions, or after a dirty sample is leached, the o-rings on the ZHE should also be changed.

10.4 Make sure that all documentation is complete and have the paperwork checked by the general chemistry lab supervisor or manager. Then make copies for the organics analysis department and distribute the sample fractions with the paperwork.

11.0 QC REQUIREMENTS

11.1 A method blank must be done for every 20 extractions that are done in an extraction vessel. A different container should be used for the method blank for each batch. The blank containers should be rotated so that all of the containers are used for a blank over time. It is recommended that a method blank be prepared on each different analysis day. In addition, method blanks must be prepared for each type of extraction fluid used for a batch. If the sample does not need leaching due to low percent solids, then DI water is provided as the method blank associated with that sample.

11.2 An aliquot of the appropriate extraction fluid must be provided to each analytical area to use to prepare a leachate spike blank for each batch. Extraction fluid #1 is provided for all extracted samples and DI water is provided for samples that are filtered only.

11.3 For each matrix type extracted, (soil, water, sludge, etc.) a leachate spike must be performed. Various unique matrices may require their own leachate spikes. Check with the lab supervisor or manager to find out the leachate volume required for a given sample. A minimum of one leachate spike must be performed for every 20 samples of a specific matrix.

12.0 DOCUMENTATION

12.1 A minimum of once per week, check and record the rotation speed of the TCLP agitation apparatus on the sample worksheet. The rotator should turn at a rate of 30 ± 2 rpm.

12.2 Record all extraction information on the data worksheet, including the characterization, the sample weights used, the extraction fluid pH, the final extract pH, the initial and final pressures, etc. Make sure to record all pH values to 2 places past the decimal.

12.3 Record all the reagent information, including manufacturers, lot numbers, and expiration dates, in the TCLP reagent log.

12.4 Record the temperature at the beginning and end of each leaching period. Make sure to use a calibrated thermometer to measure the temperature.

12.5 Record all leak testing and maintenance on the ZHE extractors and rotators in the TCLP maintenance log.

13.0 DATA REVIEW AND REPORTING

13.1 All samples should be updated to QC batches in the LIMS system. The analyst is responsible for reviewing all data for compliance with the QC outlined in this SOP. They are responsible for making sure that the raw data is fully documented and it is updated and entered into the LIMS system.

13.2 After the analyst review is completed, the supervisor or a designated reviewer shall review the data for technical compliance to the SOP. Additional reviews are periodically done by the manager of the department for technical completeness. The raw data is then electronically filed by the report generation department.

14.0 POLLUTION PREVENTION & WASTE MANAGEMENT

14.1 Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents, and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids to the environment must be followed. All method users must be familiar with the waste management practices described in section 14.2.

14.2 Waste Management. Individuals performing this method must follow established waste management procedures as described in the waste management SOP, EHS004. This document describes the proper disposal of all waste materials generated during the testing of samples as follows:

13.2.1 Non hazardous aqueous wastes.

13.1.2 Hazardous aqueous wastes

13.1.3 Chlorinated organic solvents

13.1.4 Non-chlorinated organic solvents

13.1.5 Hazardous solid wastes

13.1.6 Non-hazardous solid wastes

14.0 ADDITIONAL REFERENCES

14.1 No additional references are required for this method.

Accutest Laboratories
Standard Operating Procedure

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Lab Manager______________

QA Manager______________

Effective Date___________________

TEST NAME: METHOD 8260B, VOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/ MASS SPECTROMETRY (GC/MS)

METHOD REFERENCE: SW846 8260B (Revision 2, December 1996)

Revised Section: 2.8

1.0 SCOPE AND APPLICATION

1.1 This SOP describes the analytical procedures, which are utilized by Accutest to acquire samples for analysis of volatile organic compounds by gas chromatographic/mass spectrometric (GC/MS) following purge and trap utilizing the internal standard technique. The compounds in Table 1 may be determined by this method. An option has been included for the analysis of 1,4-Dioxane by selected ion monitoring GC/MS (GC/SIM-SIM).

1.2 This analytical method is designed for nearly all types of samples, regardless of water content, including ground water, aqueous sludges, liquors, waste solvents, oily wastes, tars, filter cakes, sediments and soils.

1.3 The applicable concentration range of this method is compound, matrix, and instrument dependent. Volatile water-soluble compounds can be included in this analytical technique. However, for some low-molecular weight halogenated hydrocarbons, aromatics, ketones, nitriles, acetates, acrylates, ethers, and sulfides, quantitation limits are approximately ten times higher because of poor purging efficiency. Determination of some structural isomers (i.e. xylenes) may also be hampered by coelution.

2.0 SUMMARY OF METHOD

2.1 Volatile compounds are introduced into the gas chromatograph by purge-and-trap (Method 5030/5035). Method 5030 may be used directly on ground water samples. Method 5035 is used for low-concentration and medium-concentration soils, sediments, and wastes. Medium concentration samples are preserved and stored in methanol prior to purge-and-trap analysis.

2.2 An inert gas is bubbled through a 5 ml sample contained in a specifically designed purging chamber at ambient temperature. The purgeables are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the purgeables are trapped. After purging is completed, the sorbent column is heated and backflushed with the inert gas to desorb the purgeables onto a gas chromatographic (GC) column.

2.3 The volatile compounds are separated by the temperature programmed GC column and detected using a mass spectrometer, which is used to provide both qualitative and quantitative information.

2.4 The peaks detected are qualitated by comparison to characteristic ions and retention times specific to the known target list of compounds.

2.5 Once identified the compound is quantitated by comparing the response of major (quantitation) ion relative to an internal standard technique with an average response factor generated from a calibration curve.

2.6 Additional unknown peaks with a response > 10 % of the closest internal standard may be processed through a library search with comparison to a database of approximately 75,000 spectra. An estimated concentration is quantitated by assuming a response factor of 1.

2.7 Water soluble volatile organic and other poor purging compounds maybe analyzed using this methodology, however this method is not the method of choice for these compounds and the laboratory's ability to achieve all calibration and quality control criteria for this method cannot be guaranteed. These compounds are noted as (pp) in Table 7.

2.8 The method includes an analytical option for the analysis of 1,4-Dioxane by GC/MS-SIM. The selected ions that are characteristic of the analytes of interest are analyzed using lower concentrations of calibration standards under the same MS conditions. SIM analysis is performed upon client request and is documented in the report.

3.0 REPORTING LIMIT AND METHOD DETECTION LIMIT

3.1 Reporting Limit. The reporting limit for this method is established at the lowest concentration standard in the calibration curve and may vary depending on matrix interferences, sample volume or weight and percent moisture. Detected concentrations below this concentration cannot be reported without qualification. See Table 10.

3.1.1 Compounds detected at concentrations between the reporting limit and MDL are quantitated and qualified as "J", estimated value. Program or project specifications may dictate that "J" qualified compounds are not to be reported.

3.2 Method Detection Limit. Experimentally determine MDLs using the procedure specified in 40 CFR, Part 136, Appendix B. This value represents the lowest reportable concentration of an individual compound that meets the method qualitative identification criteria.

3.2.1 Experimental MDLs must be determined annually for this method.

3.2.2 Process all raw data for the replicate analysis in each MDL study. Forward the processed data to the QA group for archiving.

4.0 DEFINITIONS

BLANK - an analytical sample designed to assess specific sources of laboratory contamination. See individual types of Blanks: Method Blank, Instrument Blank, Storage Blank, Cleanup Blank and Sulfur Blank.

4-BROMOFLUOROBENZENE (BFB) - the compound chosen to establish mass spectral instrument performance for volatile (VOA) analyses.

CALIBRATION FACTOR (CF) - a measure of the gas chromatographic response of a target analyte to the mass injected. The calibration factor is analogous to the Relative Response Factor (RRF) used in the Volatile and Semivolatile fractions.

CONTINUING CALIBRATION - analytical standard run every 12 hours to verify the initial calibration of the system.

CONTINUOUS LIQUID-LIQUID EXTRACTION - used herein synonymously with the terms continuous extraction, continuous liquid extraction, and liquid extraction. This extraction technique involves boiling the extraction solvent in a flask and condensing the solvent above the aqueous sample. The condensed solvent drips through the sample, extracting the compounds of interest from the aqueous phase.

EXTRACTED ION CURRENT PROFILE (EICP) - a plot of ion abundance versus time (or scan number) for ion(s) of specified mass (Es).

INITIAL CALIBRATION - analysis of analytical standards for a series of different specified concentrations; used to define the linearity and dynamic range of the response of the mass spectrometer to the target compounds.

INTERNAL STANDARDS - compounds added to every standard, blank, matrix spike, matrix spike duplicate, sample (for volatiles), and sample extract (for semivolatiles) at a known concentration, prior to analysis. Internal standards are used as the basis for quantitation of the target compounds.

MATRIX - the predominant material of which the sample to be analyzed is composed. For the purpose of this SOP, a sample matrix is either water or soil/sediment. Matrix is <u>not</u> synonymous with phase (liquid or solid).

MATRIX SPIKE - aliquot of a matrix (water or soil) fortified (spiked) with known quantities of specific compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery.

MATRIX SPIKE DUPLICATE - a second aliquot of the same matrix as the matrix spike (above) that is spiked in order to determine the precision of the method.

METHOD BLANK - an analytical control consisting of all reagents, internal standards and surrogate standards that is carried throughout the entire analytical procedure. The method blank is used to define the level of laboratory, background and reagent contamination.

METHOD DETECTION LIMITS (MDLs) - The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. MDLs should be determined approximately once per year for frequently analyzed parameters.

PERCENT DIFFERENCE (%D) - As used in this SOP and elsewhere to compare two values, the percent difference indicates both the direction and the magnitude of the comparison, i.e., the percent difference may be either negative, positive, or zero. (In contrast, see relative percent difference.)

PERCENT MOISTURE - an approximation of the amount of water in a soil/sediment sample made by drying an aliquot of the sample at 105°C. The percent moisture determined in this manner also includes contributions from all compounds that may volatilize at or below 105 °C, including water. Percent moisture may be determined from decanted samples and from samples that are not decanted.

PRIMARY QUANTITATION ION - a contract specified ion used to quantitate a target analyte.

REAGENT WATER - water in which an interferant is not observed at or above the minimum detection limit of the parameters of interest.

RECONSTRUCTED ION CHROMATOGRAM (RIC) - a mass spectral graphical representation of the separation achieved by a gas chromatograph: a plot of total ion current versus retention time.

RELATIVE PERCENT DIFFERENCE (RPD) - As used in this SOP and elsewhere to compare two values, the relative percent difference is based on the mean of the two values, and is reported as an absolute value, i.e., always expressed as a positive number or zero. (In contrast, see percent difference.)

RELATIVE RESPONSE FACTOR (RRF) - a measure of the relative mass spectral response of an analyte compared to its internal standard. Relative Response Factors are determined by analysis of standards and are used in the calculation of concentrations of analytes in samples.

RELATIVE RETENTION TIME (RRT) - the ratio of the retention time of a compound to that of a standard (such as an internal standard).

INSTRUMENT BLANK – a system evaluation sample containing lab reagent grade water with internal standards and surrogate standards added. An instrument blank is used to remove and/or evaluate residual carryover from high level standards, spike samples and field samples.

5.0 HEALTH & SAFETY

5.1 The analyst must follow normal safety procedures as outlined in the Accutest Health and Safety Plan and Personal Protection Policy, which include the use of safety glasses and lab coats. In addition, all acids are corrosive and must be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact the supervisor.

5.2 The toxicity or carcinogenicity of each reagent used in this method has not been precisely determined; however, each chemical must be treated as a potential health hazard. Exposure to these reagents must be reduced to the lowest possible level. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of data handling sheets must be made available to all personnel involved in these analyses.

5.3 The following analytes covered by this method have been tentatively classified as known or suspected, human or mammalian carcinogens: benzene, carbon tetrachloride, 1,4-dichlorobenzene, 1,2-dichlorethane, hexachlorobutadiene, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, chloroform, 1,2-dibromoethane, tetrachloroethene, trichloroethene, and vinyl chloride. Primary standards of these toxic compounds must be prepared in a hood. A

NIOSH/Mass approved toxic gas respirator should be worn when the analyst handles high concentrations of these toxic compounds.

6.0 INTERFERENCES

6.1 The data from all blanks, samples, and spikes must be evaluated for interferences.

6.2 Impurities in the purge gas, organic compounds out-gassing from the plumbing ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running laboratory reagent blanks. The use of non-TFE tubing, non-TFE thread sealants, or flow controllers with rubber components in the purging device should be avoided.

6.3 Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) through the septum seal into the sample during shipment and storage. A trip blank prepared from reagent water and carried through the sampling and handling protocol can serve as a check on such contamination.

6.4 Contamination by carry-over can occur whenever high level and low-level samples are sequentially analyzed.

6.4.1 Whenever an unusually concentrated sample is encountered, it should be followed by an analysis of an instrument blank to check for cross contamination. Refer to Table 11 for compounds that may cause carryover for this method.

6.4.2 It may be necessary to wash the purging device with methanol, rinse it with organic-free water, and then dry the purging device in an oven at 105^0 C. Follow the instrument manual for instructions on cleaning. Document the occurrence in the maintenance log and notify the manager/supervisor.

6.4.2.1 Clean and bake purging tube.

6.4.2.2 Clean or replace purge needle.

6.4.2.3 Clean and bake sample filter or sparge filter.

6.4.2.4 Clean and bake sample loop.

6.4.2.5 Replace trap if necessary.

6.4.2.6 Replace water management module if necessary.

6.4.2.7 Rinse transfer line with methanol. Caution: disconnect the trap before rinsing.

6.4.3 In extreme situations, the entire purge-and trap device may require dismantling and cleaning. Follow the instrument's manual for instructions on disassembly. Document the occurrence in the maintenance log and notify the manager/supervisor. Screening of the samples prior to purge-and-trap GC/MS analysis is highly recommended to prevent contamination of the system. This is especially true for soil and waste samples.

6.4.4 If the contamination has been transferred to gas chromatograph, any of the following approaches may be used to cleanup the instrument.

6.4.4.1 Baking out the column between analyses.

6.4.4.2 Change the injector liner to reduce the potential for cross-contamination.

6.4.4.3 Remove a portion of the analytical column in the case of extreme contamination.

6.4.5 The oven temperature program must include a post-analysis bake out period to ensure that semivolatile hydrocarbons are stripped from the chromatographic column.

6.4 Special precautions must be taken during the analysis to avoid contamination from methylene chloride and other common laboratory solvents.

6.5.1 The sample storage and analytical area should be isolated from all atmospheric sources of methylene chloride or other common solvents.

6.5.2 Laboratory clothing worn by the analyst should be clean and used in designated areas only. Clothing previously exposed to solvent vapors in the organics sample preparation laboratory can contribute to sample contamination.

7.0 SAMPLE HANDLING AND PRESERVATION AND HOLDING TIME

7.1 HANDLING and PRESERVATION

7.1.1 Water samples

7.1.1.1 Container - 40 ml glass screw-cap VOA vial with Teflon-faced silicone septum. The 40-ml glass VOA vials are pre-cleaned and certified.

7.1.1.2 Collect all samples in duplicate. Test all samples for residual chlorine using test paper for free and total chlorine. If samples contain residual chlorine, three milligrams of sodium thiosulfate should be added for each 40 ml of water sample.

7.1.1.3 Fill sample bottles to overflowing, but do not flush out the dechlorinating agent. Sample should be taken with care so as to prevent any air or bubbles entering vials creating headspace.

7.1.1.4 Adjust the pH of all samples to ≤ 2 at the time of collection, but after dechlorination, by carefully adding two drops of 1:1 HCl for each 40 ml of sample. Seal the sample bottles, Teflon face down, and mix for one minute.

Note: Do not mix the sodium thiosulfate with the HCl in the sample bottle prior to sampling.

7.1.1.5 The samples must be protected from light and refrigerated at 2 - 6 °C from the time of receipt until analysis.

7.1.2 Soil Samples

7.1.2.1 Refer to the SOP for SW846 Method 5035 for preservation requirement of non-aqueous solids. ForOhio VAP freezing is not allowed; samples must be preserved with sodium bisulfate.

7.2 HOLDING TIME

7.2.1 Water Samples.

7.2.1.1 All samples are to be analyzed within 14 days of sampling (HCl preserved for aqueous sample) unless otherwise specified by the contract. If aqueous samples are received unpreserved, the client is notified of the deficiency and the samples must be analyzed within 7 days. The sample preservation deficiency is noted on the chain of custody.

7.2.2 Soil Samples

7.2.2.1 Refer to the SOP for SW846 Method 5035 for holding time requirement of non-aqueous solids.

7.2.2.2 All samples are analyzed within 14 days of sampling unless otherwise specified.

8.0 APPARATUS AND MATERIALS

8.1 SYRINGE

8.1.1 10, 25, 50, 100, 500 and 5000 μl graduated syringes, manually held (Hamilton/equiv.).

8.1.2 5 ml and 50 ml glass gas tight syringes with Luerlok end, if appropriate for the purging device.

8.2 BALANCE

8.2.1 Analytical balance capable of weighing 0.0001 gram.

8.2.2 Top loading balance capable of weighing 0.1 gram.

8.3 PURGE AND TRAP DEVICES

8.3.1 The autosampler models are used for purging, trapping and desorbing the sample into GC column.

- O.I. Model 4560 sample concentrator with 4551 vial multi-sampler
- O.I. Model 4560 sample concentrator with 4552 Water/Soil multi-sampler

8.3.2 The sample purge vial must be designed to accept 5 ml samples with a water column at least 3 cm deep.

8.3.3 The auto-sampler is equipped with a heater capable of maintaining the purge chamber at 40 °C to improve purging efficiency. The heater is to be used for low level soil/sediment analysis, but not for water or medium level soil/sediment analysis.

8.3.4 The OI #10 trap is 42 cm with an inside diameter of 0.105 inches. The trap must be packed to contain the following absorbents (3-ring) and should be conditioned at 180 °C for 30 minutes by backflushing with a Helium gas flow at least 20 ml/min before initial use.

- Tenax (2,6-Diphenylene oxide polymer).
- Silica gel.
- Carbon Molecule Sieve (CMS).

8.3.5 The desorber should be capable of rapidly heating the trap to 190^{0} C for desorption. Do not exceed 210 ^{0} C during bake-out mode. Alternatively, follow manufacturer's instructions.

8.3.6 The response of chloromethane and bromonethane can be tracked for thermal decomposition products formed. If levels over the calibration requirement, the trap must be replaced and the system re-calibrated after the manager/supervisor been notified.

8.4 GAS CHROMATOGRAPH/MASS SPECTROMETER SYSTEM

8.4.1 Gas Chromatograph.

8.4.1.1 An analytical system complete with a temperature programmable gas chromatograph and all required accessories including syringes, analytical columns, and gases.

8.4.1.2 The injection port should be suitable for split or splitless with appropriate interface.

8.4.1.3 The narrow bore capillary column is directly coupled to the source for HP-6890 model.

8.4.1.4 The wide bore capillary column is interfaced through a jet separator to the source for HP-5890 model.

8.4.2 Column.

- 75 m x 0.53mm ID x 3 μm film thickness capillary column coated with DB-624 (J&W Scientific), or equivalent. Condition as per manufactures directions.

- 105 m x 0.53mm ID x 3 μm film thickness capillary column coated with HP-VOA, or equivalent. Condition as per manufactures directions.

- 60 m x 0.25mm ID x 1.4 μm film thickness capillary column coated with DB-624 (J&W Scientific), or equivalent. Condition as per manufactures directions.

- 60 m x 0.45mm ID x 1.7 μm film thickness capillary column coated with DB-VRX (J&W Scientific), or equivalent. Condition as per manufactures directions.

8.4.3 Mass Spectrometer.

8.4.3.1 HP5973 or HP5970 is capable of scanning from 35 to 300 amu every 2 seconds or less, utilizing a 70 volt (nominal) electron energy in the electron impact ionization mode.

8.4.3.2 The mass spectrometer must be capable of producing a mass spectrum which meets all the criteria in Table 3 when injecting or purging 50 ng of the GC/MS tuning standard - Bromofluorobenzene (BFB).

8.4.3.3 SIM Mode – Capable of selective ion grouping at specified retention times for increased compound sensitivity (Table 2a).

8.5 DATA SYSTEM

8.5.1 Data Acquisition and Instrument Control (HP Chemstation) **-** A computer system is interfaced to the mass spectrometer, which allows the continuous acquisition and storage on a machine-readable media (disc) of all mass spectra obtained throughout the duration of the chromatographic program.

8.5.2 Data Processing (HP Enviroquant) - The software accommodates searching of GC/MS data file for target analytes which display specific fragmentation patterns. The software also allows integrating the abundance of an EICP between specified time or scan number limits. The data system includes the recent version of the EPA/NBS or NIST98 mass spectral library for qualitative searches of non-target compounds present in the chromatogram. The data system flags all data files that have been edited manually by laboratory personnel.

8.5.3 Off line Magnetic Tape Storage Device (Lagato Networker) - The magnetic tape storage device copies data for long-term, off-line storage.

9.0 REAGENTS AND STANDARDS

9.1 Solvent

9.1.1 Methanol: purge-and-trap grade quality or equivalent. Store separately, away from the other solvents.

9.2 Reagent Water

9.2.1 Reagent water is defined as water in which an interferant is not observed at the method detection limit of the parameters of interest.

9.2.2 Reagent water is generated by either passing tap water through a bed of approximately one pound of activated carbon or by using the water purification system at Accutest that is a series of deionizers and carbon cartridges.

9.3 Stock Standard Solutions

9.3.1 Commercially prepared standards used.

9.3.1.1 EPA Method 524.2 Volatiles (78 components): Absolute (or equivalent) at 200 μg/ml or 2,000 μg/ml concentration.

9.3.1.2 Custom Volatiles Mix A: Restek (or equivalent) at 2,000 μg/ml concentration.

9.3.1.3 Custom Volatiles Mix B: Restek (or equivalent) at 2,000 - 100,000 μg/ml concentration.

9.3.1.4 VOC Gas Mixture: Ultra (or equivalent) contains 200 μg/ml or 2,000 μg/ml of the following compound**s** in methanol.

- Bromomethane
- Chloroethane
- Chloromethane
- Dichlorodifluoromethane
- Trichlorofluoromethane
- Vinyl Chloride

9.3.1.5 Multiple neat compounds.

9.3.1.6 Surrogate standard mixture: Ultra (or equivalent) at a concentration of 2,500 μg/ml each surrogate compound.

- 1,2-Dichloroethane-d_4
- Dibromofluoromethane
- Toluene-d_8
- 4-Bromofluorobenzene

9.3.1.7 Internal standard mixture: Ultra (or equivalent) at a concentration of 2,000 μg/ml for all the compounds except Tert Butyl Alcohol-d_9, which is from Absolute (or equivalent) at a concentration of 50,000 μg/ml. The following five internal standards are used that exhibit similar analytical behavior to the compounds of interest.

- 1,4-Dichlorobenzene-d_4
- 1,4-Difluorobenzene
- Chlorobenzene-d_5
- Pentafluorobenzene
- Tert Butyl Alcohol-d_9

9.3.1.8 1,4-Dioxane Solution for SIMS : Ultra (or equivalent) at 100 μg/ml in methanol .

9.3.2 Unopened stock standard (ampoules) must be stored according to manufacturer's documented holding time and storage temperature recommendations (usually placed on the ampoule).

9.3.3 After opened, stock standards, internal standards, and surrogate solutions must be replaced after 6 months (one month for purgeable gases standard) or sooner if manufacture expiration date come first or comparison with quality control check samples indicates degradation.

9.3.4 Store all stock standards in vials with minimal headspace and Teflon lid liners after open, protect from light, and refrigerate to –10°C or colder or as recommended by the standard manufacturer.

9.3.5 Return the standards to the freezer as soon as the analyst has completed mixing or diluting the standards to prevent the evaporation of volatile target compounds.

9.4 Internal Standard and Surrogate Solution

9.4.1 Five internal standard and surrogate spiking solutions are prepared in methanol per Table 8.A.

9.4.1.1 25 μg /ml internal standard and surrogate mixture.

9.4.1.2 250 μg /ml internal standard and surrogate mixture.

9.4.1.3 100 μg/ml surrogate mixture.

9.4.1.4 25 μg /ml internal standard mixture.

9.4.1.5 250 μg /ml internal standard mixture.

9.4.2 A calibration range must be constructed for the surrogate compounds. Accordingly, appropriate amounts of surrogates are mixed with each calibration solution to define a range similar to the target compounds.

9.4.3 Each 5 ml sample, QC sample, and blank undergoing analysis should be spiked with any one of the above spiking solutions (depending upon the type of standards addition modules used), resulting in a concentration of 50 μg/l of each compound.

9.4.4 Prepare fresh internal standard and surrogate spiking solutions every six months, or sooner, if manufacturer’s expiration dates come first or if the solution has degraded or evaporated.

9.5 Secondary Dilution Standards

9.5.1 Using stock standard solutions, prepare secondary dilution standards in methanol containing the compounds of interest, either singly or mixed together.

9.5.1.1 100 μg /ml V8260 mixture: prepared from 2,000 μg /ml stock solution. (see Table 8-C)

9.5.1.2 100 μg /ml V8260 custom mixture: prepared from 2,000 μg /ml stock solution. (see Table 8-C)

9.5.1.3 100 μg /ml Gas mixture: prepared from 2,000 μg /ml stock solution. (see Table 8-C)

9.5.2 Replace after one month for non-gas mixtures (one week for gas mixtures) or sooner if manufacture expiration date come first or comparison with quality control check samples indicates degradation.

9.5.3 Store all secondary dilution standards in vials with no headspace and Teflon lid liners, protect from light, and refrigerate to – 10^{o}C or colder or according to manufacturer’s storage temperature recommendation.

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9.5.4 Return the standards to the freezer as soon as preparation is finished to prevent the evaporation of volatile compounds.

9.6 Aqueous Calibration Standard Solutions

9.6.1 Initial Calibration Standards

9.6.1.1 Prepare a minimum of five aqueous calibration standard solutions containing the surrogate compounds as Table 8-D.1 or 8-D.2.

9.6.1.2 To prepare a calibration standard, add a measured volume of secondary dilution standard solutions and the surrogate spiking solution to an aliquot of reagent water in the flask. Use a micro-syringe and rapidly inject the methanol standard into the expanded area of the filled volumetric flask. Remove the needle as quickly as possible after injection. Bring to volume. Mix by inverting the flask three times only. Discard the contents contained in the neck of the flask.

9.6.1.2.1 1,4-Dioxane for SIMS analysis is prepared from primary stock standard (100ppm).

9.6.2 Continuing Calibration Standard

9.6.2.1 A continuing calibration standard at a concentration of 50 μg/l is prepared as the scheme outlined in Table 8-E.

9.6.3 Aqueous standards are not stable and may be stored up to 24 hours if held in Teflon sealed screw-cap vials with zero headspace at 4^0C (± 2^0C). Protect the standards from light. If not so stored, they must be discarded after use, unless they are set up to be purged by an autosampler.

9.6.4 When using an autosampler, standards may be retained up to 12 hours if they are in purge tubes connected via the autosampler to the purge and trap device.

9.7 Second Source Calibration Check Standard (ICV)

9.7.1 Prepare the second source calibration check standards from separate sources of stock standards from the calibration curve following the procedures in Section 9.6. At a minimum, an ICV should be analyzed with every initial calibration.

9.7.2 For 1,4-Dioxane via SIMS: Prepare the second source calibration check standard using 2.5 μl of a 1000ppm (Absolute or equivalent) to 50 mL of reagent water which yields a 50 ppb standard.

9.8 4-Bromofluorobenzene (BFB) Standard

9.8.1 Two BFB solutions are prepared in methanol per Table 8-B.

9.8.1.1 25 μg /ml solution for direct injection.

9.8.1.2 250 μg /ml solution for purging.

9.8.2 The solution must be replaced after 6 months or sooner if mass spectrum indicates degradation or if manufacture expiration date comes first.

10.0 CALIBRATION

10.1 Daily Maintenance. Routine Daily maintenance must be performed before any tuning, calibration or sample analysis activities are initiated. These include checks of the following items:

<u>Purge and Trap Device:</u>

Clean & bake purge tube
Bake trap and transfer lines
Check or refill internal/surrogate spike solution on SIM/SAM vials
Clean/replace syringe (if necessary)
Change and refill rinse bottle
Empty and rinse waste bottle

<u>GC Oven:</u> (if necessary)

Change septum
Change liner
Clip column, indicated by carbon build-up

10.2 Initial Calibration

10.2.1 The calibration range covered for routine analysis under RCRA, and SIM, employs standards of 1(specified compounds only), (2)*, 5, 10, 20, 50, 100, 200,(300 or 400)* μg/l. (*instrument dependent). A minimum of five standards must be run sequentially. The low calibration standard defines the reporting limit. Lower concentration standards (1.0 or 2.0 μg/l) may be needed to meet the reporting limit requirements of state specific regulatory programs. Refer to Table 8-D-1 and 8-D-2 for calibration standard preparation.

10.2.2 A calibration range must be constructed for each surrogate compound. Accordingly, add appropriate amounts of each surrogate compound to the calibration solution to define a range similar to the target compounds.

10.2.2.1 For most samples and spikes both the internal standard and the surrogate are added automatically. When doing an initial calibration surrogates are added manually. In order to compensate for the difference between the automatic and manual surrogate additions a correction factor must be applied to the amount of surrogate added in Table 8-D. To determine the correction factor divide the surrogate concentration from an automatic injection by the surrogate concentration from a manual injection for each of the surrogates. Average the result for each of the surrogates to determine the correction factor. Finally multiply the correction factor by the appropriate amount of surrogate from Table 8-D and add this amount to the standard.

10.2.3 For water and medium-level soil calibration: Transfer and fill up (no air space) each standard to labeled 40 ml vial and cap with Teflon septum, then place the vial into O.I. sample tray.

10.2.4 For low-level soil calibration: Transfer 5 ml of each standard to labeled 40 ml vial and cap with Teflon septum, then place the vial into O.I. sample tray.

10.2.4.1 When calibrating for Method 5035 low-level samples, if the sodium bisulfate option was used, add 1g of sodium bisulfate to the 40-ml vial before aliquot 5 ml of each standard into vial otherwise do not add sodium bisulfate. This is equivalent to the amount of sodium bisulfate added to the samples and will maintain a consistent purging efficiency of the compounds. Cap the vial with Teflon septum and place it into O.I sample tray.

10.2.5 The linear range covered by this calibration is the highest concentration standard.

10.2.6 Program the autosampler to add internal standard mixture to each standard. This results in a concentration of 50 μg/l for each internal standard.

10.2.6.1 For O.I. SIM spiker: Automatically adds 10 μl of 25 μg/ml internal standard solution **(**Section 9.4.1.4) to each standard.

10.2.6.2 For O.I. SAM spiker: Automatically adds 1 μl of 250 μg/ml internal standard solution (Section 9.4.1.5) to each standard.

10.2.7 Analyze the standard solutions using the conditions established in Section 11.0. Whenever the highest concentration standard is analyzed, it is usually followed by the analyses of two reagent water blanks. Further analysis may not proceed until the blank analysis is demonstrated to be free of interferences.

10.2.8 Each analyte is quantitatively determined by internal standard technique using the closest eluting internal standard and the corresponding area of the major ion. See Table 7.

10.2.9 The Response Factor (RF) is defined in Section 13.1. Calculate the mean RF for each target analyte using minimum of five RF values calculated from the initial calibration curve.

10.2.10 For the initial calibration to be valid, the following criteria must be met.

10.2.10.1Five compounds (System Performance Check Compounds, SPCCs) are checked for a minimum average response factor. The minimum mean response factors are listed in Table 6. If the initial calibration criteria for SPCCs are not achieved, perform corrective action before completing the calibration

10.2.10.2The % RSD for each individual Calibration Check Compound (CCC) must be less than 30 %. This check is used to identify gross instrument operating problems. If the initial calibration criteria for CCCs are not achieved, perform corrective action before completing the calibration.

10.2.10.3 The percent relative standard deviation (% RSD) (see Section 13.2) of all target analytes must be less than 15 %.

10.2.10.4 If the average response factor criteria cannot be achieved, and if the problem is associated with one or more of the standards, reanalyze the standards and recalculate the RSD. The instrument logbook should have clear documentation as to what the suspected problem was.

10.2.10.4.1 A calibration standard is allowed to be repeated only once; if the second trial fails, a new initial calibration must be performed. Notify the team leader/manager. Document this occurrence in the instrument log.

10.2.10.5 Alternately, if the average response factor criteria cannot be achieved, the calibration range can be narrowed by dropping the low or high point of the curve.

10.2.10.5.1 The changes to the upper end of the calibration range will affect the need to dilute samples above the range, while changes to the lower end will affect the overall sensitivity of the method. Consider the regulatory limits or action levels associated with the target analytes when adjusting the lower end.

10.2.10.6 If the average response factor criteria still cannot be achieved, employ an alternative calibration linearity model. Specifically, linear regression using a least squares approach may be employed.

10.2.10.6.1 If Linear regression is employed select the linear regression calibration option of the mass spectrometer data system. Do not force the regression line through the origin and do not employ 0,0 as a sixth calibration standard.

10.2.10.6.2 The correlation coefficient (r value) must be $\geq$0.99 for each compound to be acceptable.

10.2.10.6.3 Perform corrective action and recalibrate if the calibration criteria cannot be achieved.

10.2.10.7 The initial calibration criteria for this method applies to all additional compounds of concern specified by the client.

10.2.10.8 The relative retention times of each target analyte in each calibration standard should agree within 0.06 relative retention time units.

10.3 Initial Calibration Verification (ICV) - Second Source Calibration Check Standard

10.3.1 The calibration is verified with a calibration check standard at 50 μg/l from an external source (Section 9.7). It must be analyzed immediately following the initial calibration.

10.3.2 The percent difference (% D) (Section 13.3) for this standard must meet the criteria of 20% for all the target compounds.

10.3.2.1 If % D is greater than 20%, reanalyze the second source check. If the criteria cannot be met upon re-injection, re-prepare the second source solution using a fresh ampoule and repeat the process.

10.3.2.2 If the %D criteria cannot be achieved after re-preparation of the second source, prepare a third source and repeat the process. Make fresh calibration standards using one of the two standard sources that matches each other and repeat the initial calibration.

10.4 Continuing Calibration Verification Standard(CCV)

10.4.1 A continuing calibration verification standard at a concentration near mid-level of the initial calibration range (50 μg/l) must be acquired every 12 hrs or at the beginning of each analytical batch.

10.4.1.1 For water and medium level soil analysis: Transfer and fill up (no air space) the calibration verification standard to labeled 40 ml vial and cap with Teflon septum, then place the vial into O.I. sample tray. Analyze as per Section 11.7.

10.4.1.1.1 Vary the concentration of the continuing calibration verification standard on alternate verifications (i.e. every other calibration verification) using an alternative concentration standard. The standard selected must be lower than the midpoint calibration standard.

10.4.1.2 For low-level soil analysis: Transfer 5 ml of the calibration verification standard to labeled 40 ml vial and cap with Teflon septum, then place the vial into O.I. sample tray. Analyze as per Section 11.7.

10.4.1.2.1 When calibrating for Method 5035 low-level samples, if the sodium bisulfate option was used add 1g of sodium bisulfate to the 40-ml vial before aliquot 5 ml of the calibration verification standard into vial, otherwise do not use sodium bisulfate. This is equivalent to the amount of sodium bisulfate added to the samples and will maintain a consistent purging efficiency of the compounds. Analyze as per Section 11.7.

10.4.1.3 A continuing calibration standard is analyzed whenever the analyst suspects that the analytical system is out of calibration. If the calibration cannot be verified, corrective action is performed to bring the system into control. Analysis may not continue until the system is under control.

10.4.2 For the continuing calibration to be valid, all of the following specified criteria must be met.

10.4.2.1 The minimum RF for SPCC compound is shown on Table 6. Each SPCC compound in the calibration verification standard must meet its minimum response factor.

10.4.2.2 The percent difference (% D, see Section 13.3) for CCC must be less than 20%.

10.4.2.2.1 If the CCCs and SPCCs are not required analytes, such as the shortlist analysis for BTEX only, then all required project analytes must meet the 20 %D.

10.4.3 If the first continuing calibration verification does not meet criteria, a second standard may be injected after notify the team leader/manager and checking the system for defects.

10.4.3.1 A continuing calibration check is allowed to be repeated only once; if the second trial fails, a new initial calibration must be performed. In situations where the first check fails to meet the criteria, the instrument logbook should have clear documented notations as to what the problem was and what corrective action was implemented to enable the second check to pass.

10.4.3.2 If the calibration verification is being performed using an auto sampler for night batch, two (2) vials of standard solution are placed in the device for analysis. The second standard must meet continuing calibration criteria and is used for calibration verification. The second check may be discarded because of a purge failure or incorrect spike concentration provided the first calibration standard meets the requirement. In this case, the first calibration standard is used as calibration verification following team leader/manager approval. Document this occurrence on instrument log.

10.4.4 If the verification criteria cannot be achieved, a new initial calibration must be performed.

10.4.5 If any of the internal standard areas change by a factor of two (- 50% to + 100%) or the retention time changes by more than 30 seconds from the midpoint standard of the last initial calibration, the mass spectrometer must be inspected for malfunctions and corrections must be made, as appropriate.

10.4.5.1 Reanalyze the continuing calibration standard. New initial calibration is required if reanalyzed standard continues to fail the internal standard requirements.

10.4.5.2 All samples analyzed while the system was out of control must be reanalyzed following corrective action.

10.5 Corrective Action Maintenance For Failed Tuning and Calibration Procedures

10.5.1 Inability to achieve criteria for instrument tuning or calibration may indicate the need for instrument maintenance. Maintenance may include routine system cleaning and replacement of worn expendables or the need for outside service if the scope of the repair exceeds the capability of the staff.

10.5.2 If maintenance is performed on an instrument, return to control must be demonstrated before analysis can continue. Return to control is demonstrated as follows:

10.5.2.1 Successful instrument tune using PFTBA.

10.5.2.2 Successful tune verification by the analysis of 4-bromofluorobenzene.

10.5.2.3 Successful initial calibration or continuing calibration.

11.0 PROCEDURE

11.1 Instrument conditions.

11.1.1 Recommended instrument conditions are listed in Table 2 and 2a (SIM only). Modifications of parameters specified with an asterisk are allowed as long as criteria of calibration are met. Any modification should be approved by team leader/manger.

11.1.2 Optimize GC conditions for analyte separation and sensitivity. Once optimized, use the same GC conditions for the analysis of all standards, blanks, samples, and QC samples.

11.2 Purge and Trap Device conditions.

11.2.1 See Table 2.

11.2.2 Daily Maintenance. Routine Daily maintenance must be performed before any tuning, calibration or sample analysis activities are initiated. These include checks of the following items:

<u>Purge and Trap Device:</u>

- Clean & bake purge tube.
- Bake trap and transfer lines.
- Check or refill internal/surrogate spike solution on SIM/SAM vials.
- Clean/replace syringe (if necessary).
- Change and refill rinse bottle.
- Empty and rinse waste bottle.

11.3 Step 1: Daily GC/MS performance check.

11.3.1 Every 12 hours, either

- Inject 2 μl (50 ng) of BFB solution directly on column or
- Purge 10 μg/l of 5ml (50ng) to GC column.

11.3.2 The GC/MS system must be checked to verify acceptable performance criteria are achieved (see Table 3).

11.3.3 This performance test must be passed before any samples, blanks or standards are analyzed. Evaluate the tune spectrum using three mass scans from the chromatographic peak and a subtraction of instrument background.

11.3.3.1 Select the scans at the peak apex and one to each side of the apex.

11.3.3.2 Calculate an average of the mass abundances from the three scans.

11.3.3.3 Background subtraction is required. Select a single scan in the chromatogram that is absent of any interfering compound peaks and no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the tuning compound peak.

11.3.4 If all the criteria are not achieved, the analyst must retune the mass spectrometer with team leader/manager and repeat the test until all criteria are met.

11.3.4.5 Alternatively, an additional scan on each side of the peak apex may be selected and included in the averaging of the mass scans. This will provide a mass spectrum of five averaged scans centered on the peak apex. NOTE: The selection of additional mass scans for tuning may only be performed with supervisory approval on a case by case basis.

11.3.5 The injection time of the acceptable tune analysis is considered the start of the 12-hour clock.

11.3.6 Until performance check is acceptable, then calibration check (step 2) can be analyzed.

11.4 Step 2 : Daily calibration check

11.4.1 Initial calibration

11.4.1.1 Refer to Section 10.2.

11.4.1.2 An initial calibration must be established (or reestablished) on each instrument:

- Prior to any sample analyses;
- Whenever a new column is installed;
- Whenever instrument adjustments that affect sensitivity are made; and
- Whenever a continuing calibration standard fails to meet the specified acceptance criteria, on the second trial.

11.4.2 Initial Calibration Verification - Second Source Calibration Check Standard

11.4.2.1 This standard is only analyzed when initial calibration provided. Refer to Section 10.3.

11.4.3 Continuing Calibration verification standard

11.4.3.1 Refer to Section 10.4.

11.4.4 The method blank (step 3) cannot be analyzed until the continuing calibration verification meets the criteria.

11.5 Step 3 : Method blank

11.5.1 The acceptable method blank must be analyzed for every 12-hour time period or sooner.

11.5.1.1 Water and medium-level soil samples - Place a 40 ml vial, filled with DI water onto the autosampler.

11.5.1.2 Low-level soil samples without sodium bisulfate - Transfer 5 ml of DI water to a 40 ml vial and cap with Teflon septum, then place the vial into O.I. sample tray.

11.5.1.2.1 Low-level soil samples with sodium bisulfate (Method 5035) - Add 1g of sodium bisulfate to a 40 ml vial before aliquot 5 ml of DI water into the vial and cap with Teflon septum, then place the vial onto the autosampler.

11.5.2 Program the autosampler to add internal standard and surrogate solution to the method blank for a concentration of 50 μg/l for each internal standard and surrogate.

11.5.2.1 For O.I. SIM spiker: Automatically adds 10 μl of 25 μg/ml internal standard and surrogate solution (Section 9.4.1.1) to the method blank.

11.5.2.2 For O.I. SAM spiker: Automatically adds 1 μl of 250 μg/ml internal standard and surrogate solution (Section 9.4.1.2) to the method blank.

11.5.3 No compound can be present above the laboratory's MDL. If common laboratory solvents (i.e. methylene chloride, acetone) are present in the sample between the MDL and RL, the analyst must determine if the contamination will negatively impact data quality. If the contamination impacts data quality, all affected samples must be re-analyzed.

11.5.4 Surrogates must meet recovery criteria specified in house limits.

11.5.5 If the method blank does not meet surrogate criteria or contains target analytes above the MDL, then

11.5.5.1 All samples analyzed following an out of control method blank must be reanalyzed.

11.5.5.2 Check for the potential of contamination interference from the following areas. Make sure all items are free contamination.

- the analytical system,
- dust and vapor in the air,
- glassware and
- Reagents.

11.5.5.3 Re-analyze the method blank following the system evaluation. In this situation, the instrument logbook should have clear documented notations as to what the problem was and what corrective action was implemented to enable the second blank to pass.

11.5.5.4 If re-analyzed method blank remains out of control, notify team leader or manager.

11.5.6 If two consecutive method blanks are analyzed during unattended operations, the second analysis must meet criteria for the subsequent sample analysis to be valid. Always report the second method blank. The second analysis can only be discarded because of a purge failure provided that the first blank meets the requirement. In this case, the first blank is reported following team leader/manager approval. Document this occurrence on the instrument log.

11.5.7 The blank spike (BS) (step 4) cannot be analyzed until the method blank meets criteria.

11.6 Step 4: Blank spike (BS)

11.6.1 An acceptable blank spike must be analyzed with every analytical batch. The maximum number of samples per analytical batch is twenty.

11.6.2 Spike 50 ml of reagent water with appropriate amount of the standards to prepare a blank spike containing 50 μg/L of each analyte. In situations where lower detection limits are required, a blank spike at 20 μg/L may be prepared. The stock solution for the BS must be from a different source than the initial calibration solution. Refer to Table 8-F for the preparations of the blank spikes.

11.6.2.1 Water and medium-level soil samples - Place a 40 ml vial, filled with DI water onto the autosampler.

11.6.2.2 Low-level soil samples without sodium bisulfate - Aliquot 5 ml of the blank spike into vial and cap with Teflon septum, then place the vial into O.I. sample tray.

11.6.2.2.1 Low-level soil samples with sodium bisulfate for Method 5035 - Add 1g of sodium bisulfate to labeled 40 ml vial before aliquot 5 ml of the blank spike into vial and cap with Teflon septum, then place the vial into O.I. sample tray.

11.6.3 Initiate auto addition of internal standard and surrogate into the syringe per 11.5.2.

11.6.4 Compare the percent recoveries (% R) (see Section 13.5) to the in house limits acceptance criteria. If a blank spike is out of control, all the associated samples must be reanalyzed. The exception is if the blank spike recovery is high and no hits reported in associated samples and QC batch. In that case, the sample results can be reported with footnote (remark) and no further action is required.

11.6.5 Do not analyze samples and MS/MSD (step 5) unless the BS meets acceptance criteria.

11.7 Step 5: Samples /MS/MSD analysis

11.7.1 All samples and standard solutions must be allowed to warm to ambient temperature before analysis.

11.7.2 Select the sample dilution factor to assure the highest concentration analyte is above the calibration range midpoint, but below the upper limit of the range depend on project requirements. See Table 9 for dilution guideline.

- Utilize FID screen data.
- Utilize acquired sample data.
- Utilize the history program.
- Sample characteristics (appearance, odor).

11.7.3 Water samples.

11.7.3.1 Using <u>O.I.Model 4560 sample concentrator with 4551 or 4552 vial multisampler,</u>

- Place the 40 ml vial in the tray, or
- Load 5ml sample into purge tube if sample volume limited.

11.7.4 Sediment/ soil sample

11.7.4.1 <u>Low-level soil method</u>

11.7.4.1.1 Collect the sample using the procedures detailed in the SOP for SW846 Method 5035 low - level soil samples.

11.7.4.1.2 Weigh out 5 g of each sample into a labeled vial. Add 5 ml of reagent water and cap the vial quickly. Transfer the 40ml vial to the autosampler tray. Stir and heat the sample at the time of analysis.

11.7.4.2 <u>Medium-level soil method</u>

11.7.4.2.1 Collect the sample using the procedures detailed in the SOP for SW846 Method 5035 medium - level soil samples.

11.7.4.2.2 Select a methanol aliquot of appropriate volume (see Table 9) determined via screening and transfer to 40 ml of reagent water.

11.7.5 Program the autosampler to inject the internal standard and surrogate solution into the robotic syringe used to withdraw sample from the 40 ml vial. This addition to 5 ml of sample is equivalent to a concentration of 50 μg/L of each internal standard and surrogate.

11.7.5.1 For O.I. SIM spiker: Automatically adds 10 μl of 25 μg/ml internal standard and surrogate solution (Section 9.4.1.1) to each sample.

11.7.5.2 For O.I. SAM spiker: Automatically adds 1 μl of 250 μg/ml internal standard and surrogate solution (Section 9.4.1.2) to each sample.

11.7.6 Purge the sample for 11 minutes with Helium.

11.7.6.1 Low-level soil sample must be performed at 40 °C while the sample is being agitated with the magnetic stirring bar or other mechanical means.

11.7.6.2 To improve the purging efficiency of water-soluble compounds, aqueous samples may also be purged at 40 °C as long as all calibration standards, samples and QC samples are purged at the same temperature and acceptable method performance is demonstrated.

11.7.7 One sample is randomly selected from each analytical batch of similar matrix types and spiked in duplicate to determine whether the sample matrix contributes bias to the analytical results. A matrix spike and matrix spike duplicate are performed by spiking the sample for a concentration of 50 μg/l or 50 μg/kg based on 5 g dry weight. In situations where lower detection limits are required, a blank spike at lower concentration may be prepared.

11.7.8 Desorb the sample for 4 minutes by rapidly heating the trap to 190 °C while backflushing with Helium. Desorb time may require performance optimum between 2.0 and 4.0 minutes as dictated by trap manufacturers specifications or instrument characteristics.

11.7.9 Program the purge and trap system to automatically rinse purge tube at least twice with heated organic-free water (reagent water) between analyses to avoid carryover of target compounds. For samples containing large amounts of water-soluble materials, suspended solids, high-boiling compounds, or high purgeable levels, it may be necessary to wash out the purging device with methanol solution between analyses, rinse it with distilled water.

11.7.10 Bake the trap at least 10 minutes at 210 °C to remove any residual purgeable compounds.

11.7.11 If the initial analysis of the sample or a dilution of the sample has a response for any ion of interest that exceeds the working range of the GC/MS system, the sample must be reanalyzed at a higher dilution.

11.7.11.1 When ions from a compound in the sample saturate the detector, this analysis must be followed by the analysis of reagent water blank. If the blank analysis is not free of interferences, then the system must be decontaminated. Sample analysis may not resume until the blank analysis is demonstrated to be free of interferences.

11.8 Sample dilutions

11.8.1 Using Screening Data to Determine Dilution Factors

11.8.1.1 Dilution for High Concentration Analytes Exceeding The Calibration Range

11.8.1.1.1 The highest concentration target compound detected in the screen data is compared to the highest concentration calibration standard used for determinative volatile organics analysis.

11.8.1.1.1.1 Divide the calibration concentration of the highest concentration calibration standard by the screen concentration.

11.8.1.1.1.2 If the result is >1, sample dilution is considered.

11.8.1.1.2 The result from step 11.8.1.1.1 determines the dilution factor. The dilution factor is targeted to assure that the highest concentration diluted analyte is at the mid-range concentration of the calibration curve for the determinative analysis.

11.8.1.1.3 In all cases a conservative approach to dilution is applied to minimize the increase of detection and reporting limits

11.8.1.2 Dilution for High Concentration Matrix Interferences

11.8.1.2.1 The peak height of the background is compared to the peak height of the later eluting calibration standards from the screening analysis.

11.8.1.2.1.1 A rough estimate of background concentration is calculated by dividing the background peak height by the peak height of the selected screening standard and multiplying by its concentration.

11.8.1.2.2 If the result is >1, sample dilution is considered.

11.8.1.2.3 The result from step 11.8.1.2.1 determines the dilution factor. The dilution factor is targeted to avoid Carry-over contamination between samples and facilitate qualitative and quantitative analysis of target compounds present in the sample.

11.8.1.2.4 In all cases a conservative approach to dilution is applied to minimize the increase of detection and reporting limits

11.8.2 If the concentration of any target compound in any sample exceeds the initial calibration range, a new aliquot of that sample must be diluted and re-analyzed. Until the diluted sample is in a sealed sample vial, all steps in the dilution procedure must be performed without delay.

11.8.3 Water Samples.

11.8.3.1 Prepare all dilutions of water samples in volumetric flasks (10 ml to 100 ml). Intermediate dilutions may be necessary for extremely large dilutions.

11.8.3.2 Calculate the approximate volume of reagent water, which will be added to the volumetric flask, and add slightly less than this quantity to the flask. Refer to Table 9 for dilution guideline.

11.8.3.3 Inject the proper sample aliquot from a syringe into the volumetric flask. Dilute the flask to the volume mark with reagent water. Cap the flask and invert the flask three times.

11.8.3.4 Fill a 40 ml sample vial and seal with a Teflon baked silicon septa, load the diluted sample into the autosampler and analyze according to Section 11.7.

11.8.3 Low-level Soil Samples.

11.8.3.1 The screening data are used to determine which is the appropriate sample preparation procedure for the particular sample, the low-level soil method or the medium-level soil method.

11.8.3.2 If any target compound exceeds the initial calibration range from the analysis of 5 g sample, a smaller sample size must be analyzed. However, the smallest sample size permitted is 0.5 g. If smaller than 0.5 g sample size is needed to prevent any target compounds from exceeding the initial calibration range, the medium level method must be used.

11.9 Data interpretation

11.9.1 Qualitative identification.

11.9.1.1 The targeted compounds shall be identified by analyst with competent knowledge in the interpretation of mass spectra by comparison of the sample mass spectrum to the mass spectrum of a standard of the suspected compound.

11.9.1.2 The characteristic ions for target compounds that can be determined are listed in Table 7. Table 4 and Table 5 list the characteristic ions for internal standards and surrogate compounds respectively.

11.9.1.3 The criteria required for a positive identification are listed below.

11.9.1.3.1 The sample component must elute at the same relative retention time (RRT) as the daily standard. Criteria are the RRT of sample component must be within ± 0.06 RRT units of the standard component.

11.9.1.3.2 The relative intensities of these ions must agree within ± 30 % between the daily standard and sample spectra. (Example: For an ion with an abundance of 50 % in the standard spectra, the corresponding sample abundance must be between 20 and 80 %.)

11.9.1.3.2.1 Compounds can have secondary ions outside criteria from co-eluting compounds and/or matrix effect that can contribute to ion abundances. The interference on ion ratios can’t always be subtracted out by software programs resulting in qualified compound identification.

11.9.1.3.2.2 Quantitation reports display compounds that have secondary ions outside the ratio criteria with a “#” flag.

11.9.1.3.2.3 Any quant reports with compounds that are deemed to be reportable despite the “#” flag, will be initialed in the “#” column by the analyst. Further review to the reporting of qualified compounds will be done by a supervisor or team leader and initialed on the quantitation.

11.9.1.3.3 Structural isomers that produce very similar mass specrtra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 25 % of sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.

11.9.2 Quantitative analysis

11.9.2.1 Once a target compound has been identified, its concentration (Section 13.4) will be based on the integrated area of the quantitation ion, normally the base peak (Table 7). The compound is quantitated by internal standard technique with an average response factor generated from the initial calibration curve.

11.9.2.2 If the sample produces interference for the primary ion, use a secondary ion to quantitate (see Table 7). This is characterized by an excessive background signal of the same ion, which distorts the peak shape beyond a definitive integration. Also interference could severely inhibit the response of the internal standard ion. This secondary ion must also be used to generate new calibration response factors.

11.10 Library search for tentatively identified compounds.

11.10.1 If a library search is requested, the analyst should perform a forward library search of NBS or NIST98 mass spectral library to tentatively identify 15 non-reported compounds.

11.10.2 Guidelines for making tentative identification are listed below.

11.10.2.1 These compounds should have a response greater than 10 % of the nearest internal standard. The response is obtained from the integration for peak area of the Total Ion Chromatogram (TIC).

11.10.2.2 The search is to include a spectral printout of the 3 best library matches for a particular substance. The results are to be interpreted by analyst.

11.10.2.3 Molecular ions present in the reference spectrum should be present in the sample spectrum.

11.10.2.4 Relative intensities of major ions in the reference spectrum (ions > 10 % of the most abundant ion) should be present in the sample spectrum.

11.10.2.5 The relative intensities of the major ions should agree within ± 20 %. (Example: For an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance must between 30 and 70%).

11.10.2.6 Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds.

11.10.2.7 Ions present in the reference spectrum but not in the sample spectrum should be verified by performing further manual background subtraction to eliminate the interference created by coeluting peaks and/or matrix interference.

11.10.2.8 Quantitation of the tentatively identified compounds is obtained from the total ion chromatogram based on a response factor of 1 and is to be tabulated on the library search summary data sheet.

11.10.2.9 The resulting concentration should be reported indicating: (1) that the value is estimate, and (2) which internal standard was used to determine concentration. Quantitation is performed on the nearest internal standard.

11.11 An instrument blank is a system evaluation sample containing lab reagent grade water with internal standards and surrogates. An instrument blank is used to remove and or evaluate residual carryover from high level standards, spike samples and field samples. Since target compound lists have expanded to overlap some volatile and semi-volatile compounds, instrument blanks are necessary to remove carryover contamination.

11.11.1 The compounds that may exhibit carryover for this method are listed in Table 11.

11.11.2 If instrument blanks following a standard or spike sample exhibits carrry-over effect, then any samples that show the same carryover profile, after a comparable concentration must be considered suspect and rerun for confirmation. For example, if an instrument blank has 1ppb detected after a 200ppb standard, then any sample following a sample containing 200ppb or above of the same compound must be confirmed for possible carryover.

11.11.3 If an Instrument Blank(s) was run following suspect high concentration samples and it exhibits the same carryover profile after a comparable concentration must be considered suspect and rerun for confirmation.

11.11.4 In some cases, several instrument blanks may have to be run to eliminate contamination from over loaded samples.

11.11.5 The analytical system is considered free of carryover, when no target analytes can be detected above the MDL.

11.12 Selected Ion Monitoring (SIM) Option Selected Ion Monitoring (SIM) Option

11.12.1 Instrument Set-Up: Modify the method for SIM analysis and define ion groups with retention times, ions and dwell times to include base peak ion for the target compounds of interest, surrogates, and internal standards (Table 2a.) Select a mass dwell time of 50 milliseconds for all compounds.

11.12.2 Calibration: Calibrate the mass spectrometer in the selected ion monitoring mode using 6 calibration standards of 5, 10, 20, 50, 100, 200 ug/l. Spike each standard with the SIM specific internal standard solution at 4ug/ml. Calculate individual response factors and response factor RSDs.

11.12.3 Initial Calibration Verification. Verify the initial calibration after its completion using a 50 ug/l calibration standard purchased or prepared from a second standards reference materials source. The initial calibration verification must meet the criteria of Section 10.2.

11.12.4 Continuing Calibration Verification. Verify the initial calibration every 12 hours using a 50 ug/l calibration. The continuing calibration verification must meet the criteria of Section 10.4.

11.12.5 Surrogate Standard Calculation.. Report surrogate spike accuracy for the surrogates spiked for the full scan GC/MS analysis.

12.0 QUALITY CONTROL

12.1 QC Requirements Summary

BFB	Beginning of the analytical shift and every 12 hours
Second Source Calibration Check Standard	Following initial calibration
Calibration Verification Standard	Every 12 hours
Method Blank	Every 12 hours
Blank Spike	One per analytical batch*
Matrix Spike	One per analytical batch*
Matrix Spike Duplicate	One per analytical batch*
Surrogate	Every sample and standard
Internal Standard	Every sample and standard

*The maximum number of samples per analytical batch is twenty.

12.2 Daily GC/MS Performance Check - BFB

12.2.1 Refer to Section 11.3.

12.3 Second Source Calibration Check Standard

12.3.1 Refer to Section 10.3.

12.3.2 Calibration Verification Standard

12.3.3 Refer to Section 10.4.

12.5 Method Blank

12.5.1 Refer to Section 11.5.

12.6 Blank Spike

12.6.1 Refer to Section 11.6.

12.7 Matrix Spike (MS)/Matrix Spike Duplicate (MSD)

12.7.1 One sample is selected at random from each analytical batch of similar matrix types and spiked in duplicate to check precision and accuracy.

12.7.2 Assess the matrix spike recoveries (Section 13.5) and relative percent difference (RPD) (Section 13.6) against the control limits..

12.7.3 If the matrix spike recoveries do not meet the criteria, check the blank spike recovery to verify that the method is in control. If the blank spike did not meet criteria, the method is out of control for the parameter in question and should be reanalyzed or qualified with an estimate of potential bias. Otherwise, matrix interference is assumed and the data is reportable. No further corrective action is required.

12.8 Surrogates

12.8.1 All standards, blanks, samples, and matrix spikes contain surrogate compounds, which are used to monitor method performance. If the recovery of any surrogate compound does not meet the control limits, the result must be flagged and:

12.8.1.1 The calculation must be checked.

12.8.1.2 The sample must be reanalyzed if the recovery of any one surrogate is out of control limit.

12.8.2 If the sample exhibits matrix interference, defined as excessive signal levels from target or non-target interfering peaks. In this case, reanalysis may not be required following team leader/manager approval.

12.8.3 If surrogate recoveries are acceptable upon reanalysis, the data from the reanalysis is reported. If the reanalysis date did not meet the hold time, then both sets of data must be submitted with the reanalysis reported.

12.8.4 If surrogates are still outside control limits upon reanalysis, then both sets of data should be submitted with the first analysis reported.

12.9 Internal Standard

12.9.1 Retention time for all internal standards must be within ± 30 seconds of the corresponding internal standard in the latest continuing calibration or 50 μg/l standard of initial calibration.

12.9.2 The area (Extracted Ion Current Profile) of the internal standard in all analyses must be within 50 to 200 % of the corresponding area in the latest calibration standard (12 hr. time period).

12.9.3 If area of internal standard does not meet control limits, the calculations must be checked. If a problem is not discovered, the sample must be reanalyzed.

12.9.4 If areas are acceptable upon reanalysis, the reanalysis data is reported.

12.9.5 If areas are unacceptable upon reanalysis, then both sets of data are submitted with the original analysis reported.

13.0 CALCULATION

13.1 Response Factor (RF)

$$RF = \frac{As \times Cis}{Ais \times Cs}$$

where:
As = Area of the characteristic ion for the compound being measured.
Ais = Area of the characteristic ion for the specific internal standard.
Cs = Concentration of the compound being measured (ug/l).
Cis = Concentration of the specific internal standard (ug/l).

13.2 Percent Relative Standard Deviation (% RSD)

$$\%RSD = \frac{SD}{RFav} \times 100$$

where:
SD = Standard Deviation
RFav = Average response factor from initial calibration.

13.3 Percent Difference (%D)

$$\%D = \frac{(RFav - RFcv)}{RFav} \times 100$$

where:
RFcv = Response factor from Calibration Verification standard.
RFav = Average response factor from initial calibration.

13.4 Concentration (Conc.)

For water:

$$\text{Conc. } (\mu g/l) = \frac{Ac \times Cis \times Vp}{Ais \times RF \times Vi}$$

For soil/sediment low level (on a dry weight basis):

$$\text{Conc. } (\mu g/kg) = \frac{Ac \times Cis \times Vp}{Ais \times RF \times Ws \times M}$$

For soil/ sediment medium level (on a dry weight basis)

$$\text{Conc. } (\mu g/kg) = \frac{Ac \times Cis \times Vp \times Vt}{Ais \times RF \times Vme \times Ws \times M}$$

Where:
Ac = Area of characteristic ion for compound being measured.
Ais = Area of characteristic ion for internal standard.
Cis = Concentration of internal standard
RF = Response factor of compound being measured(from initial calibration)
Vi = Initial volume of water purged (ml)
Vp = 5 ml (Total Purge Volume)
Vme = Volume of Methanol aliquot
Vt = Ml Solvent + ((100-% solid)/100 x Ws)
Ws = Weight of sample extracted (g).
M = (100 - % moisture in sample) / 100 or % solids / 100

13.5 Percent Recovery (% R)

$$\% R = \frac{\text{Concentration found}}{\text{Concentration spiked}} \times 100$$

13.6 Relative Percent Difference (RPD)

$$RPD = \frac{| MSC - MSDC |}{(1/2)(MSC+MSDC)} \times 100$$

Where:
MSC = Matrix Spike Concentration
MSDC = Matrix Spike Duplicate Concentration

13.7 Linear regression by the internal standard technique.

$$C_s = \left(\frac{\frac{A_s}{A_{is}} - b}{A} \right) \times C_{is}$$

Where:
Cs = concentration of target analyte
As = Area of target analyte
Cis = concentration of the internal standard
b = Intercept
a = slope of the line

$$a = \frac{N\,\Sigma xy - \Sigma x\,\Sigma y}{N\,\Sigma x^2 - (\Sigma x)^2}$$

$$b = \frac{\Sigma y - a\,\Sigma x}{N}$$

N = number of points
x = amount of analyte
y = response of instrument

13.8 Correlation Coefficient

$$r = \frac{\Sigma(x - \overline{x})(y - \overline{y})}{\sqrt{\Sigma(x - \overline{x})^2\,\Sigma(y - \overline{y})^2}}$$

Where r = correlation coefficient
x = amount of analyte
y = response of instrument

$\overline{x}$ = average of x values

y = average of y values

14.0 DOCUMENTATION

14.1 The Analytical Logbook records the analysis sequence; the logbook must be completed daily. Each instrument will have a separate logbook.

14.1.1 If samples require reanalysis, a brief explanation of the reason must be documented in the Comments section.

14.2 Standards Preparation Logbook must be completed for all standard preparations. All information must be completed; the page must be signed and dated by the appropriate person.

14.2.1 The Accutest lot number must be cross-referenced on the standard vial.

14.3 Instrument Maintenance Logbook must be completed when any type of maintenance is performed on the instrument. Each instrument has a separate log.

14.4 Any corrections to laboratory data must be done using a single line through the error. The initials of the person and date of correction must appear next to the correction.

14.5 Supervisory (or peer) personnel must routinely review (at least once per month) all laboratory logbooks to ensure that information is being recorded properly. Additionally, the maintenance of the logbooks and the accuracy of the recorded information should also be verified during this review.

15.0 POLLUTION PREVENTION & WASTE MANAGEMENT

15.1 Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents, and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids to the environment must be followed. All method users must be familiar with the waste management practices described in section 15.2.

15.2 Waste Management. Individuals performing this method must follow established waste management procedures as described in the waste management SOP, EHS004. This document describes the proper disposal of all waste materials generated during the testing of samples as follows:

15.2.1 Non hazardous aqueous wastes

15.2.2 Hazardous aqueous wastes

15.2.3 Chlorinated organic solvents

15.2.4 Non-chlorinated organic solvents

15.2.5 Hazardous solid wastes

15.2.6 Non-hazardous solid wastes

Table 1. TARGET COMPOUNDS

- Acetone
- Acetonitrile
- Acrolein
- Acrylonitrile
- Allyl Chloride
- Benzene
- Benzyl chloride
- Bromobenzene
- Bromochloromethane
- Bromodichloromethane
- Bromoform
- Bromomethane
- 2-Butanone (MEK)
- Butyl Acetate (1)
- n-Butyl Alcohol (1)
- n-Butylbenzene
- sec-Butylbenzene
- tert-Butylbenzene
- Carbon Disulfide
- Carbon Tetrachloride
- Chlorobenzene
- Chlorodifluoromethane (1)
- Chloroethane
- 2-Chloroethyl Vinyl Ether
- Chloroform
- Chloromethane
- Chloroprene (2-chloro-1,3-butadiene)
- o-Chlorotoluene
- p-Chlorotoluene
- Cyclohexane (1)
- Cyclohexanone
- di-Isobutylene (1)
- di-Isopropyl Ether
- 1,2-Dibromo-3-Chloropropane
- Dibromochloromethane
- 1,2-Dibromoethane
- Dibromomethane (1)
- 1,2-Dichlorobenzene
- 1,3-Dichlorobenzene
- 1,4-Dichlorobenzene
- Dichlorodifluoromethane
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- 1,1-Dichloroethene
- cis-1,2-Dichloroethene
- trans-1,2-Dichloroethene
- 1,2-Dichloropropane
- 1,3-Dichloropropane
- 2,2-Dichloropropane
- 1,1-Dichloropropene
- cis-1,3-Dichloropropene
- trans-1,3-Dichloropropene
- 1,4-Dioxane
- Epichlorohydrin (1)
- Ethyl Acetate
- Ethyl Ether
- Ethyl Methacrylate
- Ethylbenzene
- p-Ethyltoluene (1)
- Freon 113
- Heptane (1)
- Hexachlorobutadine
- Hexachloroethane
- Hexane (1)
- 2-Hexanone
- Iodomethane (Methy iodide)
- IsoAmyl Alcohol (1)
- Isobutyl Alcohol
- Isopropyl Acetate (1)
- Isopropylbenzene
- p-Isopropyltoluene
- Methacrylonitrile
- Methyl Acetate (1)
- 3 Methyl-1-Butanol (1)
- Methyl Tert Butyl Ether
- Methylcyclohexane (1)
- Methyl Methacrylate
- 4-Methyl-2-pentanone (MIBK)
- Methylene Bromide
- Methylene Chloride
- 1-Methylnaphthalene (1)
- 2-Methylnaphthalene (1)
- Naphthalene
- 2-Nitropropane (1)
- Pentachloroethane
- Propionitrile
- Propyl Acetate (1)
- n-Propylbenzene
- Styrene
- Tert Butyl Alcohol
- tert-Amyl Methyl Ether
- tert-Butyl Ethyl Ether
- 1,1,1,2-Tetrachloroethane
- 1,1,2,2-Tetrachloroethane
- Tetrachloroethene
- Tetrahydrofuran
- Toluene
- trans-1,4-Dichloro-2-Butene
- 1,2,3-Trichlorobenzene
- 1,2,4-Trichlorobenzene
- 1,1,1-Trichloroethane
- 1,1,2-Trichloroethane
- Trichloroethene
- Trichlorofluoromethane
- 1,2,3-Trichloropropane
- 1,2,4-Trimethlylbenzene
- 1,3,5-Trimethylbenzene
- Vinyl Acetate
- Vinyl Chloride
- Vinyltoluene (1)
- m,p-Xylene
- o-Xylene
- Ethanol
- Methyl Acrylate

(1) NELAC Accreditation is not offered for this compound. Results may not be useable for regulatory purposes in States where this accreditation option is not offered.

Table 2. RECOMMENDED OPERATING CONDITION	
Gas Chromatograph/ Mass Spectrometer	
Carrier Gas (linear velocity)	Helium at *30 cm/sec
Mass range	35 – 300 amu
Electron Energy	70 volts (nominal)
Scan time	not to exceed 2 sec. per scan
Injection port temperature	200 - 225 °C
Source temperature	200 - 250 °C
Transfer line temperature	220 - 280 °C
Analyzer temperature	220 - 250 °C
Gas Chromatograph temperature program*	
Initial temperature	*40 °C
Time 1	*3 minutes
Column temperature rate	*8 degrees/min.
Final temperature	*220 °C.- 240 °C
Total run time	*25 – 50 mins
Purge and Trap Device	
Purge time	9 min. (at 40 °C for low-level soil) SIM – 6 min @ 50 °C
Desorb**	4 min. at 190 °C
Bake	>10 min. at 210 °C
Transfer line	100 - 130 °C
Valve temperature	approx. transfer line temperature

* Parameter modification allowed for performance optimization provided operational and QC criteria is achieved.(must be approved by team leader/manager)

** Desorb time may require performance optimum between 2.0 and 4.0 minutes as dictated by trap manufacturers specifications or instrument characteristics

Table 2a – SIM Group Parameters

Group No.	Retention Time (minutes)	Ions
1	0 – 10.8	58, 65, 66, 88
2	10.8 – 16.0	95, 174, 176, 98, 100, 70

Table 3. BFB KEY IONS AND ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
50	15-40% of mass 95
75	30-60% of mass 95
95	Base peak, 100% relative abundance
96	5-9% of mass 95
173	< 2% of mass 174
174	> 50% of mass 95
175	5-9% of mass 174
176	>95% and <101% of mass 174

177	5-9% of mass 176

Table 4. INTERNAL STANDARD QUANTITION IONS	
Internal Standard	**Primary/Secondary Ions**
1,4-Difluorobenzene	114 / 63,88
Chlorobenzene-d5	117 / 82, 119
Pentafluorobenzene	168
1,4-Dichlorobenzene-d4	152 / 115, 150
Tert Butyl Alcohol-d9	65/66
Internal Standard (SIM)	
Tert Butyl Alcohol-d9	65/66

Table 5. SURROGATE QUANTITION IONS	
Surrogate Compound	**Primary/Secondary Ions**
1,2 Dichloroethane – d_4	102
Dibromofluoromethane	113
Toluene-d8	98
4-Bromofluorobenzene	95 / 174, 176

Table 6. CRITERIA FOR CCC AND SPCC		
Initial Calibration	Maximum % RSD for CCC is 30 %	
Continuing Calibration	Maximum % D for CCC is 20 %	
Calibration check compounds (CCC)	**Volatile Compound**	
	Vinyl chloride 1,1-Dichloroethene Chloroform 1,2-Dichloropropane Toluene Ethylbenzene	
System Performance Check Compounds (SPCC)	**Compound Name**	**Minimum RF**
	Chloromethane	0.1
	1,1-Dichloroethane	0.1
	Bromoform	0.1
	1,1,2,2-Tetrachloroethane	0.3
	Chlorobenzene	0.3

Table 7. Volatile Internal Standards with Corresponding Analytes Assigned for Quantitation

Analyte	Primary Characteristic Ion	Secondary Characteristic Ion (s)	Analyte	Primary Characteristic Ion	Secondary Characteristic Ion (s)
Tert Butyl Alcohol-d9			Dibromomethane	93	95, 174
Tert Butyl alcohol	59	57	Di-isobutylene	57	
Ethanol	45	46	Epichlorohydrin (pp)	57	57, 49, 62, 51
Pentafluorobenzene			Ethyl methacrylate	69	69, 41, 99, 86, 114
1,1,1-Trichloroethane	97	99, 61	Heptane	57	
1,1-Dichlorethane	63	65, 63	Hexane	56	
1,1-Dichloroethene	96	61, 63	Isopropyl acetate	43	
2,2-Dichloropropane	77	97	Methyl cyclohexane	83	
2-Butanone (pp)	72	43, 72	Methyl methacrylate	69	69, 41, 100, 39
Acetone (pp)	58	43	n-Butanol (pp)	56	41
Acetonitrile (pp)	41	41, 40, 39	Propyl Acetate	43	
Acrolein (pp)	56	55,58	tert Amyl Methyl Ether	73	
Acrylonitrile (pp)	53	52, 51	Toluene	92	91
Allyl Chloride	41		Toluene-d_8	98	
Bromochloromethane	128	49, 130	trans-1,3-Dichloropropene	75	77, 39
Bromomethane	94	96	Trichloroethene	95	97, 130, 132
Carbon disulfide	76	78			
Chlorodifluouromethane	51	86	**Chlorobenzene-d5**	117	82,119
Chloroethane	64	66	1,1,1,2-Tetrachloroethane	131	133, 119
Chloroform	83	85	1,2-Dibromoethane	107	109, 188
Chloromethane	50	52	1,3-Dichloropropane	76	78
Chloroprene	53	53, 88, 90, 51	Bromoform	173	175, 254
cis-1,2-Dichloroethene	96	61, 98	Butyl Acetate	56	
Cyclohexane	84		Chlorobenzene	112	77, 114
Dibromofluoromethane	113		Dibromochloromethane	129	127
Dichlorodifluoromethane	85	87	Ethylbenzene	91	106
Dichloroethane-d_4	102	65	m-Xylene	106	91
Diethyl ether	74	45, 59	o-Xylene	106	91
Diisopropyl ether	45	102	p-Xylene	106	91
Ethyl acetate (pp)	88	43, 45, 61	Styrene	104	78
Ethyl tert Butyl Ether	59		Tetrachloroethene	164	129,131,166
Freon 113	151				
Iodomethane	142	127, 141	**1,4 Dichlorobenzene-d4**	152	115,150
Isobutyl alcohol (pp)	43	43, 41, 42, 74	1,1,2,2-Tetrachloroethane	83	131, 85
Methacrylonitrile (pp)	41	41, 67, 39, 52, 66	1,2,3-Trichlorobenzene	180	182, 145
Methyl Acetate	43	74	1,2,3-Trichloropropane	75	77
Methylene chloride	84	86, 49	1,2,4-Trichlorobenzene	180	182, 145
Methyl-t-butyl ether	73	57	1,2,4-Trimethylbenzene	105	120
Propionitrile (ethyl cyanide)(pp)	54	54, 52, 55, 40	1,2-Dibromo-3-chloropropane(pp)	75	155, 157
Tetrahydrofuran	42		1,2-Dichlorobenzene	146	111,148
trans-1,2-Dichloroethene	96	61, 98	1,3,5-Trimethylbenzene	105	120
Trichlorofluoromethane	151	101, 153	1,3-Dichlorobenzene	146	111, 148
Vinyl acetate	43	86	1,4-Dichlorobenzene	146	111, 148
Vinyl chloride	62	64	2-Chlorotoluene	91	126
Methyl Acrylate	55	85	4-Bromofluorobenzene	95	174, 176
1,4 Difluorobenzene	114	63, 88	4-Chlorotoluene	91	126

Table 7. Volatile Internal Standards with Corresponding Analytes Assigned for Quantitation

Analyte	Primary Characteristic Ion	Secondary Characteristic Ion (s)	Analyte	Primary Characteristic Ion	Secondary Characteristic Ion (s)
1,1,2-Trichloroethane	83	97, 85	Benzyl chloride	91	91, 126, 65, 128
1,1-Dichloropropene	75	110, 77	Bromobenzene	156	77, 158
1,2 Dichloroethane	62	98	Cyclohexanone	55	
1,2 Dichloropropane	63	112	Hexachlorobutadiene	225	223, 227
1,4-Dioxane (pp)	88	88, 58, 43, 57	Hexachloroethane (pp)	201	166, 199, 203
2-Chloroethyl-vinylether (pp)	63	65, 106	Isopropylbenzene	105	120
2 – Hexanone	43	58,57,100	Naphthalene	128	-
2-Hexanone (pp)	43	58, 57, 100	n-Butylbenzene	91	92, 134
2-Nitropropane	46	-	n-Propylbenzene	91	120
3 Methyl –1 butanol	55		Pentachloroethane (pp)	167	167,130,132,165,169
4-Methyl-2-pentanone (pp)	100	43, 58, 85	p-isopropyltoluene	119	134,91
Benzene	78	-	sec-Butylbenzene	105	134
Bromodichloromethane	83	85, 127	tert-Buytlbenzene	119	91, 134
Carbon tetrachloride	117	119	trans-1,4-Dichloro-2-butene (pp)	53	88, 75
cis-1,3-Dichloropropene	75	77, 39			
			(pp) = Poor Purging Efficiency		

Table 7-1 SIM - Volatile Internal Standards with Corresponding Analytes Assigned for Quantitation

Analyte	Primary Characteristic Ion	Secondary Characteristic Ion (s)
Tert Butyl Alcohol-d9		
1,4-Dioxane	88	58
Toluene –d8	98	100
4-BFB	95	174, 176

Table 8. STANDARDS PREPARATION

A) Internal standard and Surrogate mixtures:

	a) 25/250 μg/ml	**b) 250/2,500 μg/ml**
Internal Standard Mixture (2,000 μg/ml)	1.25 ml	1 .25 ml
Tert Butyl Alcohol-d_9 (50,000 μg/ml)	0.5 ml	0.5 ml
Surrogate Mixture (2,500 μg/ml)	1 ml	1 ml
Methanol	97.25 ml	7.25 ml
Total	100 ml	10 ml

- 25/250 μg /ml internal standard and surrogate mixture: The mixture is prepared by measuring 1.25ml of 2,000 μg /ml Internal Standard Mixture (Ultra or equivalent), 0.5 ml of 50,000 μg/ml TBA-d_9 (Absolute or equivalent), 1 ml of 2,500 μg /ml Method 8260A Surrogate Standard Mixture (Ultra or equivalent) and bringing to 100 ml with methanol.

- 250/2,500 μg /ml internal standard and surrogate mixture: The mixture is prepared by measuring 1.25 ml of 2,000 μg /ml Internal Standard Mixture (Ultra or equivalent), 0.5 ml of 50,000 μg/ml TBA-d_9 (Absolute or equivalent), 1 ml of 2,500 μg /ml Method 8260A Surrogate Standard Mixture (Ultra or equivalent) and bringing to 10 ml with methanol.

- 100 μg/ml surrogate mixture: The solution is prepared at 100 μg/ml by measuring 0.4 ml of 2,500 μg/ml Method 8260A Surrogate Standard Mixture (Ultra or equivalent) and bringing to 10 ml with methanol.

- 25/250 μg /ml internal standard mixture: The solution is prepared by measuring 1.25 ml of 2,000 μg /ml Internal Standard Mixture (Ultra or equivalent), 0.5 ml of 50,000 μg/ml TBA-d_9 (Absolute or equivalent), and bringing to 100 ml with methanol.

- 250/2,500 μg /ml internal standard mixture: The solution is prepared by measuring 1.25 ml of 2,000 μg /ml Internal Standard Mixture (Ultra or equivalent), 0.5 ml of 50,000 μg/ml TBA-d_9 (Absolute or equivalent), and bringing to 10 ml with methanol.

B) Bromofluorobenzene (BFB):

	a) 25 μg/ml	**b)) 250 μg/ml**
BFB (25,000 μg/ml)	0.1 ml	0.1 ml

Methanol	99.9 ml	9.9 ml
Total	100 ml	10 ml

- 25 µg /ml solution for direct injection: The BFB is prepared at 25 µg /ml by measuring 0.1 ml of 25,000 µg /ml (Absolute Stock or equivalent) and diluting to 100 ml with methanol.

- 250 µg /ml solution for purging: The BFB is prepared at 250 µg /ml by measuring 0.1 ml of 25,000 µg /ml (Absolute Stock or equivalent) and diluting to 10 ml with methanol.

Table 8. STANDARD PREPARATION (Continued)

C) Secondary dilution standards:

2^{nd} Dilution Standards	Stock Solution	Concentration (μg/ml)	Volume Added (μl)	Final Volume in Methanol (ml)	Final Concentration (μg/ml)
V8260 Mixture	EPA Method 524.2 Volatiles	2,000	2,500	50	100
	Acrolein	Neat (90%)	66.2		1,000
	Acrylonitrile*	Neat	25		500^{+}
	Propionitrile**	Neat	58.9		$1,000^{++}$
	Di-iso Butylene	Neat	7.1		100
	Cyclohexane	Neat	6.5		100
	Cyclohexanone	Neat	52.9		1,000
V8260 Custom Mixture	Custom Volatiles Mix A	2,000	2,500	50	100
	Custom Volatiles Mix B	2,000 - 100,000	2,500		100 - 5,000
	Epichlorohydrin	Neat	21.4		500
	Iso-Amyl alcohol	Neat	125		2,000
	2-Chloroethyl vinyl ether	Neat	20.1		500
	Ethyl tert-butyl ether	Neat	6.8		100
	Tert-Amyl methyl ether	Neat	6.56		100
	Benzyl chloride	Neat	4.6		100
Gas Mixture	VOC Gas Mixture	2,000	1,000	20	100

- 100 μg /ml V8260 mixture: The mixture is prepared at 100 μg /ml by measuring 2 ml of 2,000 μg /ml EPA Method 524.2 Volatiles stock standard, appropriate amount of some neat compounds, and bringing to 50 ml with methanol.
  * Acrylonitrile = 400 μg /ml (Neat) + 100 μg /ml (EPA Method 524.2 Volatiles)
  ** Propionitrile = 900 μg /ml (Neat) + 100 μg /ml (EPA Method 524.2 Volatiles)

- 100 μg /ml V8260 custom mixture: The mixture is prepared at 100 - 5,000 μg /ml by measuring 2.5ml of 2,000 μg /ml Custom Volatiles Mix A, 2.5 ml of 2,000 - 100,000 μg/ml Custom Volatiles Mix B, appropriate amount of some neat compounds, and bringing to 50 ml with methanol.

- 100 μg /ml gas mixture ***: The mixture is prepared at 100 μg /ml by measuring 1 ml of 2,000 μg /ml stock standard and bring to 20 ml with methanol.
  ******* Gas mixture should be prepared weekly.

Table 8. STANDARD PREPARATION (Continued)

D).1 Initial Calibration Standards: using DI water bring to 50 ml final volume: all mixtures used should be **secondary dilution** standards at **100 ppm**.

Standard and Surrogate Concentration	V8260 Mix (100 ppm)	V8260 Custom Mix (100 ppm)	Gas compound Mix (100 ppm)	Surrogate Mix (100ppm)
1 ppb	0.5 µl	0.5 µl	0.5 µl	0.5 µl#
2 ppb *	1.0 µl	1.0 µl	1.0 µl	1.0 µl#
5 ppb	2.5 µl	2.5 µl	2.5 µl	2.5 µl#
10 ppb *	5 µl	5 µl	5 µl	5 µl#
20 ppb	10 µl	10 µl	10 µl	10 µl#
50 ppb	25 µl	25 µl	25 µl	25 µl#
100 ppb	50 µl	50 µl	50 µl	50 µl#
200 ppb	100 µl	100 µl	100 µl	100 µl#
300 ppb *	150 µl	150 µl	150 µl	150 µl#
400 ppb *	200 µl	200 µl	200 µl	200 µl#

* depending upon the instrument.
\# See Section 10.2.2.1 for correction factor.

- When calibrating for Method 5035 low-level soil samples, add 1g of sodium bisulfate to the 40-ml vial before aliquot 5 ml of each standard into vial. This is equivalent to the amount of sodium bisulfate added to the samples and will maintain a consistent purging efficiency of the compounds.

D).2 Initial Calibration Standards for 1,4-Dioxane using SIMS

Standard and Surrogate Concentration (ppb)	1,4-Dioxane Solution (100ppm)	Surrogate Mix (100ppm)	DI Water – Final Volume (ml)
2	2 µl	1 µl	100
5	5 µl	2 µl	100
25	25 µl	5 µl	100
50	25 µl	2.5 µl	50
100	50 µl	5 µl	50
200	100 µl	10 µl	50
400	200 µl	20 µl	50

Table 8. STANDARD PREPARATION (Continued)

E) Continuing Calibration Standard: using DI water bring to 50 ml final volume: All mixtures used are secondary dilution standards at 100 ppm.

Concentration	V8260 Mix (100 ppm)	V8260 Custom Mix (100 ppm)	Gas compound Mix (100 ppm)
50 ppb	25 µl	25 µl	25 µl

- When calibrating for Method 5035 low-level soil samples, add 1g of sodium bisulfate to the 40-ml vial before aliquot 5 ml of the continuing calibration standard into vial. This is equivalent to the amount of sodium bisulfate added to the samples and will maintain a consistent purging efficiency of the compounds.

F) Blank Spike (BS): using DI water bring to 50 ml final volume: All mixtures used are 100 ppm secondary dilution standards.

Concentration	V8260 Mix (100 ppm)	V8260 Custom Mix (100 ppm)	Gas compound Mix (100 ppm)
50 ppb	25 ul	25 ul	25 ul

For lower detection level required (test code: V8260LL)

Concentration	V8260 Mix (100 ppm)	V8260 Custom Mix (100 ppm)	Gas compound Mix (100 ppm)
20 ppb	10 ul	10 ul	10 ul

- When calibrating for Method 5035 low-level soil samples, add 1g of sodium bisulfate to the 40-ml vial before aliquot 5 ml of the blank spike into vial. This is equivalent to the amount of sodium bisulfate added to the samples and will maintain a consistent purging efficiency of the compounds.

Table 9. GUIDELINE FOR DILUTION PREPARATION

Water Sample

Dilution	Sample amount taken	Final volume A (volumetric)	Take from final volume A	Final volume B (volumetric)
1:2	25 ml	50 ml		
1:5	10 ml	50 ml		
1:10	5 ml	50 ml		
1:20	2.5 ml	50 ml		
1: 25	2 ml	50 ml		
1:50	1 ml	50 ml		
1:100	0.5 ml	50 ml		
1:200	250 µl	50 ml		
1:250	200 µl	50 ml		
1:500	100 µl	50 ml		
1:1000	50 µl	50 ml		
1:2000	25 µl	50 ml		
1:2500	20 µl	50 ml		
1:5000	10 µl	50 ml		
1:10000	0.5 ml	50 ml	0.5 ml	50 ml
1:20000	0.5 ml	50 ml	250 µl	50 ml
1:25000	0.5 ml	50 ml	200 µl	50 ml
1:50000	0.5 ml	50 ml	100 µl	50 ml
1:100000	0.5 ml	50 ml	50 µl	50 ml

Soil-Low level (Non-Encore sample)

Dilution	Sample amount taken	Final volume
1:2	2.5 gram	5 ml
1:5	1 gram	5 ml
1:10	0.5 gram	5 ml

Soil-medium level

Additional Dilution	Sample in Methanol amount taken	Final volume (volumetric)
1:1	1 ml	50 ml
1:2	0.5 ml	50 ml
1:5	200 µl	50 ml

1:10	100 µl	50 ml	
1:20	50 µl	50 ml	
1: 25	40 µl	50 ml	
1:50	20 µl	50 ml	
1:100	10 µl	50 ml	
1:200	5 µl	50 ml	
1:250	4 µl	50 ml	
1:500	2 µl	50 ml	

Table 10. REPORTING LIMITS

Compound	Water	Soil	Compound	Water	Soil
	µg/l	µg/kg		µg/l	µg/kg
Chlorodifluoromethane	5	5	Chloroform	5	5
Dichlorodifluoromethane	5	5	Freon 113	5	5
Chloromethane	5	5	Methacrylonitrile	10	10
Vinyl chloride	5	5	Butyl Acetate	5	5
Bromomethane	5	5	1,1,1-Trichloroethane	5	5
Chloroethane	5	5	Heptane	5	5
Trichlorofluoromethane	5	5	n-Propyl acetate	5	5
Ethyl ether	5	5	2-Nitropropane	10	10
Acrolein	50	50	Tetrahydrofuran	10	10
1,1-Dichloroethene	2	2	2-Chloroethyl Vinyl Ether	20	20
Tertiary butyl alcohol	50	50	n-Butyl alcohol	250	250
Acetone	5	5	Cyclohexane	5	5
Methyl acetate	5	5	Carbon Tetrachloride	1	1
Allyl chloride	5	5	1,1-Dichloropropene	5	5
Acetonitrile	100	100	Isopropyl Acetate	5	5
Iodomethane	25	25	Benzene	1	1
Iso-butyl alcohol	50	50	1,2-Dichloroethane	2	2
Carbon disulfide	5	5	Trichloroethene	1	1
Methylene chloride	2	2	Methyl methacrylate	10	10
Methyl tert butyl ether	1	1	1,2 Dichloropropane	1	1
Trans-1,2-Dichloroethene	5	5	Di-isobutylene	5	5
Di-isopropyl ether	5	5	Dibromomethane	5	5
2-Butanone	5	5	1,4 Dioxane	125	125
1,1-Dichloroethane	2	2	Bromodichloromethane	1	1
Hexane	5	5	cis-1,3-Dichloropropene	1	1

Chloroprene	5	5	4-Methyl-2-pentanone	5	5
Acrylonitrile	5	5	Toluene	1	1
Vinyl acetate	10	10	trans-1,3-Dichloropropene	1	1
Ethyl acetate	5	5	Ethyl methacrylate	10	10
2,2-Dichloropropane	5	5	1,1,2-Trichloroethane	3	3
Cis-1,2-Dichloroethene	5	5	2-Hexanone	5	5
Bromochloromethane	5	5	Cyclohexanone	5	5

Table 10. REPORTING LIMITS (Continued)

Compound	Water	Soil	Compound	Water	Soil
	µg/l	µg/kg		µg/l	µg/kg
Tetrachloroethene	1	1	4-Chlorotoluene	5	5
1,3-Dichloropropane	5	5	1,3,5-Trimethylbenzene	5	5
Dibromchloromethane	5	5	tert-Butylbenzene	5	5
1,2-Dibromoethane	2	2	1,2,4 Trimethylbenzene	5	5
Chlorobenzene	2	2	sec-Butylbenzene	5	5
1,1,1,2-Tetrachloroethane	5	5	1,3-Dichlorobenzene	5	5
Ethylbenzene	1	1	p-Isopropyltoluene	5	5
M,p-Xylene	1	1	1,4-Dichlorobenzene	5	5
o-Xylene	1	1	1,2-Dichlorobenzene	5	5
Styrene	5	5	n-Butylbenzene	5	5
Bromoform	4	4	1,2-Dibromo-3-choropropane	10	10
Isopropylbenzene	2	2	1,2,4-Trichlorobenzene	5	5
Bromobenzene	5	5	Hexachlorobutadiene	5	5
1,1,2,2-Tetrachloroethane	2	2	Naphthalene	5	5
Trans-1,4-Dichloro-2-butene	5	5	1,2,3-Trichlorobenzene	5	5
1,2,3-Trichloropropane	5	5	Epichlorohydrin	100	100
n-Proplybenzene	5	5	3-Methyl-1-butanol	5	5
2-Chlorotoluene	5	5	Hexachloroethane	5	5
Ethanol	50	--	Methyl Acrylate	5	--
Benzyl Chloride	1	--			

Table 11. COMPOUNDS THAT MAY EXHIBIT CARRYOVER

Compound
1,2,4-Trichlorobenzene
Hexachlorobutadiene
Naphthalene
1,2,3-Trichlorobenzene

Accutest Laboratories
Standard Operating Procedure

FN: EGN007-08
Pub. Date: 12/07/1990
Rev. Date: 09/22/09
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Lab Manager:___________________

QA Manager:___________________

Effective Date:______________________

TITLE: PERCENT SOLIDS and TOTAL SOLIDS in SOIL/SOLID MATRICES

METHOD REFERENCES: SM18 2540G , ASTM Method D4643-00

Revised Sections: *1.3, 6.2*

1.0 SCOPE AND APPLICATION

1.1 This method is for the measurement of the percent solids or total solids in samples of soil, sludge, or other solid material. This method is based on a method SM18 2540G and on ASTM method 4643-93.

1.2 The oven drying techniques for percent solids as described in this SOP can be applied to any sample type where percent solids can be determined. The microwave drying technique for percent solids described in this SOP can only be applied to samples which do not fall into the categories listed: lower percent solids (<50%), sludges or any other sample with a high organic content, samples containing high amounts of hydrated materials or larger clumps or particles, and samples with high TDS in the pore water (i.e. marine deposits). In addition, samples designated for hexavalent chromium analysis or NYASPB reporting cannot be dried in the microwave.

1.3 Sludge samples for regulatory reporting must follow the sludge procedure outlined in this SOP. These samples are tracked using the product code SLDGSOL

2.0 SUMMARY OF METHOD

2.1 A homogeneous aliquot of sample is placed in a tared dish and weighed. The wet sample is then dried to constant weight. The difference between the initial and final weight indicates the amount of water in the sample. Percent solids are calculated using the dry weight of the sample divided by the total weight of the sample. Percent moisture is calculated using the weight of water in the sample divided by the total weight of the sample.

3.0 REPORTING LIMIT AND METHOD DETECTION LIMIT

3.1 Not applicable.

4.0 DEFINITIONS

<u>BATCH</u>: A group of samples which behave similarly with respect to the sampling or the testing

procedures being employed and which are processed as a unit. For QC purposes, if the number of samples in a group is greater than 20, then each group of 20 samples or less will all be handled as a separate batch.

MATRIX: The component or substrate (e.g., water, soil) which contains the analyte of interest.

MATRIX DUPLICATE (DUP): A duplicate sample is digested at a minimum of 1 in 20 samples. The relative percent difference (RPD) between the duplicate and the sample should be assessed.

5.0 HEALTH AND SAFETY

5.1 The analyst must follow normal safety procedures as outlined in the Accutest Laboratory Chemical Hygiene Plan. Always wear a lab coat and glasses and the appropriate gloves when analyzing samples for percent solids.

6.0 COLLECTION, PRESERVATION, AND HOLDING TIME

6.1 No specific holding time is in place for the calculation of percent solids in soil samples. The samples should be stored at 0 to 4°C until the time of analysis.

6.2 Sludge samples for regulatory reporting must be analyzed within 7 days from time of collection.

7.0 APPARATUS AND MATERIALS

The items listed below are needed for the sample analysis.

7.1 Crucibles. Capable of heating to 105°C and capable of being heated in a microwave.

7.2 Two or three place balance. All balances must have their calibration verified with Class S weights daily before the analysis of each batch of samples. Note: A 3 place balance is required for CLP samples.

7.3 Stainless Steel or Teflon coated Spatulas

7.4 Drying oven capable of maintaining a constant temperature at 103 to 105°C.

7.5 Variable temperature microwave oven.

7.6 Dessicator with dessicant.

8.0 STANDARDS AND REAGENTS

8.1 No special standards or reagents are required for this method.

9.0 INTERFERENCES

9.1 When heated at 103 to 105°C, samples will lose moisture, but can also lose certain volatile components and ammonium carbonate. When heated in the microwave, there is a possibility that the soil is overheated if the microwave is not cycled properly. Microwave heating should not be used for any samples with high organic content (black or oily appearance), with low percent solids (50% or less), or on soils containing significant amounts of hydrated materials or soils in which the pore water contains high dissolved solids (for example, marine deposits).

10.0 SAMPLE CLASSIFICATION PROCEDURE.

10.1 Each sample must first be classifed as one of the following three types; a) a soil or solid that can be analyzed using the microwave method, b) a soil or solid that can be analyzed using the oven %solids method, or c) a sludge being analyzed for regulatory purposes that must use the sludge method. Classify the sample for analysis by microwave or oven. Certain sample types and certain protocols do not allow for the use of the microwave method. Samples which fall into any of the categories listed below should not be analyzed using the microwave.

10.1.1 Soils or solids to be analyzed by the microwave method must not be in any of the following categories.

10.1.1.1 Any NYASPB samples.

10.1.1.2 Any samples requiring analysis for hexavalent chromium (XCr).

10.1.1.3 Any samples with high organic content.

10.1.1.4 Any samples containing significant amounts of hydrated materials or with larger clumps or particles.

10.1.1.5 Any samples with low percent solids (< 50%).

10.1.1.6 Any samples in which the pore water contains high dissolved solids (for example marine deposits.)

10.1.1.7 Any sludge samples being reported for regulatory purposes.

10.1.2 Soils or solids to be analyzed by the oven %solids method can be any soils or solids that are not sludge samples being reported for regulatory purposes.

10.1.3 Sludges to be reported for regulatory purposes must be analyzed following the sludge %solids/total solids method.

11.0 MICROWAVE ANALYSIS METHOD FOR PERCENT SOLIDS/PERCENT MOISTURE

11.1 Dry the crucibles to be used at 103 to 105°C for a minimum of 1 hour or for 20 minutes at 50 to 70 percent power in the microwave. Allow to cool in a dessicator.

11.2 Tare the balance to zero. Before weighing any samples, make sure that the balance calibration has been checked with at least 2 class S weights covering the range of use before calibration and meets the specifications listed in front of the balance log. Normally 3 weights are used.

11.3 After the balance has been tared, weight the crucible(s) and record the weights. This may be done electronically or manually.

11.4 Mix the sample well using a stainless steel or teflon coated spatula. Do not just mix the top of the sample, but make sure that the whole sample is well mixed. Remove any stones, twigs, etc. from the sample.

11.4.1 If the sample jar is too full or the sample is difficult to mix, then empty the sample into a large stainless steel or ceramic bowl and stir well there before taking a sample aliquot.

11.5 Remove approximately a 5 to 20 g aliquot from the mixed sample and place it in the tared crucible. For at least one sample of every 20, set up a sample duplicate.

11.5.1 For any samples where it is difficult to obtain a representative sample aliquot, increase the sample aliquot size to 25 to 50 g.

11.5.2 If limited sample is available, smaller weights may be used if the aliquots are well homogenized.

11.5.3 Using the spatula, crush any large lumps in the aliquot to be weighed and dried.

11.6 Place a batch of 20 samples in the microwave and dry them for approximately 10 minutes at 50 to 70 percent power. Let the samples cool for 5 minutes and then dry them for an additional 10 minutes at 50 to 70 percent power.

11.6.1 Power levels and times will need to be adjusted for smaller batches of samples. Check with area supervisors for assistance.

11.7 Remove the samples and let cool for 5 minutes. If they are going to be out for longer than 10 minutes, place them in a dessicator before weighing.

11.8 Weigh the samples on the balance and record the final weights. This can be done manually or electronically. Take at least 2 samples and stir them with a spatula, making sure not to retain any sample particles on the spatula. The 2 samples used for this check should be the 2 that have the highest moisture content (lowest percent solids) in the batch. Any samples with < 50% solids must be submitted for redo using the oven drying method.

11.9 Place these 2 samples back in the microwave and microwave for 3 to 5 minutes at 50 percent power. Remove the samples and let cool for 5 minutes.

11.10 Weigh the samples on the balance and record the final weights. Again, this can be done either manually or electronically.

11.10.1 If the sample weights on the redry differ by more than 0.05 g or 4%, whichever is less, from the previous weights, then then the whole batch should be stirred and redried until all percent solids agree within this criteria.

12.0 OVEN ANALYSIS METHOD FOR PERCENT SOLIDS/PERCENT MOISTURE (NOT TO BE USED FOR SLUDGES).

12.1 Dry the crucibles to be used at 103 to 105°C for a minimum of 1 hour. Allow to cool in a dessicator.

12.2 Tare the balance to zero. Before weighing any samples, make sure that the balance calibration has been checked with at least 2 class S weights covering the range of use before calibration and meets the specifications listed in front of the balance log. Normally 3 weights are used.

12.3 After the balance has been tared, weight the crucible(s) and record the weights. This may be done electronically or manually.

12.4 Mix the sample well using a stainless steel or teflon coated spatula. Do not just mix the top of the sample, but make sure that the whole sample is well mixed. Remove any stones, twigs, etc. from the sample.

12.4.1 If the sample jar is too full or the sample is difficult to mix, then empty the sample into a large stainless steel or ceramic bowl and stir well there before taking a sample aliquot.

12.5 Remove approximately a 5 to 20 g aliquot from the mixed sample and place it in the tared crucible. For at least one sample of every 20, set up a sample duplicate.

12.5.1 For any samples where it is difficult to obtain a representative sample aliquot, increase the sample aliquot size to 25 to 50 g.

12.5.2 If limited sample is available, smaller weights may be used if the aliquots are well homogenized.

12.5.3 Using the spatula, crush any large lumps in the aliquot to be weighed and dried.

12.6 Place a batch of samples in the oven at 103 to 105°C. The samples must remain in the oven for a minimum of 1 hour and up to 24 hours. Drying times should not exceed 24 hours unless specific project instructions are being followed. .Record the drying time.

12.6.1 Samples with high organic content must stay in the oven for a minimum of 8 to 12 hours.

12.6.2 Remove the samples and let cool for 5 minutes. If they are going to be out for longer than 10 minutes, place them in a dessicator before weighing.

12.6.3 Weigh the samples on the balance and record the final weights. This can be done manually or electronically.

12.6.3.1 If the samples are in the oven less than 12 hours, then place all of the samples back in the oven for a minimum of 1 hour at 103 to 105°C.

12.6.3.2 If the sample weights on the redry differ by more than 0.05 g or 4%, whichever is less, from the previous weights, then then the whole batch must be stirred and redried until all percent solids agree within this criteria.

12.7 Percent solids are calculated using the equation shown below.

Percent moisure = 100 – percent solids.

$$\text{Percent solids} = 100 \times \frac{\text{(final dry weight + crucible) - crucible tare weight}}{\text{(wet weight + crucible) – crucible tare weight}}$$

13.0 ANALYSIS METHOD FOR PERCENT SOLIDS/PERCENT MOISTURE/TOTAL SOLIDS FOR SLUDGE MATRICES.

Below is a step-by-step procedure for the analysis of sludge samples for percent solids and percent moisture and total solids.

13.1 Dry the crucibles to be used at 103 to 105°C for a minimum of 1 hour. Allow to cool in a dessicator.

13.2 Tare the balance to zero. Before weighing any samples, make sure that the balance calibration has been checked with at least 2 class S weights covering the range of use before calibration and meets the specifications listed in front of the balance log. Normally 3 weights are used.

13.3 After the balance has been tared, weight the crucible(s) and record the weights. This may be done electronically or manually.

13.4 Mix the sample well using a stainless steel or teflon coated spatula. Do not just mix the top of the sample, but make sure that the whole sample is well mixed. Remove any stones, twigs, etc. from the sample.

13.4.1 If the sample jar is too full or the sample is difficult to mix, then empty the sample into a large stainless steel or ceramic bowl and stir well there before taking a sample aliquot.

13.5 Remove approximately a 25 to 50 g aliquot from the mixed sample and place it in the tared crucible. For at least one sample of every 10, set up a sample duplicate.

13.5.1 If limited sample is available, smaller weights may be used if the aliquots are well homogenized.

13.5.2 Using the spatula, crush any large lumps in the aliquot to be weighed and dried.

13.6 Place a batch of samples in the oven at 103 to 105°C. The samples must remain in the oven for a minimum of 8 hours and up to 24 hours. Drying times should not exceed 24 hours unless specific project instructions are being followed. .Record the drying time.

13.6.1 Remove the samples and place them in a dessicator to cool.

13.6.2 Once the samples are cool, weigh them on the balance and record the final weights. This can be done manually or electronically.

13.6.3 Then place all of the samples back in the oven for a minimum of 1 hour at 103 to 105°C. Repeat steps 13.6.1 and 13.6.2.

13.6.4 If the sample weights on the redry differ by more than 0.05 g or 4%, whichever is less, from the previous weights, then the affected sample(s) must be stirred and redried until all percent solids agree within this criteria.

13.7 Percent solids are calculated using the equation shown below.

Percent moisure = 100 – percent solids.

$$\text{Percent solids} = 100 \times \frac{(\text{final dry weight} + \text{crucible}) - \text{crucible tare weight}}{(\text{wet weight} + \text{crucible}) - \text{crucible tare weight}}$$

14.0 QC REQUIREMENTS

14.1 Each batch of 20 samples will include a duplicate sample. The exception is for sludge samples where a duplicate is required for one in 10 samples.

14.2 The limit for duplicate samples is 5 % RPD. If the RPD values are outside of this range, and all other method quality control is within limits, then sample non-homogeneity should be suspected. A description of the duplicate sample appearance should be provided for all batches where the 5% RPD is not met. In general, it is recommended that batches with samples with high RPD's be reanalyzed to confirm the original results.

$$\text{The calculation for \%RPD} = \frac{100 \times (\text{Sample result} - \text{Duplicate result})}{(\text{Sample result} + \text{Duplicate result})/2}$$

14.3 The balance calibration must be verified at a minimum of 2 levels bracketing the range of weights measured each day before use. The calibration must meet the specifications listed in the balance logbook. If they do not, the balance must be recalibrated and rechecked before any samples can be analyzed.

14.4 For samples dried in the microwave, a minimum of 2 redries is required for every 20 samples. For solid or soil samples dried in the oven, all samples must be redried if the original drying time is less than 12 hours. For sludge samples, all samples must be redried. Redries must match within 0.05 g or 4% of the original weight, whichever is less.

15.0 DOCUMENTATION REQUIREMENTS

15.1 All data regarding the analysis must be recorded on the data worksheet. Make sure that all sample information is included on these sheets. Any unusual characteristics of the samples should be noted in the comment section. This can be done electronically or manually. Make sure to double check crucible and sample ID's when they are recorded.

15.2 Initial balance calibrations must be recorded in the balance calibration check log for each balance.

16.0 DATA REVIEW AND REPORTING

16.1 All samples should be updated to QC batches in the LIMS system. The analyst is responsible for reviewing all data for compliance with the QC outlined in this SOP. They are responsible for making sure that the raw data is fully documented.

16.2 After the analyst review is completed, the supervisor or a designated reviewer shall review the run for technical compliance to the SOP. The supervisor is also responsible for making sure that the QC calculations are done correctly and responsible for reviewing the data entry into the LIMS. No LIMS entry review is necessary when the data is electronically transferred.

16.3 After the supervisor or designated reviewer completes their review, the data is released for client access in the LIMS. The raw data is submitted to the area manager. The manager will periodically review data for technical completeness. The raw data is then transferred to the report generation department.

17.0 POLLUTION PREVENTION & WASTE MANAGEMENT

17.1 Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents, and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids to the environment must be followed. All method users must be familiar with the waste management practices described in the waste management SOP.

17.2 Waste Management. Individuals performing this method must follow established waste management procedures as described in the waste management SOP, EHS004. This document describes the proper disposal of all waste materials generated during the testing of samples as follows:

17.2.1 Non hazardous aqueous wastes.

17.2.2 Hazardous aqueous wastes

17.2.3 Chlorinated organic solvents

17.2.4 Non-chlorinated organic solvents

17.2.5 Hazardous solid wastes

17.2.6 Non-hazardous solid wastes

ACCUTEST LABORATORIES
STANDARD OPERATING PROCEDURE

FN: EQA036-02
Pub Date: 7/20/2001
Rev Date: 10/20/2003
Page 1 of 6

Lab Manager:___________________

QA Manager:___________________

Effective Date:__________________

TITLE: DOCUMENTATION OF EQUIPMENT MAINTENANCE

Revised Sections*: *Modified 7.4, 10.1.1, 10.6 & 11.1

1.0 Scope & Application

1.1 Documenting procedures for the preventive maintenance, repair, and instrument removal from operation. Documentation occurs in individual instrument maintenance logbooks and on instruments as in or out of service.

2.0 Summary

2.1 Laboratory equipment requires routine preventive maintenance, repair by technical staff or outside vendors, and removal from service when the equipment is deemed inadequate to perform to a method specification. Proper documentation and/or labeling are required for these processes. With accurate and concise documentation, the maintenance history of an instrument can aid in future troubleshooting, prevention, and tracking repetitive problems.

3.0 Method Detection Limit: N/A

4.0 Definitions

DAILY MAINTENANCE. Procedures performed by the instrument operator prior to use of the instrument to assure that the equipment is in acceptable operating conditions.

LOCK OUT-TAG OUT. Safety procedures used by individuals performing instrument maintenance to assure that equipment being serviced does not inadvertently energize and cause injury to any individual within proximity of the equipment.

LOGBOOK. A bound series of forms used to record daily maintenance and non-routine maintenance activities.

NON-ROUTINE MAINTENANCE. Repair procedures that cannot be performed by in-house staff, which require the assistance of external service professionals.

5.0 Health & Safety

5.1 The analyst should follow normal safety procedures as outlined in the Accutest Laboratory Safety Manual and Accutest Safety Policy, which includes the use of safety glasses and lab coats. Handle all acids, which are corrosive with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact the supervisor.

5.2 Safety glasses must be worn when servicing any equipment.

5.3 Solvent resistant gloves when handling solvents for cleaning or rinsing components.

5.4 Power plugs must be unplugged when servicing electronic components.

5.5 Lock-out and Tag-out hardware must be used when equipment is hard wired for power.

6.0 Collection, Preservation, & Holding Times: N/A

7.0 Apparatus and Materials

7.1 Organics - GC/GCMS

7.1.1 Septum
7.1.2 Injection liners
7.1.3 Column ferrules
7.1.4 Injection port disc
7.1.5 Injection port Welman Assembly
7.1.6 Jet separator
7.1.7 Columns
7.1.8 FID jet
7.1.9 Mass Spec source parts

7.2 Organics - Concentrators

7.2.1 Purge tubes
7.2.2 Traps
7.2.3 Transfer lines
7.2.4 Syringe

7.3 Organics - ASE

7.3.1 Frits and O-rings (clog)

7.4 Inorganics - Metals

7.4.1 ICP/ICPMS torches
7.4.2 ICP/ICPMS nebulizers
7.4.3 ICP/ICPMS injector tubes
7.4.4 ICP/ICPMS pump tubings
7.4.5 ICP/ICPMS rinse lines
7.4.6 ICP/ICPMS internal standard mixing coils
7.4.7 ICP/ICPMS autosamplers
7.4.8 ICPMS cone
7.4.9 ICPMS skimmer cone

7.5 Inorganics - Wet chemistry

7.5.1 Lachat tubing
7.5.2 Lachat UV lamps
7.5.3 IC columns
7.5.4 IC tubing

7.5.5 TOX quartz wool
7.5.6 TOX pyrolysis
7.5.7 TOX electrodes
7.5.8 TOX O-rings
7.5.9 TOC Column catalyst
7.5.10 TOC needle
7.5.11 TOC O-rings
7.5.12 HG permeation tube
7.5.13 HG vapor/ liquid separator
7.5.14 HG Pump tubing
7.5.15 HG Lamp
7.5.16 HG Cell

7.6 General

7.6.1 Out of Service Labels
7.6.2 Lock-in Lock-out tags

8.0 Standards & Reagents

8.1 Polishing compound for GC/MS source cleaning.

8.2 Purge and trap grade methanol for source rinsing and transfer line flushing.

9.0 Interferences: N/A

10.0 Procedure – Modifications to instrument hardware during the performance of instrument maintenance procedures must be documented in the instrument maintenance logbook.

10.1 Organics - GC/GCMS. The following items must be checked and/or replaced at the specified frequency. GC/MS maintenance activities are performed daily.

10.1.1 Septum - replace daily or after 30 to 50 injections for semivolatile instruments; replace monthly or after 30 to 50 injections for volatile instruments.

10.1.2 Injection liners - replace or clean daily for semivolatile instruments.

10.1.3 Column ferrules - Replace when re-installing used columns or new columns.

10.1.4 Injection port disc - Clean with methanol and/or polishing compounds when buildup of sample residue or active sites affecting chromatography performance.

10.1.5 Injection port Welman Assembly - replace when leaks. Clean purge line when buildup of heavy boiling extract residues.

10.1.6 Jet separator - Clean when clogged.

10.1.7 Columns - Clip injection port side to eliminate active sites or residue buildup. Symptom of compound breakdown and sensitivity loss.

10.1.8 FID jet - Clean with methanol when clogged or loss of sensitivity.

10.1.9 Mass Spec source parts - Clean with polishing compound and methanol rinse when dirty. Symptom of sensitivity loss, high mass loss, and compound stability problems.

10.2 Organics - Concentrators. The following items must be checked and/or replaced at the specified frequency. Concentrator maintenance activities are performed daily.

10.2.1 Purge tubes - Rinse when sample residue is evident.

10.2.2 Traps - Bake out to remove residual contaminants. Replace when over contaminated as in sample foaming or performance degradation.

10.3 Transfer lines - rinse with methanol when contaminated or clogged.

10.4 Syringe - Clean with methanol and bake when sample residue evident. Perform daily.

10.5 Organics - ASE. The following items must be checked and/or replaced at the specified frequency.

10.5.1 Frits and O-rings - Clean with methanol when clogged or replace.

10.6 Inorganics - Metals. The following items must be checked and/or replaced at the specified frequency.

10.6.1 ICP/ICPMS torches - Clean or replace when loss in sensitivity.

10.6.2 ICP/ICPMS nebulizers - Clean or replace when clogged or contaminated affecting sensitivity.

10.6.3 ICP/ICPMS injector tubes - Clean or replace when clogged or contaminated affecting sensitivity.

10.6.4 ICP/ICPMS pump tubings - Clean or replace when clogged or contaminated.

10.6.5 ICP/ICPMS rinse lines - Clean or replace when clogged or contaminated.

10.6.6 ICP/ICPMS internal standard mixing coils - Clean or replace when clogged or contaminated.

10.6.7 ICP/ICPMS autosamplers - Clean the slides on the autosampler with methanol and wipe them with a KimWipe saturated with Teflon spray once per day.

10.6.8 ICPMS cone and skimmer cone - Clean when clogged or contaminated.

10.6.9 ICP vacuum instrument - Check and change the oil on the vacuum pump at a minimum of once every 6 months or whenever the vacuum is greater than 25 to 30.

10.7 Inorganics - Wet chemistry. The following items must be checked and/or replaced at the specified frequency.

10.7.1 Lachat tubing - Clean or replace when clogged or contaminated.

10.7.2 Lachat UV lamps - Replace when loss of sensitivity.

10.7.3 IC columns - Rinse or replace when chromatography is affected as in peak shape, peak separation and sensitivity variations.

10.7.4 IC tubing - Replace when clogged or contaminated.

10.7.5 TOX quartz wool - Replace when low recoveries observed.

10.7.6 TOX pyrolysis - Replace when badly devitrified or cracked.

10.7.7 TOX electrodes - Clean when oxidation coating is evident or loss in sensitivity on cell checks.

10.7.8 TOX O-rings - Replace when worn or leaking.

10.7.9 TOC Column catalyst - Replace when flow is reduced or particulate buildup.

10.7.10 TOC needle - Replace when worn.

10.7.11 TOC O-rings - Replace when worn or leaking.

10.7.12 HG permeation tube - Replace when loss of sensitivity.

10.7.13 HG vapor/ liquid separator - Replace when loss of sensitivity.

10.7.14 HG Pump tubing - Clean or replace when clogged or contaminated.

10.7.15 HG Lamp - Replace when loss of sensitivity.

10.7.16 HG Cell - Clean with residue buildup or replace when cracked.

10.8 General

10.8.1 Out of Service Labels - Any equipment that is deemed unusable or out of service for long term repair must be tagged with an out of service label until repaired or disposed of.

10.8.2 Lock-out Tag-out hardware - Any equipment that is hard wired must have Lock out tag on instrument along with circuit breaker panel to eliminate risk of injury of a premature power up by unaware personnel. This also applies to outside contractors servicing equipment.

10.8.3 Outside contractor service - Equipment being repaired by outside service personnel must also be documented in the instrument maintenance logbooks.

11.0 Quality Assurance

11.1 Supervisors must review and sign instrument maintenance logbooks quarterly.

12.0 Documentation

12.1 Documentation of all preventive maintenance and instrument repair must be recorded in individual instrument maintenance logbooks. Most of the routine preventive maintenance items are listed in the logbooks and checked off with date performed. Outside contractor repair is documented in detail under non-routine maintenance.

13.0 Data Review & Reporting

13.1 Supervisors must regularly review and sign instrument maintenance logbooks.

14.0 Pollution Prevention and Waste Management

14.1 Any solvents used for cleaning must be disposed in properly labeled container.

14.2 Waste Management. Individuals performing this method must follow established waste management procedures as described in the waste management SOP, ESM003. This document describes the proper disposal of all waste materials generated during the testing of samples as follows:

14.2.1 Non hazardous aqueous wastes.

14.2.2 Hazardous aqueous wastes

14.2.3 Chlorinated organic solvents

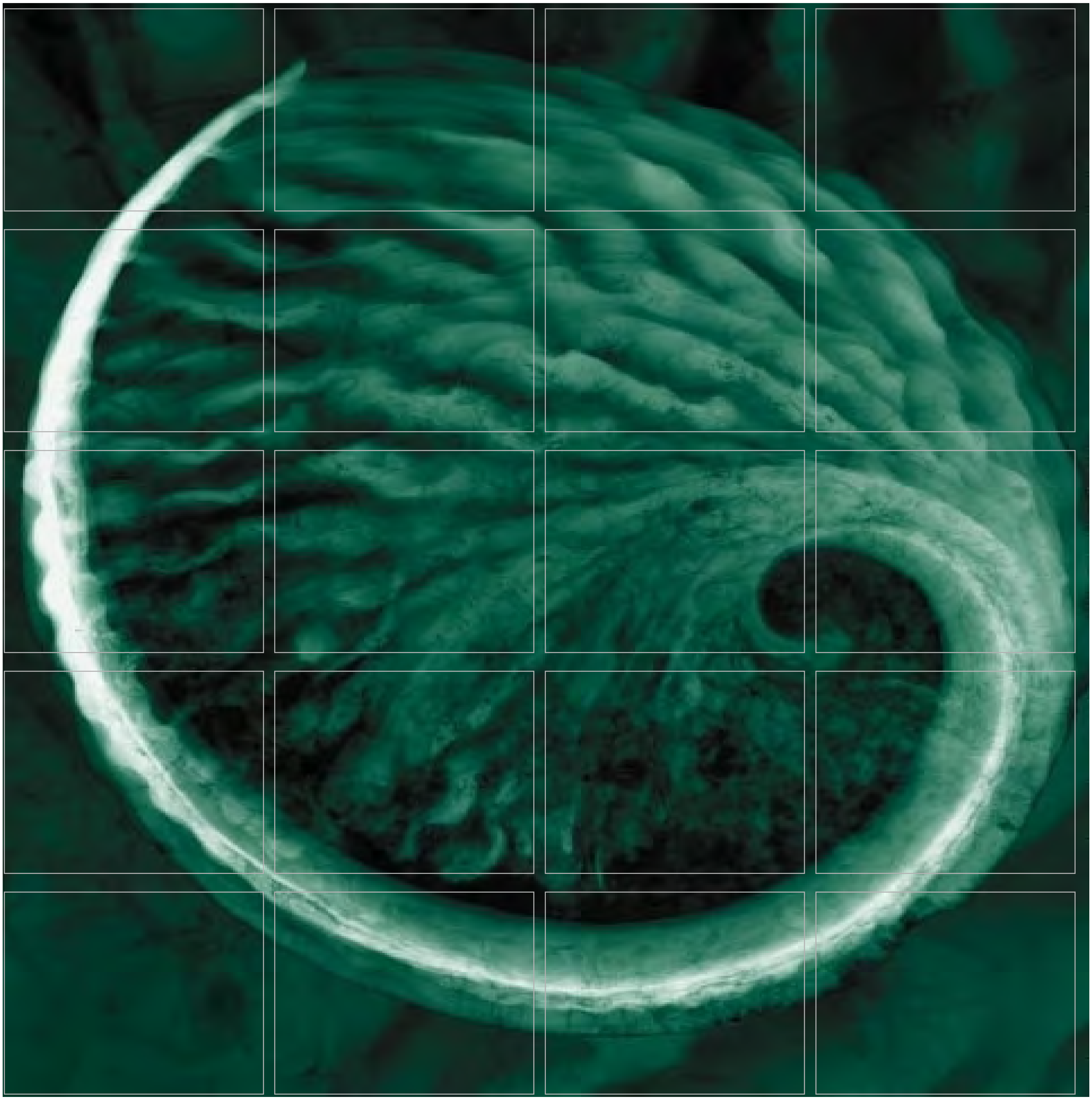
14.2.4 Non-chlorinated organic solvents

14.2.5 Hazardous solid wastes

14.2.6 Non-hazardous solid wastes

15.0 References: None

Appendix B - Health & Safety Contingency Plan



DRAFT Operable Unit 1
Health & Safety Contingency Plan

Fulton Avenue Superfund Site
150 Fulton Avenue
Garden City Park, Nassau County, New York

January 2010

www.erm.com

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Project No. 0097881

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SITE-SPECIFIC HEALTH AND SAFETY PLAN

ERM developed the following Health and Safety Contingency Plan (HASCP) for use by ERM personnel and by ERM contractors (individually, an "ERM Contractor" and collectively, "ERM Contractors"). ERM personnel must adhere to the practices and procedures specified in the HASCP. Each ERM Contractor must review the HASCP and agree to accept and abide by the HASCP, subject to any modifications to the HASCP (to address the ERM Contractor's more stringent practices and procedures) agreed upon in writing by ERM and the ERM Contractor. The ERM Contractor shall indicate such acceptance by signing this document prior to commencing work at the Site. However, if any ERM Contractor commences work at the Site, the ERM Contractor shall be deemed to have accepted the HASCP and the terms hereof and the failure to execute and return to ERM a copy of this notice shall not be relevant to such interpretation.

If a contractor or a person other than the Client, ERM employees and ERM Contractors (individually, a "Third Party" and collectively, "Third Parties") receives a copy of the HASCP, such Third Party should not assume that the HASCP is appropriate for the activities being conducted by the Third Party.

NO THIRD PARTY HAS THE RIGHT TO RELY ON THE HASCP. EACH THIRD PARTY SHOULD ABIDE BY ITS OWN SITE-SPECIFIC HEALTH AND SAFETY PLAN IN ACCORDANCE WITH ITS OWN PROFESSIONAL JUDGMENT AND ESTABLISHED PRACTICES.

ERM shall not be responsible for the implementation of any Third Party safety program(s), except to the extent otherwise expressly agreed upon by ERM and a Third Party in writing. The services performed by ERM for the Client and any right of the client and/or an ERM Contractor to rely on the HASCP shall in no way inure to the benefit of any Third Party, including, but not limited to, employees, agents, or consultants and subcontractors of ERM Contractors, so as to give rise to any cause of action by such Third Party against ERM.

The HASCP generated by ERM in connection with the Project is for use on a specific site and in connection with a specific project. ERM makes no representation or warranty as to the suitability of the HASCP for reuse on another site or as to the suitability of the HASCP for reuse on another project or for modifications made by the Client or a Third Party to the HASCP.

All entrants to portions of the jobsite controlled by ERM must sign the HASCP. Signing below certifies understanding and willingness to comply with the contents of this HASCP. ERM has prepared this plan solely for the purpose of protecting the health and safety of ERM employees. Subcontractors, visitors, and others at the site are required to follow provisions in this document at a minimum, but must refer to their organization's health and safety program for their protection.

Printed Name	**Signature**	**Company**	**Date**

1.0 PROJECT AND SITE INFORMATION

1.1 GENERAL PROJECT INFORMATION

ERM developed this HASCP for use on the Fulton Avenue Superfund Site Operable Unit 1 (OU1) Remedial Design (RD) and Remedial Action (RA) project.

The OU1 Remedy consists of two key components to actively address groundwater impacts directly attributable to the Avenue Superfund Site: 1) In-situ chemical oxidation (ISCO) treatment of the shallower groundwater at and near the 150 Fulton Avenue Property, and 2) extraction and treatment of PCE-impacted groundwater from the deeper Magothy aquifer at locations upgradient of impacted supply wells operated by the Garden City Water District (Well Nos. 13 & 14) followed by subsequent recharge of the treated groundwater to the Upper Glacial aquifer. Subsequent short-term performance and long-term effectiveness groundwater monitoring will be required

1.2 SITE DESCRIPTION & HISTORY

The property located at 150 Fulton Avenue, Garden City Park, Nassau County, New York (hereinafter, "the Fulton Avenue Property") is owned by Gordon Atlantic Corporation. It is located within the Garden City Park Industrial Area (GCPIA), Village of Garden City Park, Town of North Hempstead (TNH), Nassau County, New York. Figure 1 of the OU1 RD Work Plan shows the location of the 150 Fulton Avenue Property.

The Fulton Avenue Property has been identified as a contributing source of Tetrachloroethene (PCE) contamination of groundwater beneath the Site creating plumes in the Upper Glacial and Magothy aquifers which extend to the southwest, impacting certain public supply wells owned by the Incorporated Village of Garden City (Garden City).

The Fulton Avenue Property is listed on the Registry of Inactive Hazardous Waste Disposal Sites in New York State (Registry) as Site Number 130073. The United States Environmental Protection Agency (USEPA) also included the Fulton Avenue Property on the National Priorities List (NPL) of Federal Superfund Sites as part of USEPA's Fulton Avenue Superfund Site in April 1998.

The New York State Department of Environmental Conservation (NYSDEC) defines the "Site" as the 0.8-acre Fulton Avenue Property and environmental conditions, including groundwater contamination that has migrated beyond the property boundary (the "NYSDEC Site"). In contrast, the USEPA defines the Fulton Avenue Superfund Site as the 0.8-acre property located at 150 Fulton Avenue, Garden City Park, Nassau County, New York (hereinafter, the Fulton Property), all contamination emanating from the Fulton Property, as well all other contamination impacting the groundwater in the vicinity of the Fulton Avenue Property including an overlapping trichloroethene (TCE) -dominant plume in the Upper Glacial and Magothy aquifers, whose origin is currently unknown, and all sources of this contamination.

Between 1966 and 1977, several businesses conducted dry cleaning operations at the Site, and at some unknown time during this period, tetrachloroethene (a.k.a. perchloroethene or {PCE}) was apparently discharged to an on-Site storm water drywell. Studies indicate that groundwater beneath and downgradient of the GCPIA was found to be primarily impacted by the following chlorinated volatile organic compounds (VOCs):, PCE, trichloroethene (TCE), 1,2-dichloroethene (1,2-DCE) and 1,1,1-trichloroethane (1,1,1-TCA).

The source of the PCE contamination at the Fulton Property was identified as a former drywell which was subject to an interim remedial measure (IRM) that involved soil/sediment removal, air sparging (AS) and soil vapor extraction (SVE). The former dry well was closed as part of the IRM. The IRM removed an estimated 10,000 lbs of PCE during its period of operation (1999 – 2001). A sub-slab depressurization system was installed beneath the building at the conclusion of the Soil IRM to mitigate the potential for intrusion of soil vapor containing residual PCE into the existing building.

Between 1999 – 2006, a Remedial Investigation (RI), Exposure Pathways Analysis, Baseline Risk Assessment, and a Feasibility Study (FS) (collectively an "RI/FS") was performed under a NYSDEC Administrative Order on Consent (AOC), Index # W1-0707-94-08. The RI/FS focused on environmental conditions at the Fulton Avenue Property and contamination that has migrated beyond the property boundary.

The RI and FS Reports were reviewed by NYSDEC and USEPA, and approved under the AOC. At that point in time, lead-agency status changed from NYSDEC to USEPA. USEPA subsequently developed a Proposed Remedial Action Plan (PRAP) for OU1 which, following a public comment period, was finalized and presented a selected remedy in a Record of Decision (ROD) issued on 28 September 2007. The ROD defines OU1 as follows, "…includes a 0.8-acre property located at 150 Fulton Avenue, Garden City Park, Nassau County, New York (hereinafter, the Fulton Property), all contamination emanating from the Fulton Property, as well all other contamination impacting the groundwater in the vicinity of the Fulton Property including an overlapping TCE-dominant plume in the Upper Glacial and Magothy aquifers, whose origin is currently unknown, and all sources of this contamination."

During 2007 – 2009, USEPA issued a Statement of Work (SOW) for the OU1 RA and commenced negotiation with a number of potentially responsible parties (PRPs) to implement the RA set forth in the OU1 ROD. One of the identified PRPs, Genesco Inc. (Respondent) agreed to implement the OU1 RA and entered into a Consent Judgment (CJ) with USEPA.

The CJ (USEPA CJ No. CV–09–3917) and attached SOW were lodged with the United States District Court for the Eastern District of New York on 10 September 2009. Notice of the same inviting public comment was published in the Federal Register / Vol. 74, No. 179, 17 September 2009. On 18 November 2009, USEPA issued notice to proceed initiating the OU1 RD and subsequent implementation of the OU1 RA.

This OU1 Health and Safety Contingency Plan (HASCP) is an integral part of the OU1 Remedial Design (RD) Work Plan. The HASCP establishes ERM's occupational health and safety requirements, responsibilities and procedures to protect workers during the OU1 RD pre-design and design studies, groundwater monitoring and OU1 RA construction activities. The HASCP is a dynamic document that will be subject to revision as the OU1 RD/RA progresses. Revisions will likely be required to address changes in regulatory requirements or field conditions to ensure the protection of Site workers and the public.

1.2 CLIENT-SPECIFIC HEALTH & SAFETY REQUIREMENTS

There are no client-specific requirements for the work governed by this HASCP, other than those described in subsequent sections below.

2.0 KEY PROJECT PERSONNEL AND RESPONSIBILITIES

Table 2-1 includes the roles, names, contact information, and responsibilities of ERM personnel, ERM Contractors, and other individuals associated with the health and safety leadership of this project. This page must be posted on-site.

TABLE 2-1: Key Project Health & Safety Personnel

Role	*Person*	*Contact Information*	*Responsibilities*
Partner-In-Charge (PIC)	Jim Perazzo	Office: 631-756-8900 Mobile: 516-353-8849 E-mail: jim.perazzo@erm.com	Final authority in approving the HASCP and ensuring that the project team is supplied with the training, equipment and materials necessary for a safe work environment.
Project Manager (PM) or Construction Manager (CM)	Chris Wenczel	Office: 631-756-8900 Mobile: 516-315-8221 E-mail: chris.wenczel@erm.com	Implementing the requirements of the ERM Health & Safety Program on this project and maintaining management awareness of the project's health and safety status. Provide H&S leadership during project performance.
Field Safety Officer (FSO)	Justin Bunton (or designee)	Office: 860-466-8500 Mobile: 860-508-3239 E-mail: justin.bunton@erm.com	Assist the PM/CM by implementing HASCP on a day-to-day basis. Recognize significant H&S hazards and utilize STOP WORK authority when appropriate.
Subject Matter Expert	John Kuhn	Office: 716-633-3460 Mobile: 585-820-3957 E-mail: john.kuhn@erm.com	Assist in the recognition, evaluation, and control of hazards associated with the site.
ERM Employees	Listed on Signature Page	N/A	ERM employees will fully participate in the implementation of the HASCP by obtaining necessary training, attending site safety meetings, wearing designated PPE, complying with site H&S rules, and advising the FSO of H&S concerns at the site.
Client Contact	Roger Sisson, Esq.	Office: 615-367-7000	
Subcontractor Safety Contact	TBD before Mobilization	Office: Mobile: E-mail:	
Emergency Spill Response Contractor	TBD before Mobilization	Office:	
Local First Responders	Local Fire/Police	Office: 911	
Local Hospital (attach map)	Winthrop-University Hospital	Office: 516-663-0333	
Work Care/ Accident Intervention		1-888-449-7787	

3.0 EMPLOYEE TRAINING AND MEDICAL SURVEILLANCE REQUIREMENTS

All ERM and ERM Contractor personnel working on-site (including their on-site supervisors) who may be exposed to hazardous substances, health hazards, or safety hazards will not be permitted to participate in or supervise field activities until they have been trained to a level required by their job function and responsibility, and medically qualified to perform the work. Prior to mobilization, all site workers are required to have the following training and medical surveillance:

- Training meeting the requirements of 29 CFR 1910.120 or 29 CFR 1926.65 (as applicable), *Hazardous Waste Operations and Emergency Response (HAZWOPER)*;
- Site-specific permanganate safety training;
- Site-specific compressed gas safety training.

The PM/CM and FSO must possess additional training, as described below:

- ERM FSO training

The PM/CM will verify that site personnel have received all appropriate training as required by this HASCP prior to their arriving on-site by reviewing written training documentation. Copies of the written training documentation will be retained in the project file. ERM Contractor personnel will not be allowed to work at the site unless said training documentation is available.

4.0 FIELD ACTIVITIES

4.1 MAJOR PROJECT TASKS

Major tasks to be performed by ERM personnel include the following:

- Oversight of ISCO system installation;
- Perform ISCO injections;
- Oversight of trenching and excavation;
- Oversight of groundwater extraction, treatment and recharge systems installation;
- Oversight of extraction well vault installation;
- Oversight of extraction well installations;
- Oversight of treatment facilities construction; and
- Groundwater sampling.

Major tasks to be performed by ERM contractor personnel include the following:

- ISCO system installation;
- Trenching and excavation activities;
- Groundwater extraction, treatment and recharge systems installation;
- Extraction well installations;
- Well vault installation; and
- Treatment facilities construction.

Each of the tasks above has a Safe Work Practice (SWP) associated with it, or Job Hazard Analysis (JHA) prepared for it. SWPs and JHAs are further described below.

4.2 SITE PERSONNEL JOB TASKS & CERTIFICATION REQUIREMENTS

Workers with the following job descriptions will be engaged in activities conducted at the site.

Excavator Operator - The excavator operator operates the excavator from within the boundaries of each impoundment. The work is performed approximately eight hours per working day

Truck Driver - The truck driver operates the vehicle from the cab. Trucks are utilized for hauling excavated materials. The work is performed approximately eight hours per working day.

Laborers – Field laborers will be utilized during completion of all work activities. In addition to providing assistance where needed for those activities listed in Section 4.1, other work duties will include, but are not limited to, construction of site structures (decontamination pad, trailer set up/renovation), welding, saw cutting, operation of stormwater pumps, equipment decontamination, and general site and equipment upkeep and maintenance.

Excavation/Trenching Competent Person(s)- One who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Other visitors to the site not directly involved in proposed work activities (i.e., various Terminal employees and contractors) will be considered in the HASCP as technical personnel listed above.

5.0 HAZARD IDENTIFICATION AND CONTROL

5.1 JOB HAZARD ANALYSES

Prior to initiating any new project activity not covered by a Safe Work Practice, or when there is a change in site conditions, the FSO will assist project team members in completing a Job Hazard Analysis (JHA). The JHA will list the hazards associated with the project activity as well as associated control strategies. JHAs for the tasks listed in Section 4.1, as well as a blank copy of the JHA form, are located in Appendix B.

5.2 SAFE WORK PRACTICES

ERM has established Safe Work Practices (SWP) which define minimum requirements for controlling hazards related to the work and surroundings for specific work tasks commonly by ERM employees. As such, jobsite tasks whose hazards are identified and controlled by use of a SWP do not require JHAs to be developed for them. Copies of the SWPs that have been identified as pertinent to the hazards inherent in the work for this project are identified in the table of contents and have been included in the Attachments section of this document.

5.3 SITE INSPECTIONS

The FSO or designee will inspect the job site at least once per day using the Site Walk Checklist in Appendix D as a guide. Completed checklists will be retained in the site safety file.

5.4 BEHAVIOR-BASED SAFETY

Everyone on-site as part of this project will make a commitment to work safely and to look out for others on the job site. A tool will be used to help ERM personnel and ERM Contractors to think about the safety related aspects of the work at hand, as described in applicable JHAs.

Prior to the start of each work day, workers will complete a Personal Safety Contract (PSC). By completing their PSCs each day, site workers agree to make a daily commitment to their own safety and the safety of those around them. The PSC helps workers think about proper work techniques, appropriate PPE, and ambient site conditions immediately prior to beginning a work task. The PSC for a particular task is based on the JHA developed for that task. A copy of the PSC is located in Appendix E. All PSCs must be turned in to the FSO at the end of the work day or shift.

5.5 STOP WORK AUTHORITY

It is ERM policy that all site personnel have the authority, without fear of reprimand or retaliation to:

- **Immediately** stop any work activity that presents a danger to the site team or the public; and

- Get involved, question, and rectify any situation or work activity that is identified as not being in compliance with the HASCP or with broader ERM health & safety policies.

All site personnel are empowered to identify and correct Unsafe Acts, Unsafe Conditions and Near Misses before they can cause an Incident (see Section 13). After all:

You see it, you own it!

If someone utilizes their Stop Work Authority, then work can only be restarted by the FSO, in concert with the CM/PM, PIC and ERM Coordinator.

5.6 CHEMICAL HAZARDS

Chemicals may be introduced into the body by ingestion, inhalation, or absorption through the skin. Since not all chemicals have the same level of toxicity, the length of time for the exposure and the concentration of the chemical are important in determining the risk. Inhalation and skin contact are the most common routes of entry. Chemicals can be introduced into the body by ingestion when chemicals present on the hands are transferred to food or cigarettes.

Based on historical soil and groundwater sampling, the following constituents of concern listed in Table 5-1, as well as chemicals brought to the site by ERM or contractors listed in Table 5-2 may be encountered at the site. Material Safety Data Sheets for the constituents of concern are located in Appendix G.

TABLE 5-1: Constituents of Concern

PCE
TCE
1,2 DCE
1,1,1 TCA

Table 5-2 shows chemicals that are routinely used by ERM at the site as part of the project. The MSDS for these chemicals are located in Appendix G.

TABLE 5-2: Chemicals Used for Project Execution

- Isopropyl Alcohol
- Liquinox
- Gasoline
- Diesel
- Hydrogen Peroxide (35% solution)
- Sodium Thiosulfate
- PVC Cement
- Isobutylene Balance Air (calibration gas)
- Potassium Permanganate
- Sodium Permanganate
- Acetic Acid (household vinegar)
- Compressed Nitrogen Gas

5.7 AMBIENT AIR MONITORING

Ambient air monitoring should be conducted by the FSO when there is a question of employee exposure to hazardous concentrations of substances to assure the proper selection of engineering controls, work practices, and PPE.

Additional monitoring should be conducted under any of the following circumstances.

- Work begins on a different portion of the site;
- Change in job tasks;
- Change in weather;
- Change in ambient levels of hazardous constituents as indicated by the sense of smell or changes in the physical appearance of the soil or groundwater;
- When new hazardous substances are encountered; and
- During high-risk operations (e.g. drum opening, or handling of leaking drums, or when working in areas with obvious liquid contamination).

Ambient air monitoring will be conducted using direct-reading, real-time instruments as indicated in Table 5-3. If more that one instrument is listed, either instrument may be chosen. Not all work at the site will require ambient air monitoring for all contaminants. During the mobilization phase of a particular project task or activity, either the PM or the FSO will determine what contaminants may be encountered in order to have the appropriate instrumentation on-site. The Project Health and Safety Consultant is available to assist the PM or the FSO in determining the appropriate instrumentation.

TABLE 5-3: Ambient Air Monitoring Instruments

Constituent	***Instrument***
Organics	OVM Model 580B with 10.6 eV lamp or MiniRae 2000 with 10.6 eV lamp or equivalent – if you are unsure what kind of organic vapor monitor to use based on the contaminants of concern, contact your OpCo H&S representative. Remember, straight chain hydrocarbons do not register well on PID units and a FID may be required.

Direct reading instrumentation will be calibrated daily per manufacturer's instructions. Cylinders of the appropriate calibration gas will be required for fieldwork lasting longer than one day.

Under stable site conditions, ambient air monitoring will be conducted at least once every two hours in the workers' breathing zone and at other locations based on the professional judgment of the FSO or the Subject Matter Expert. Ambient air monitoring results will be recorded on the Ambient Air Monitoring Form found in Appendix H. If site conditions become unstable or change dramatically, ambient air monitoring will be conducted more frequently based on the professional judgment of the FSO or the Subject Matter Expert.

Table 5-4 outlines the steps to be taken by the FSO when the action levels of the various contaminants are exceeded. Respiratory protection is selected based on occupational exposure limits of the constituents at the site and the potential for exposure to vapors and dust from site activities.

TABLE 5-4: Action Levels and Response Actions Requirements

Chemical	*Action Level*	*Response Actions*
Organics	PID reads 25 ppm sustained in the breathing zone for 1 minute	Stop work and workers leave immediate area • FSO evaluates need for Tyvek coveralls, dons half-face respirator with organic vapor cartridges and monitors again after allowing vapors to dissipate. • If readings are less than 25 ppm, resume work. • If readings are 25 ppm or greater, contact project PIC, PM and H&S Officer to evaluate control options
	PID reads 50 ppm sustained in the breathing zone for 1 minute	• Stop work and workers leave immediate area. • Contact PM and Subject Matter Expert. • Evaluation work practices and assess engineering controls to reduce airborne concentrations. • FSO waits 15 minutes, evaluates need for Tyvek covers, dons half-face respirator with organic vapor cartridges, approaches work area slowly, if PID reaches 50 ppm, back out and wait an additional 15 minutes before repeating monitoring.

6.0 PERSONAL PROTECTIVE EQUIPMENT

The level of PPE selected for a task is based on the following:

- Type and measured concentration of the chemical substance in the ambient atmosphere and its toxicity;
- Potential for exposure to substances in air, splashes of liquids, or other direct contact with material due to work being done; and
- Knowledge of chemicals on-site along with properties such as toxicity, route of exposure, and contaminant matrix.

In situations where the type of chemical, concentration, and possibilities of contact are not known, the appropriate level of protection must be selected based on professional experience and judgment until the hazards can be better identified.

In addition to summarizing the general PPE requirements for tasks performed at the site, Table 6-1 also serves as the written certification that the PPE Hazard Assessment has been conducted. The signature page containing the client's name, project name and number, date and signatures of the parties responsible for the development of the HASCP also serve as part of the written certification.

6.1 RESPIRATORY PROTECTION

The type of respiratory protection required will be based on the results of ambient air monitoring, the results of any models used to predict ambient air concentrations, and the professional judgment of either the FSO or the Project Health and Safety Consultant. Respiratory protection requirements are outlined on Table 5-4, above.

TABLE 6-1: Personal Protection Equipment Requirements

PPE Level	***Ensemble Components***	***Tasks Requiring Use***
Level D Should be worn only as a work uniform and not in any area with respiratory or skin hazards. It provides minimal protection against chemical hazards.	• Long pants and shirt with sleeves. • Safety-toed footwear. • Safety glasses with molded side shields. • Hard hat. • General purpose work gloves if task does not involve water or wet materials. • Hearing protection. • High visibility traffic vest. • Nitrile Gloves	ISCO system installation Trenching and excavation activities Pump and Treat system installation Recovery well installation Groundwater sampling
Modified Level D	Level D and the following (as appropriate): • Disposal Tyvek coveralls. • Safety-toed rubber boots or disposable boot covers over shoes. • Thin nitrile gloves.	ISCO Injection Well vault installation

	• Green nitrile gloves over thin nitrile gloves when primary gloves may tear or puncture. • Splash protective goggles • Face shields • Heat protective leather gloves and aprons • Welding shields or goggles	
Level C Should be worn when the criteria for using air-purifying respirators are met, and a lesser level of skin prot1ection is needed.	Level D or Modified Level D and the following: • Air purifying respirator with combination organic vapor/high efficiency particular air (HEPA) cartridges.	Tasks requiring Level C PPE are not anticipated during this project. If Level C PPE is needed, as determined by the FSO and/or the Project Health and Safety Consultant, the HASCP will be revised.
Level B Should be worn when the highest level of respiratory protection is needed, but a lesser level of skin protection is needed.	Not anticipated to be required	Tasks requiring Level B PPE are not anticipated during this project. If Level B PPE is needed, as determined by the FSO and/or the Project Health and Safety Consultant, the HASCP will be revised.
Level A Should be worn when the highest level of respiratory, skin, and eye protection is needed.	Not authorized for this project	Tasks requiring Level A PPE are not authorized during this project. If Level A PPE is needed, as determined by the FSO and/or the Project Health and Safety Consultant, contact the North America H&S Leader for assistance.

7.0 MEDICAL SUPPORT REQUIREMENTS

First aid supplies will be made available to all personnel on-site. A list of first-aid supplies on-hand at the project site include:

- Construction bulk first-aid kit (for up to 10 people at minimum).
- Temporary eyewash station will be set up on site and maintained as needed.

For the duration of the project, at least one individual currently certified to render emergency first aid and/or CPR will be present during all work activities. Additional medical surveillance will be provided for employees who are injured, become ill, or develop signs or symptoms due to possible exposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation.

8.0 SITE INFRASTRUCTURE, CONTROL, AND GENERAL RULES

8.1 INFRASTRUCTURE

8.1.1 Smoking and Eating Areas

Smoking will only be allowed in designated areas. Upon mobilization at the site, the FSO will establish smoking areas per site-specific or client-specific requirements. Individuals caught smoking outside the designated smoking areas will be subject to disciplinary action.

Upon mobilization at the site, the FSO will establish eating and break areas per site-specific or client-specific requirements. Eating will only be allowed in the designated areas and the areas will be maintained in a clean and sanitary condition. Employees will wash their hands before entering eating areas.

8.1.2 Sanitation and Potable Water

Containers used for drinking water will be equipped with a tap and capable of being tightly closed. In addition, the container will be labeled as "Drinking Water" or "Potable Water." Disposal cups will be stored in a sanitary condition and a receptacle for disposing of the cups will be near-by.

Potable and non-potable water containers and portable toilets (if used) will comply with OSHA 29 CFR 1910.141 requirements.

8.1.3 Temporary Facilities

Temporary sanitary facilities will be made available in each work area upon site mobilization.

Trailers and other temporary structures used as field offices or for storage will be anchored with rods and cables or by steel straps to ground anchors. The anchor system will be designed to withstand winds and must meet applicable state or local regulations for the anchoring of mobile trailer homes.

All temporary facilities will be maintained in a clean and sanitary condition to discourage the entrance of rodents or vermin. If rodents or vermin become an issue, the FSO will be responsible for implementing an extermination program per site-specific or client-specific guidelines.

8.1.4 Safety Equipment

A first aid kit containing first aid items for minor incidents only, a fire extinguisher, and air horn are all maintained on each ERM site. ERM will ensure at least one member of the on site field staff is trained in First Aid and CPR.

The FSO will be responsible for ensuring that all fire extinguishers are inspected monthly as required by 29 CFR 1910.157 *Portable Fire Extinguishers*. The monthly inspections will be documented on a tag attached to each extinguisher or a master list of fire extinguishers and their location. If the duration of the project exceeds one year, the FSO will contract with an outside vendor to perform the annual maintenance on all fire extinguishers.

Eye wash stations will be located at the following designated locations:

- Temporary eyewash stations will be set up where necessary during the ISCO injection phase of the project.

8.1.5 Communications

Cell Phones will be used as the primary means of communication between the project team members, contractors, and the client.

8.2 SITE CONTROL

Access to site activities is limited to authorized personnel (i.e., ERM, Subcontractors, Client Representatives, and Regulatory Agents). The names of ERM employees, Subcontractors, Client Representatives, and Regulatory Agents working at or visiting any work site shall be recorded in the field logbook.

Residents often wander into work area. Coning or taping off work areas will help to keep unauthorized personnel out of these areas. All ERM employees working in this area should have cell phones on their person, turned on, and the project team should have each other's numbers to facilitate communication.

During the ISCO portion of the project in order to minimize both exposure of unprotected personnel and migration of contamination due to tracking by personnel or equipment, work areas where intrusive site activities are conducted will be appropriately and clearly identified. The FSO will be responsible for establishing the following zones:

- The Exclusion Zone or "Hot" zone (EZ);
- Contamination Reduction Zone (CRZ); and
- The Support Zone.

Areas used for staging, storage, and mixing will be clearly identified to prohibit untrained personnel from entering those areas.

Eating, drinking, and smoking are prohibited in the EZ and CRZ with the exception of consuming fluids for rehydration purposes in the CRZ. When providing fluids for rehydration, single use disposable cups should be used to prevent contaminating "clean areas".

All open excavations or trenches will barricaded in a manner to keep unauthorized personnel away from the area. Open trenches and excavations left overnight must be fenced or barricaded to prevent access to the area.

Any work to be performed in the public roadway will be done with assistance of the Garden City Police (GCP) who will provide traffic control. Anyone working in or crossing into the public roadway must don a reflective traffic vest and cross with extreme caution, following any applicable traffic laws or instructions from the GPC.

Appropriate signage describing possible hazards and PPE requirements for each area of the site must be posted. Areas requiring signage include:

- ISCO chemical storage;
- ISCO treatment area;
- Treatment system housing;
- Site Entrance
- CRZ, EZ, SZ (during ISCO)

Refer ***ALL*** questions from interested persons such as residents, business owners, etc. to Chris Wenczel of ERM-Melville (631) 756-8900.

If, during the course of work, you are approached by individuals and a threat or confrontation is perceived, telephone the Garden City Police Department and request immediate assistance.

8.3 GENERAL SITE RULES

The following general rules will be adhered to at all times:

- All personnel entering the site must check in with the FSO.
- All personnel must sign in on the Daily Sign In sheet.
- All personnel entering the site must review the project HASCP and sign the HASCP acknowledgement page.
- All individuals entering the site must demonstrate to the FSO that they have been adequately trained as defined in Section 3.
- All individuals must be familiar with emergency communication methods and how to summon emergency assistance.
- Use of alcoholic beverages before, during operations, or immediately after hours is absolutely forbidden. Alcohol can reduce the ability to detoxify compounds absorbed into the body as the result of minor exposures and may have negative effects with exposure to other chemicals. In addition, alcoholic beverages will dehydrate the body and intensify the effects of heat stress.
- Horseplay of any type is forbidden.
- All unsafe conditions will be immediately reported to the FSO, who will document such conditions in the field log. The FSO will be responsible for ensuring that the unsafe condition is correctly as quickly as possible.
- No smoking, eating, chewing gum or tobacco, taking medication, or applying cosmetics in the Contamination Reduction Zone or the Exclusion Zone. Wash hands and face thoroughly prior to conducting the activities in the Support Zone.

- Smoking, matches, and lighters are only allowed in the designated smoking area.
- Avoid contact with potentially contaminated substances. Avoid, whenever possible, kneeling on the ground, or leaning or sitting on trucks, equipment, or the ground. Do not place equipment on potentially contaminated surfaces.
- If PPE becomes torn or saturated with contaminated material, immediately leave the Exclusion Zone, go through the decontamination steps, and replace the affected PPE. Additionally, wash any exposed skin thoroughly with soap and water.
- The FSO will be responsible for determining what site work can be performed safely in the rain and at what point work will cease due to either quality or safety issues. In the event of thunder and/or lightning, all work will be suspended until 15 minutes have elapsed from the last clap of thunder or flash of lightning. During rain, lightning and/or thunder events, site workers should seek shelter in either a building or vehicle. In the event of a tornado, site workers should seek shelter in a building, expect trailers, or in a low-lying area.

9.0 DECONTAMINATION PROCEDURES

Decontamination involves the orderly controlled removal of contaminants from both personnel and equipment. The purpose of decontamination procedures is to prevent the spreading of contaminated materials into uncontaminated areas. All site personnel should limit contact with contaminated soil, groundwater or equipment in order to reduce the need for extensive decontamination.

Equipment and materials used in the decontamination process may include the following:

- High pressure/hot water cleaning using only potable water/fire water;
- Phosphate-free detergent;
- Five-gallon bucket;
- Potable water;
- Distilled water;
- Paper towels; and
- Brushes.

9.1 PERSONNEL DECONTAMINATION

The following procedures will be utilized for personnel decontamination:

- Remove all PPE and dispose of the PPE in the designated drums or trash bags; and
- Wash hands and any skin that may have come in contact with affected soil or groundwater with moistened disposable towels, such as baby wipes, or soap and water.

9.2 EQUIPMENT DECONTAMINATION

The following will be required for equipment and tool decontamination:

- A decontamination area will be designated for cleaning all equipment that has been in contact with the site materials before leaving the site. All decontamination will be conducted on a pad with an impermeable synthetic liner and fluid-containment boom. Equipment will be placed on the pad and rinsed, brushed and/or steam cleaned to remove any contamination.
- Disposal of fluids generated from the decontamination process will be in accordance with approved work plans.
- Disposal of all solids collected within the decontamination pad and the pad liner will be in accordance with approved work plans.
- For major equipment, utilize a soap and/or water rinse and steam cleaning with temperature between 160 degrees to 180 degrees Fahrenheit with a pressure at or greater than 1,200 pounds per square inch (psi) will be the minimum required procedure.

10.0 SPILL CONTAINMENT PROGRAM

The spill contamination program for this project will involve the use of preventative measures in order to reduce the potential for environmental releases. These preventative measures will include the following:

- Equipment inspection;
- Staging equipment on containment pads;
- Secondary containment for fuel storage tanks; and
- General housekeeping practices.

If project activities involve the use of drums or other containers, the drums or containers will meet the appropriate DOT regulations and will be inspected and their integrity assured prior to being moved. Operations will be organized so as to minimize drum or container movement. Drums or containers that cannot be moved without failure will be over-packed into an appropriate container.

Further spill containment procedures are described below under ISCO Injection Section 11.1

11.0 PROJECT SPECIFIC TASKS

11.1 IN-SITU CHEMICAL OXIDATION (ISCO)

ISCO will be conducted in the Upper Glacial aquifer portion of the PCE-dominant plume. Approximately 10 chemical injection wells will be placed at and near the Fulton Property based on the results of the pre-remedial ISCO characterization activities. ISCO technology will be applied as an initial enhancement in the area at, and near the Fulton Property and two rounds of chemical injection are currently planned.

The purpose of ISCO would be to reduce the chemical mass in the PCE dominant plume in the Upper Glacial aquifer. ISCO application at or near the Fulton Avenue Property would reduce or eliminate a secondary source (i.e., elevated PCE concentrations in shallow groundwater) before it is able to migrate into deeper portions of the aquifer.

ISCO provides an effective method for the destruction of organic compounds and is commonly used for treatment of chlorinated ethenes such as PCE, and TCE, (the target constituents). Permanganate directly mineralizes the above chlorinated solvents to chloride and carbon dioxide as illustrated in the following reaction for PCE and TCE.

Either potassium or sodium permanganate would be injected. Potassium permanganate could be applied as either a solid or solution and sodium permanganate could be applied as a solution. Design studies will be conducted in order to determine the most appropriate and affective oxidant to use.

11.1.1 Site Preparation

1. Conduct a Site briefing amongst all Site personnel to review procedures, hazards, personal protective equipment, emergency contacts and notification, team responsibilities and general logistics required for this application program;
2. Define and demark work zone with caution tape, cones and/or physical barriers to limit access to only approved and trained Site personnel who may enter the work area;
3. Set up spill supplies as needed - secure neutralization solution, setup equipment storage and lay-down areas;
4. Ensure the neutralization solutions for spill response are present in the immediate work area(s), with additional supplies provided as needed in remote locations;
5. Inspect all well head, plumbing and piping and injection gallery connections to ensure presence of gate valve, pressure gauge, flow meter and check valve;
6. Designate appropriate work areas for personnel access, egress and equipment decontamination areas;
7. Record all starting flow meter readings;

8. Ensure the completion of a clean water test prior to the charging of any lines with oxidant;
9. Ensure necessary PPE is available tyvek suits, booties, chemical resistant gloves, goggle and face shields; and
10. Eyewash stations are in place and operational.

11.1.2 Line Leak Testing Procedure (Clean Water Test)

The following describes the procedure to test all lines before any oxidant is placed into the lines. This "clean water" test will be used to ensure that leaks or unsecured connections are located and repaired prior to starting any permanganate dispensing.

1. Review the procedures, hazards, and personal protective equipment required for this task;
2. Replenish safety supplies as needed;
3. Don the proper PPE (safety glasses, splash shield, Tyvek suit, and over boots or equivalent);
4. Evaluate the potential for heat/cold stress;
5. Evaluate plumbing and connections; visually inspect to ensure that all pipes are properly connected, and that the flow direction is labeled; inspect valves to ensure operation and proper positioning for the leak test;
6. Close all the injection valves;
7. Fill the system with water and pressurize by running the transfer pumps, recycling effluent water back to holding tank;
8. Visually inspect piping/equipment connections for leaks, and repair as needed; do not proceed with operation until any identified leaks are resolved. Inspect each piping run to the final distribution manifold, as appropriate;
9. Drain the water from the system; and
10. Close all valves and document leak test results.

11.1.3 Emergency Response and Contingency Plan

ERM has prepared this Emergency Response and Contingency Plan (ERCP) in support of implementation of the sodium/potassium permanganate injection activities at the Fulton Avenue Superfund Site. This ERCP documents the procedures for chemical handling, storage and contingency planning for the use of sodium/potassium permanganate and for the cleanup activities. These documents establish emergency response procedures required to minimize potential health and safety risks to site personnel, the general public and the environment, and also comply with OSHA 29 CFR 1910.120(q), EPA 40 CFR 264 Subpart D, and applicable State regulations.

ERM will conduct monitoring activities during the addition and post addition of the sodium/potassium permanganate. ERM, or its designees, will be prepared to respond to unanticipated releases of permanganate at the Site and offsite locations as detailed herein. A Site Supervisor will be on the Site at all times during the permanganate addition to provide continual support to the field staff and immediate communication with the office and additional support staff.

11.1.4 *Permanganate Use & Storage*

Chemical and Description	Amount Stored	Location (s) Stored	Notes
Sodium or Potassium Permanganate • $NaMnO_4$ or $KMnO_4$ dark purple liquid, non odorous • CAS No. 10101-50-5 • 40% dark purple solution	• Maximum 2,000 gallons 40% solution (stored for < 1 month)	• Up to 20 steel 55-gallon shipping drums • Two 3,000 gallon conical bottom poly tanks • Temporary piping between containers and addition points	• Purpose: injected subsurface to destroy VOCs • RQ – 100 pounds * • DOT Label – Oxidizer 5.1
Permanganate Neutralization and Stain Removal			
Hydrogen Peroxide •CAS No. 7722-84-1 •35% solution •3% USP solution **Acetic Acid (Vinegar)** •CAS No. 7732-18-5 •Household grade (white or cider)	• Maximum of 150 gallons • Maximum of 50 gallons • Maximum of 5 gallons	• 15 gallon plastic containers stored in containment area • Small sprayers in work area for dilute solutions	• Purpose: used for personal stain removal and neutralization** • RQ – not applicable • DOT – not regulated
Permanganate Neutralization			
Sodium Thiosulfate • $Na_2S_2O_3$ solid • CAS No. 7772-98-7 • 10% solution	• Maximum 150 pounds or 100 gallons mixed solution	• Two sacks stored in the garage area (solutions made up as, and if, needed) • Spray bottles in field locations	• Purpose: neutralize spills of sodium permanganate • DOT Label – none

Notes:

RQ = Reportable Quantity

DOT = Department of Transportation

* = *Value is the Emergency Planning and Community Right to Know Action of 1986 (EPCRA) reporting value for potassium permanganate from the (Section 313 storage reporting requirements). An RQ for sodium permanganate is not included on this list. As a matter of practice, ERM considers any spills at more than 10 gallons to constitute a potentially reportable event*

** = *Hydrogen peroxide (3% USP grade from local stores) is mixed with vinegar (household from local store) and water to make a solution used for stain removal. This mixture ("salad dressing") also provides personal decontamination and neutralization. The "salad dressing":*

- *30 parts water*
- *40 parts white vinegar*
- *30 parts 3% hydrogen peroxide*

11.1.5 Spill Prevention

Spillage of the oxidant material should be avoided. ERM will implement the following precautions:

- Bulk delivery of permanganate will be supervised by ERM;
- Bulk shipping containers will be provided to a secure location as approved by site personnel;
- Bulk shipping containers to be chocked, adequately supported and secured by shipper upon delivery;
- Bulk container tanks will be demarked by cones to limit untrained personnel from the area;
- At each subsurface addition location, absorbent material and "pig mats" will be provided sufficient to contain any spillage in the vicinity of the application during injection activities;
- Any spill will be immediately contained with adsorbent to preclude overland flow and discharge to surface water bodies;
- All additions will be conducted under constant supervision and vigilance of all site personnel to ensure that added materials are emplaced with no discharge to the surface.

Monitoring will be conducted throughout the applications to confirm that the addition does not result in adverse effects to the environment. Designated monitoring locations will be checked daily through the measurement of physical parameters (e.g. conductivity, dissolved oxygen, ORP) and visual inspection (e.g., discoloration, staining, presence of oxidized metals (e.g. iron or manganese) or other conditions that may indicate the presence of oxidant).

11.1.6 Spill Response and Follow Up

Prior commencement of the injection, local Emergency Response and HAZMAT units should be contacted by ERM and made aware of the activities going on at the site. A briefing should be delivered on the chemicals being used, the injection process, spill prevention measures and the immediate dangers of a release. Briefing local first responders on the site actives will quicken response time and help avoid confusion on site in case of an emergency situation.

Site personnel should immediately call 911 to initiate emergency response if:

- An uncontrolled release of a chemical occurs;
- A serious injury or illness requiring medical attention occurs;
- In the event of a fire, or
- If other conditions warrant.

After contacting emergency response services, field personnel should immediately provide notice to designated site representative that emergency response services have been activated. After notifying site, field personnel should immediately contact the ERM Project Manager (or Project Manager alternate), who will complete any additional notification. If site conditions warrant, the Emergency Response Contractor for the Site should be contacted and mobilized to the Site. Please see **Table 2.1** for specific agency contacts for this project.

Small spills or leaks of sodium permanganate that are less than 10 gallons (30 gallons of diluted solution) *and* can be contained (i.e. not in drains or streams) will be handled by field personnel by dilution and neutralization. Larger and uncontrolled releases will require notification and activation of the designated Emergency Response Contractor.

A description of the hazard and dilution process is summarized below.

Emergency Response Procedures for Controlled Small Spills of Sodium/Potassium Permanganate

Neutralizing Solution - Sodium Thiosulfate ($Na_2S_2O_3$) Sodium thiosulfate chemical is a colorless powder. A 10% by weight solution of $Na_2S2_2O_3$ will be prepared for emergency response and/or system clearing. NEVER ADD CONCENTRATED SODIUM THIOSULFATE SOLIDS OR SOLUTIONS DIRECTLY TO CHEMICAL SOLUTIONS. **A VIOLENT REACTION MAY OCCUR RESULTING IN INJURY.**

1. Clear personnel from the spill area to prevent exposures and to avoid expanding the affected area.

2. Suspend additions in immediate area to focus on response activities. Notify Project Manager. Coordinate activities with site staff.

3. Don protective face shield, safety glasses, and chemical-resistant clothing (coated Tyvek coveralls, rubber boots and neoprene gloves).

4. Contain spill with non-combustible materials (pigs, hogs, soil, etc.). Dilute spill with water to a concentration less than 10 g/L concentration – Do not neutralize concentrated solutions for safety reasons. Collect sample and determine the concentration using on-site analysis by Hach spectrophotometer. Hold diluted solution for neutralization. A 1 gallon spill of 23% sodium permanganate must be diluted with water 4:1 prior to being neutralized, creating 5 gallons of purple water. This 5 gallons of fluid can then be reacted with ~ 1 gallons of the neutralizer until clear. A spill of 1-gallon oxidizer thus creates 6 gallons of clear fluid.

5. Neutralize the diluted $NaMnO_4$ solution with a 10% solution of sodium bisulfite ($Na_2S_2O_3$). Add the $Na_2S_2O_3$ solution until the solution turns brown indicating neutralization is complete. Each 50 pound sack of sodium thiosulfate can be diluted into 60 gallons of neutralizer solution (~10% concentration). Each 50 gallon drum therefore can treat 10 gallons of 40% sodium permanganate solution. Do not, under any circumstances neutralize sodium permanganate prior to dilution; the neutralization reaction is highly exothermic. One drum of diluted sodium bisulfite will be maintained in storage, and will be replenished as needed.

6. Rinse area with large amounts of water, except if runoff will enter a storm drain or

water body.

7. If personnel are exposed to sodium permanganate, consult MSDS for first aid procedures. Rinse the exposed area with large amounts of water using the eye wash station and deluge shower.

Monitoring will be conducted throughout the applications to confirm that the addition does not result in adverse effects to the environment. In addition, procedures outlined in the previous section will be followed to reduce any spills or leaks. However, if evidence of breakout of permanganate is observed, ERM will *immediately* conduct the following activities:

- If active permanganate addition is being conducted in the area, it shall be immediately terminated;
- The incident will be reported to the parties involved at the Site (or their designees), refer to Table 2.1;
- ERM and the client will immediately determine if any Federal, State or Local reporting is required; and
- If site conditions warrant, the Emergency Response contractor for the site will be contacted and mobilized to the Site.

Sodium/potassium permanganate is a strong oxidizer and must be handled in a manner to avoid, to the maximum extent possible, unintended contact with the environment.

11.1.7 Emergency Response Equipment (at the Site)

ERM will maintain emergency equipment at the Site for potential use. Specific equipment includes:

- Personal protection equipment (goggle, face shields, gloves, tyvek, overboots);
- Spill kit on site truck (or at addition point);
- Hand tools including flat blade spade, broom with plastic (NOT straw) bristles;
- Notification capabilities via cell phone/radio devices;
- Neutralization liquids; and
- Additional ancillary support equipment (e.g., emergency response personnel, 24-hour emergency response subcontractor) necessary to support operations.

If necessary, additional equipment will be mobilized to the Site as necessary (e.g., temporary water storage tanks).

11.2 CONFINED SPACE ENTRY PROCEDURES

Entry into permit-required confined spaces is not anticipated and thus prohibited. If a project task or activity would involve entry into a permit-required confined space or if there is a question as to whether or not a job task or activity involves a permit-required confined space, the PM or FSO will contact the North America H&S Leader for assistance prior to entering the confined space.

11.3 SUBSURFACE CLEARANCE (SSC)

Before any groundbreaking activities can be conducted on site the PM will be responsible for ensuring the ERM SSC guidelines are followed, including verifying that the following issues have been adequately addressed and completing the ERM SSC Checklist. The ERM SSC requirements include at a minimum:

- Contacting the New York State Call Before You Dig (CBYD) or equivalent service to identify public underground utilities;
- Contacting site personnel with knowledge of the site utilities;
- Reviewing site maps and figures showing underground utilities;
- Marking out all known underground utilities in the field.

As part of the SSC investigation it may be necessary to use other available subsurface investigation resources such as Ground Penetrating Radar (GPR)

The following ground disturbance activities planned for this project include:

- Excavation
- Trenching
- Drilling

The ERM SSC requirements and SSC checklist can be found in Appendix C.

11.4 EXCAVATION AND TRENCHING

Any personnel entering in an excavation or trench deeper than 5 feet must be protected from cave-ins by an adequate OSHA safe protective system designed in accordance with the requirements of the Occupational Health and Safety Administration’s (OSHA) construction standard for excavations and trenches, CFR 1926 Subpart P. Protective systems for excavations or trenches deeper than 5 feet include:

- Sidewall sloping;
- Benching systems;
- Shoring systems;
- Use of a trench box.

The ERM subcontractor will be required to provide an excavation and trenching Competent Person, who must be on-site at all times during all excavation activities. The Competent Person must be familiar with the above protective systems and capable of identifying possible hazards or dangers to employees that are associated with any excavating or trenching activities.

All open excavations or trenches must be indentified using warning tape or cones in order to indentify the work area and keep unauthorized personnel away from the area. Open trenches and excavations left overnight must be fenced or barricaded to prevent unauthorized access to the area while work is not being performed.

11.5 EXTRACTION WELL AND WELL VAULT INSTALLATION

Groundwater will be extracted, treated and recharged at downgradient locations within the PCE-dominant portion of the plume. The extraction wells will be installed in the Magothy Aquifer.

Up to two groundwater extraction wells will be placed within the PCE-dominant plume upgradient of GCWD Well Nos. 13 and 14. These wells would intercept the PCE-dominant plume. The locations, configurations, pumping rates, and specific groundwater discharge alternatives will be evaluated using the existing data set, data obtained from the pre-design studies including the comprehensive pre-design groundwater water level measurement and sampling event, vertical profiling, the comprehensive groundwater sampling event, the public supply well pumping hydraulic evaluation, and the 3D groundwater flow model.

The extracted groundwater will either be pumped by subsurface pipes to a treatment system housed in a building constructed on vacant property adjacent to Nassau County Recharge Basin 232 or be treated and recharged at the point of extraction. The preferable treatment option will be evaluated during the OU1 RD. The groundwater treatment systems will consist of shallow-tray air stripping units, or comparable systems. If off-gasses from the air stripping units exceed regulatory thresholds the emissions will be treated prior to discharge.

The amount of groundwater extraction will be moderated to minimize, to the extent practical, any reduction in water volume to the public supply wells. Hence, a portion of the PCE-dominant plume that has passed the extraction wells and is beyond the capture zone would continue to be treated via the treatment systems at GCWD Well Nos. 13 and 14. The conceptual combined treatment approach using ISCO and the conceptual extraction well layout showing estimated capture fields is depicted in Figure 6 of the OU1 RD Work Plan. (Note, this figure only shows centralized collection, treatment and recharge of extracted groundwater. The RD will evaluate alternatives for treatment and recharge locations).

Regardless of exact location, each well will require the construction of a concrete vault that will need to be installed in the street. Any work that will be conducted on either of the public roadways will need to be done in coordination with the Garden City Police (GCP). The use of drilling and excavation equipment can mask the sound of oncoming traffic which posses a serious danger to personnel working in the area. ERM will work with the GCP to coordinate traffic management while the work is being performed. All ERM and subcontractor personnel working on or near the public road will be required to wear a high visibility traffic vest at all times. Any personnel wishing to cross into the public roadway may do so only if following local traffic laws or signaled to by a GCP officer. Further more, where possible work zones in the public roads will be fenced or barricaded to prevent personnel from unknowingly cross into traffic lanes.

11.6 TREATMENT SYSTEM BUILDING CONSTRUCTION

As noted above, the groundwater treatment system may require the construction of a building to house the groundwater treatment systems. If a treatment building is to be constructed on vacant property adjacent to Nassau County Recharge Basin 232 (located on a small parcel of land about ¼ mile from the extraction wells), groundwater will be pumped from the wells to the treatment system through subsurface pipes. The total distance the pipes would run is approximately 2,200 feet.

The installation of the piping from the extraction wells to the treatment system will require the ERM subcontractor to dig large sections of trenching. All trenching must be done in a manner that conforms with the requirements of the OSHA construction standard for excavations and trenches, CFR 1926 Subpart P and the requirements stated above in section 11.4.

11.7 COMPRESSED GAS

Compressed Nitrogen will be used during various groundwater sampling activities where bladder pumps or waterloo pumps are used. Any personnel performing these sampling tasks must be properly trained in the use and safe handling of compressed gas cylinders in accordance with the OSHA compressed gasses standard, 29 CFR 1910.101.

11.8 HEAVY EQUIPMENT

The use of heavy equipment will be necessary during the life of the project. Subcontractors will be required to provide a competent person to operate any machinery needed to complete the task. All site personnel will be informed of the use of heavy equipment and the associated hazards before work begins each day. Site personnel are expected to be aware of heavy equipment on site and follow safety precautions outlined by the FSO.

11.9 HAND AND POWER TOOLS

Several project tasks will require the use of hand and power tools. Personnel using the tools are expected to wear the proper PPE, inspect the equipment before using it, and use the tools in accordance with their design specifications

12.0 EMERGENCY RESPONSE PLAN

This section describes possible contingencies and emergency procedures to be implemented at the site.

12.1 PERSONNEL ROLES AND LINES OF AUTHORITY

The FSO has primary responsibility handling emergency situations. This includes taking appropriate measures to ensure the health and safety of site personnel and the public. The FSO will be responsible for evacuating any person and providing decontamination, and arranging for medical treatment or first aid for any person injured or requiring medical attention.

Possible actions may involve the evacuation of personnel from the site area and ensuring that corrective measures have been implemented, appropriate authorities notified, and follow-up reports completed. If the FSO is not available, the CM or other ERM field staff will assume the FSO's responsibilities. All site personnel will assist as directed by the FSO in case of an emergency.

12.2 EMERGENCY ALARMS

The emergency alarm for the site will consists of three blows of the air horn. Air horns will be kept with the site first aid kit and fire extinguisher at a location to be determined by the FSO. All personnel on site are authorized to sound the air horn in the event of an emergency that requires immediate action or posses imminent danger.

12.3 EVACUATION PROCEDURES AND ROUTES

In the event of an emergency requiring evacuation to an Assembly Point, the FSO will be responsible to account for the presence of all project team members and subcontractors on-site at the time of the emergency. When evacuating, it is important to be aware of the prevailing wind direction and evacuate upwind or crosswind.

Assembly point will be determined by the FSO upon site mobilization.

12.4 RESPONDING TO EMERGENCIES

In the event an actual or suspected incident where personal injury or illness occurs, the FSO should take the following actions sequentially as listed:

- Call 911 for emergency assistance;
- Sound air horn;
- Don appropriate PPE;
- Remove the exposed or injured person(s) from immediate danger;
- Decontaminate affected personnel as appropriate;
- Obtain ambulance transport to the local hospital in the event of any injury or illness deemed to require medical surveillance or treatment; and

- Evacuate other personnel until it is safe for work to resume.

NOTE: No ERM or subcontractor personnel are expected to carry out any emergency actions of which they have not been appropriately trained or feel comfortable performing.

12.5 REPORTING EMERGENCIES

At the earliest time practicable following the occurrence of the emergency situation, the FSO will contact the PM and ERM Coordinator to advise them of the situation. The PM will then be responsible for promptly informing the following parties about the emergency.

- Injured/involved personnel's supervisor;
- Partner-In-Charge; and
- Client Contact.

In the case of an Incident, the FSO, with the cooperation of the H&S Contact, will promptly begin formal documentation of and investigation into the root cases of the Incident following the occurrence of the incident. This process is defined in Section 13, below.

12.6 RESTARTING WORK FOLLOWING AN EMERGENCY

The FSO will determine when it is safe to resume work at the site following an emergency. Note that if there is any doubt regarding the safe condition of the area, work will not recommence until all safety issues are resolved.

12.7 EMERGENCY DRILLS

In accordance with the HAZWOPER Standard emergency response plans will be rehearsed regularly as part of the overall training program for site operations. The frequency of this drill (rehearsal) is outlined on Table 12-1. All drills will be documented on the Emergency Drill Evaluation Form found in Appendix I. Drills do not need to be elaborate. A table-top scenario during the daily safety meeting is an adequate drill.

TABLE 12-1: Emergency Drill Frequency

Project Duration	*Drill Frequency*
Less than 30 days	None, cover during review/sign-off of HASCP
Greater than one month but less than one year	Once
Greater than one year	Annually

13.0 REPORTING OF SAFETY EVENTS

Safety events are occurrences or conditions that may contribute to or result in an injury, occupational illness or property damage. ERM seeks to learn from the investigation of the following types of safety events:

- Unsafe acts and unsafe conditions;
- Near misses; and
- Incidents (injury, illness, property damage, fire, or chemical spill).

All safety events must be reported promptly. Immediate verbal notification is required, as well as completion of an ERM Incident Report Form (Appendix J), which must be forwarded to the ERM Divisional Safety Leader within 24 hours of the safety event occurring.

The FSO will initiate verbal communications regarding the occurrence of the safety event to the parties shown below, who will continue communications as appropriate.

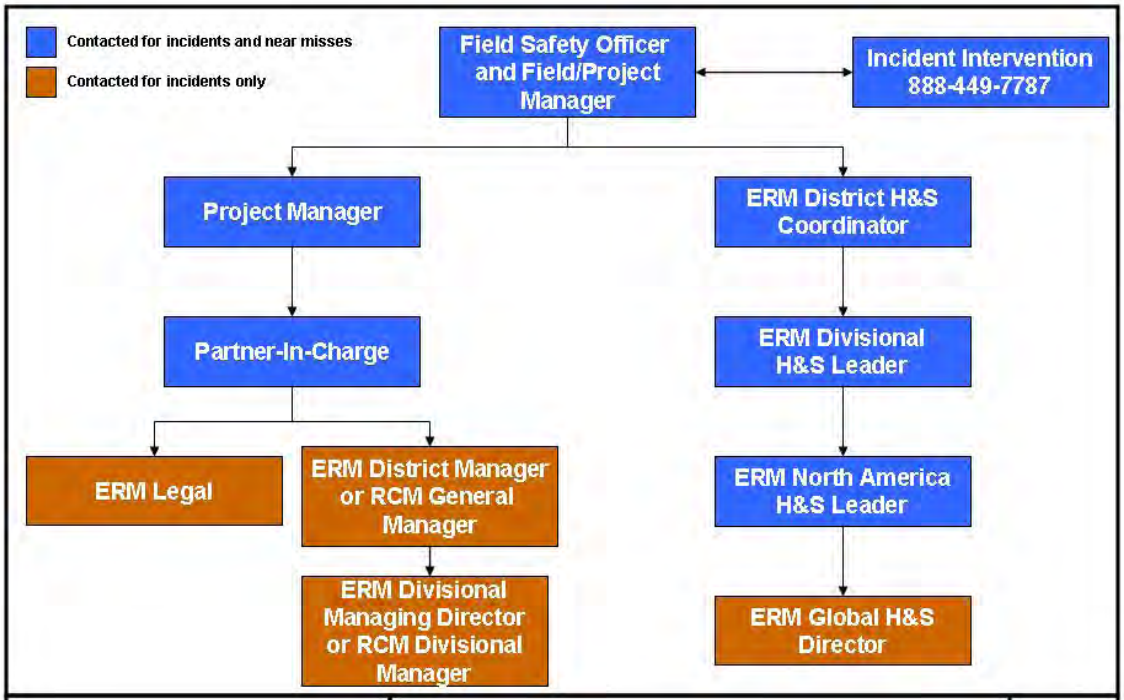

FIGURE 13-1

POST-EVENT VERBAL COMMUNICATION TREE
ERM Health and Safety Management System

Date : 8/18/2009

13.1 STANDARD INCIDENT INVESTIGATION

For most incidents, the FSO will also begin documentation of the Incident using the ERM Incident Report & Investigation Form found in Appendix J. The form consists of two parts:

- Part I, in which the facts of the Incident are gathered; and
- Part II, in which the root causes of the Incident are identified and actions are assigned to address those root causes.

The FSO will complete a draft version of the Part I Investigation and will forward it to the PM and H&S Coordinator within 24 hours of the occurrence of the Incident. The FSO, PM, and H&S Coordinator will schedule Part II of the investigation and include project supervision (ERM, ERM Contractors, and the Client), the injured/involved employee(s) and the Subject Matter Expert. Root cause analysis will be performed to assess the apparent cause and identify corrective measures to be implemented to prevent re-occurrence. Part II of the investigation will be completed within three working days of the occurrence of the Major Incident. The FSO will track to completion the corrective measures identified during the investigation.

14.0 SITE SAFETY BRIEFINGS

14.1 COMMUNICATION AND REVIEW OF THE HASCP

An initial review of the site-specific HASCP will be held either prior to mobilization or after mobilization but prior to commencing work at the site to communicate HASCP details and answer questions to individuals working at the site. The following topics will be addressed during the briefing:

- Names of the FSO and any designated alternate;
- Hazardous chemicals that may be encountered during on-site activities;
- Physical hazards that may be encountered on-site;
- Special training requirements and Safe Work Practices;
- Work tasks;
- Emergency communication signals, codes, and location of emergency contact information;
- Emergency procedures for safety events, fires, and hazardous material incidents; and
- Emergency evacuation routes.

14.2 DAILY SAFETY MEETING

A daily safety meeting will be conducted each morning. The daily safety meeting will include a discussion of the following health & safety-related topics, among others:

- Who is doing what, where and how;
- The potential for overlapping site operations;
- Changes to the HASCP or JHAs;
- Discussion of recent Incidents or safety observations; and
- Comments from the project personnel.

The meetings will be documented on the Daily Safety Meeting form found in Appendix K.

15.0 AUDITING AND HASCP REVISIONS

Selected project field activities and project files shall be audited periodically. A full site audit for conformance with the HASCP will occur at least once per year for projects with fieldwork duration of 1 year or longer. Full site audits may also be conducted for shorter duration projects. Project documentation audits may be conducted periodically for shorter term projects.

Revisions made to the site HASCP in response to audit feedback, lessons learned from Incidents, or other reasons will be explained to all site personnel at the first daily safety meeting following the institution of the HASCP revision.

ATTACHMENTS

☐	***SWP-01***	***HAZARD COMMUNICATION***
☐	***SWP-03***	***MEDICAL SERVICES AND FIRST AID***
☐	***SWP-04***	***AIRBORNE CONTAMINANTS***
☐	***SWP-05***	***HEAT STRESS***
☐	***SWP-06***	***COLD STRESS***
☐	***SWP-07***	***NATURAL HAZARDS***
☐	***SWP-08***	***PERSONAL PROTECTIVE EQUIPMENT***
☐	***SWP-09***	***RESPIRATORY PROTECTION***
☐	***SWP-10***	***CONFINED SPACE ENTRY***
☐	***SWP-13***	***EXCAVATIONS***
☐	***SWP-14***	***FALL PREVENTION AND FALL PROTECTION***
☐	***SWP-16***	***FORKLIFT AND TRUCK OPERATIONS***
☐	***SWP-17***	***HAND TOOLS***
☐	***SWP-19***	***HEAVY AND MATERIAL HANDLING EQUIPMENT***
☐	***SWP-20***	***LADDER SAFETY***
☐	***SWP-21***	***LINE BREAKING AND BLANKING***
☐	***SWP-22***	***LOCKOUT TAGOUT***
☐	***SWP-29***	***WALL FLOOR PENETRATION***

Attachments
ERM Safe Work Practices

RCM ERM Remediation & Construction Management	**STANDARD OPERATING PROCEDURE**	
	SOP #:	1
	Title:	Hazard Communication (HazCom)
	Last Rev.:	12/31/07
	Page:	1 of 2

SCOPE

This procedure provides guidance on meeting regulatory requirements and ensuring that the information necessary for the safe use, handling and storage of hazardous chemicals is provided and made available to employees.

DEFINITIONS

- **Hazardous Chemical** – Any chemical which is a physical hazard or a health hazard.

- **Hazard Warning** – Any words, pictures, symbols, or combination thereof appearing on a label or other appropriate form of warning which convey the specific physical and health hazard(s), including target organ effects, of the chemical(s) in the container(s).

- **Health Hazard** – A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals that are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes.

- **Physical Hazard** – A chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

PROCEDURE

A. RCM Health and Safety Coordinator will develop a chemical inventory of all known chemicals to be used or present as a potential contaminant at the job site.

B. RCM Health & Safety Coordinator will ensure that all containers (drums, bottles, etc.) are labeled with the identity of the known hazardous chemical contained and any appropriate hazard warnings. Containers that are not labeled or where labels have faded or been removed will be relabeled immediately.

C. RCM Health & Safety Coordinator will include NIOSH Universal Chemical Safety Data Cards for chemicals present as site constituents of concern and Material Safety Data Sheets (MSDSs) for chemicals brought to the site for the job. For assistance, contact the RCM Health and Safety Coordinator.

D. The Site Safety Officer will ensure employees have been trained on site-specific HazCom, including:

1. Methods that may be used to detect a release of hazardous chemical(s) in the workplace;
2. Physical and health hazards associated with chemicals;
3. Protective measures to be taken;
4. Safe work practices, emergency responses and use of personal protective equipment (PPE); and
5. Information on the Hazard Communication Standard including:
   a. Labeling and warning systems, and
   b. An explanation of Material Safety Data Sheets.

E. RCM Health & Safety Coordinator will identify PPE based on the task involved and the chemical properties.

F. The Site Safety Officer will inform employees of any non-routine tasks and the chemical hazards associated with the tasks. Review the safe work practices and use of required PPE prior to the start of such tasks.

G. The Site Safety Officer will provide information on hazardous chemicals known to be present to subcontractors and other employers on the site. Employers are responsible for providing necessary information to their employees. Ensure other onsite employers are provided with the applicable HazCom information.

H. All site personnel are required to report any incident of a chemical over-exposure or of a chemical spill to the Site Safety Officer. Follow the emergency response/spill response procedures described in the HASP.

REFERENCES

Regulatory References

- 29 CFR 1910.1200, Hazard Communication

Technical References

NIOSH Universal Chemical Safety Data Cards

Procedural References

- SOP – 9, Personal Protective Equipment
- RCM Health and Safety Program, Appendix B, Section 3

REVISION LOG

DATE	REV. #	APV'D	COMMENTS
12/31/07	0	ELG	Issued for use

RCM ERM Remediation & Construction Management	STANDARD OPERATING PROCEDURE	
	SOP #:	3
	Title:	Medical Services / First Aid
	Last Rev.:	12/31/07
	Page:	1 of 2

SCOPE

This procedure describes the requirements for providing medical services and first aid at the job site.

DEFINITIONS

None.

PROCEDURE

A. RCM Health & Safety Coordinator will identify the mode by which medical services and first aid will be administered and document in the Health and Safety Plan (HASP). This will generally be recorded by identifying the nearest medical facility to the job site and providing a map with the location identified.

B. In the absence of reasonably accessible medical services (i.e., within 5 minutes by ambulance), the Site Safety Officer or a person certified in first aid will be available at the site to render first aid.

C. At jobsites where the eyes or body of any employee may be exposed to corrosive or otherwise hazardous chemicals, quick-drenching/eye washing facilities must be provided.

D. First aid supplies must be easily accessible at a job site, when required. The contents of the kit must be checked by the Site Safety Officer before being sent out on each job and weekly during the job, to ensure that items used are replaced.

E. Field first aid kits should contain the following items:

Band aids 3/4″ x 3"
Non-stick pads, medium
Kling rolled bandage 2"
Triangular bandage 51"
Hypo-allergenic first aid cream
Adhesive Tape ½″ x 5 yd
Scissors
Butterfly bandages
Antiseptic wipes
Burn cream, 8 oz.
Foil packs
Amoply, ammonia inhalants 0.33 ml.
Tylenol, extra strength
Oval eye pads
Examination gloves

REFERENCES

Regulatory References

- 29 CFR 1926.50, Medical Services and First Aid

Technical References
- ANSI Z308.1-1978, Minimum Requirements for Industrial Unit-Type First-aid Kits

Procedural References
- RCM Health & Safety Program, Appendix B, Section 2

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12/31/07	0	ELG	Issued for use

RCM ERM Remediation & Construction Management	STANDARD OPERATING PROCEDURE	
	SOP #:	4
	Title:	Airborne Contaminants
	Last Rev.:	12/31/07
	Page:	1 of 2

SCOPE

This procedure provides guidance on meeting regulatory requirements when airborne contaminants may be present at the job site. This procedure applies to all types of airborne contaminants which may cause adverse health effects. These contaminants may be in the form of dusts, mists, gases, vapors or fumes.

DEFINITIONS

None.

PROCEDURE

A. RCM Health & Safety Coordinator will develop an Air Monitoring Plan (AMP) for chemical constituents identified at the job site. The AMP must include the types of samples to be collected, such as real-time measurements, personal breathing zone and area samples, as well as identify the contaminants which will be monitored for.

B. Additional regulatory requirements may be triggered if a potential site contaminant is covered by an Occupational Safety and Health Administration (OSHA) substance-specific standard. The following list of contaminants have such regulations:

Asbestos
13 Carcinogens
Vinyl Chloride
Inorganic Arsenic
Lead
Hexavalent Chromium
Cadmium
Benzene
Coke Oven Emissions
1,2-Dibromo-3-Chloropropane
Acrylonitrile
Ethylene Oxide
Formaldehyde
Methylenedianiline
1,3-Butadiene
Methylene Chloride

REFERENCES

Regulatory References

- 29 CFR 1910.1000, Air Contaminants
- 29 CFR 1910.1001, Asbestos
- 29 CFR 1910.1003, 13 Carcinogens
- 29 CFR 1910.1017, Vinyl Chloride
- 29 CFR 1910.1018, Inorganic Arsenic
- 29 CFR 1910.1025, Lead
- 29 CFR 1910.1026, Hexavalent Chromium
- 29 CFR 1910.1027, Cadmium
- 29 CFR 1910.1028, Benzene
- 29 CFR 1910.1029, Coke Oven Emissions
- 29 CFR 1910.1044, 1,2-Dibromo-3-Chloropropane

- 29 CFR 1910.1045, Acrylonitrile
- 29 CFR 1910.1047, Ethylene Oxide
- 29 CFR 1910.1048, Formaldehyde
- 29 CFR 1910.1050, Methylenedianiline
- 29 CFR 1910.1051, 1,3-Butadiene
- 29 CFR 1910.1052, Methylene Chloride

Technical References
- ACGIH Threshold Limit Values
- NIOSH Pocket Guide to Chemical Hazards

Procedural References
- SOP – 10, Respiratory Protection
- SOP – 11, Confined Space Entry
- SOP – 22, Line Breaking/Blanking

REVISION LOG

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SCOPE

This procedure provides work practices to minimize the impact of heat stress caused by exposure to hot environments or working conditions.

DEFINITIONS

- **Acclimatization** – The ability to adjust to hot working conditions. 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.

- **Heat Index** – An accurate measure of how hot it really feels when relative humidity (RH) is added to the actual air temperature.

PROCEDURE

A. The Site Safety Officer will implement techniques for preventing heat stress-related health issues. Prevention techniques include:
   1. Provide shaded areas with cross-ventilation, if possible, for lunch and breaks.
   2. Schedule physically demanding and strenuous tasks, or tasks requiring full-body chemical protection, for early in the day, if possible.
   3. Drink at least 6-8 ounces of cool water every 60 minutes.
   4. Use the buddy system and look for signs of heat stress. Any employee with signs of heat stress must immediately proceed to the break area. Signs and symptoms for various heat stress disorders and recommended first aid are listed in the following table.

Disorder	*Symptoms*	*Cause*	*Prevention/First Aid*
Heat Rash or Prickly Heat	♦ Rash ♦ Itching	♦ Hot, humid conditions ♦ Sweat doesn't evaporate easily ♦ Sweat ducts become clogged	♦ Ointments ♦ Keep skin clean and dry ♦ Good daily personal hygiene
Heat Cramps	♦ Sudden onset of muscle cramps usually in legs or arms ♦ Hot, moist skin ♦ Normal pulse ♦ Normal or slightly elevated temperature	♦ Loss of water (sweating) ♦ Loss of electrolytes ♦ Replacing water but not electrolytes	♦ Move into shade ♦ Loosen clothing ♦ Drink tepid electrolyte drinks or water ♦ Seek medical assistance if conditions persist
Heat Exhaustion	♦ Pale, clammy skin ♦ Profuse perspiration ♦ Thirst from dehydration ♦ Weakness ♦ Headache ♦ Nausea ♦ Loss of coordination	♦ Overexertion ♦ Excessive loss of water and electrolytes	♦ Move into shade ♦ Remove PPE ♦ Loosen street clothing ♦ Cool by applying damp cool compresses or ice packs ♦ Drink tepid electrolyte drinks or water ♦ Summon medical assistance
Heat Stroke	♦ Elevated temperature (>103F) ♦ Flushed, hot, dry skin ♦ Absence of sweating ♦ Delirious ♦ Rapid pulse ♦ Nausea ♦ Headache ♦ Dizziness ♦ Unconsciousness	♦ Failure of body's cooling (sweating) mechanism	♦ Summon medical assistance ♦ Move to shade ♦ Remove PPE ♦ Loosen street clothing ♦ Cool by fanning or applying damp compress or ice packs

5. The Site Safety Officer must verify that a work-rest cycle based on the heat index is implemented for site workers as applicable. Refer to the following three tables. To use the chart, read the temperature at the left and humidity across the top, the heat index is where the two intersect. For example, with a temperature of 96 and a humidity of 50%, the Heat Index is 108. Determine what the associated risk level is, based on the heat index. Use the risk level and heat index to determine the appropriate work-rest cycle.

Heat Index Chart

Relative Humidity (%)														
		40	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**
Temperature (F)	**110**	136												
	108	130	137											
	106	124	130	137										
	104	119	124	131	137									
	102	114	119	124	130	137								
	100	109	114	118	124	129	136							
	98	105	109	113	117	123	128	134						
	96	101	104	108	112	116	121	126	132					
	94	97	100	102	106	110	114	119	124	129	136			
	92	94	96	99	101	105	108	112	116	121	126	131		
	90	91	93	95	97	100	103	106	109	113	117	122	127	132
	88	88	89	91	93	95	98	100	103	106	110	113	117	121
	86	85	87	88	89	91	93	95	97	100	102	106	108	112
	84	83	84	85	86	88	89	90	92	94	96	98	100	103
	82	81	82	83	84	84	85	86	88	89	90	91	93	95
	80	80	80	81	81	82	82	83	84	84	85	86	86	87

Heat Index Risk Level and Associated Health Effects

Heat Index	***Associated Risk***
>130	*Extreme Danger* Heat stroke highly likely with continued exposure
105-130	*Danger* Heat exhaustion and heat cramps likely and heat stroke possible with prolonged exposure and/or physical activity
90-105	*Extreme Caution* Heat cramps and heat exhaustion possible with prolonged exposure and/or physical activity
80-90	*Caution* Fatigue possible with prolonged exposure and/or physical activity

NOTES:

- Heat Index values were devised for shady, light wind conditions. Exposure to full sun may increase these values by up to 15°.
- Heat Index values were devised for the general public wearing typical lightweight summer clothing. Acclimatized workers may be able to work under conditions with a slightly higher Heat Index.
- The use of personal protective equipment, including clothing increases the heat stress load on the body.

The work-rest cycle outlined below should be implemented based on the professional judgment of the Site Safety Officer and/or the Project Health and Safety Consultant. Workers must drink 8 ounces of cool water at each break.

Heat Index	*Risk Level*	*Work-Rest Cycle*
> 130	Extreme Danger	15 minute break every 30 minutes
105-130	Danger	15 minute break every 60 minutes
90-105	Extreme Caution	15 minute break every 90 minutes
80-90	Caution	15 minute break every 120 minutes

B. The Site Safety Officer and the Construction Manager will observe workers to verify compliance with and effectiveness of prevention techniques.

C. The Site Safety Officer should provide first aid treatment for heat stress related health issues.

D. In the event a heat stress related incident occurs, the Site Safety Officer will report the incident following guidelines in the HASP.

REFERENCES

Regulatory References
None

Technical References
- NOAA – National Weather Service, Heat Index, Measure of How Hot it Feels

Procedural References
None

REVISION LOG

DATE	REV. #	APV'D	COMMENTS
12/31/07	0	ELG	Issued for use

RCM **ERM** Remediation & Construction Management	**STANDARD OPERATING PROCEDURE**	
	SOP #:	6
	Title:	Cold Stress
	Last Rev.:	12/31/07
	Page:	1 of 2

SCOPE

This procedure provides work practices to minimize the impact of cold stress caused by exposure to cold environments or working conditions.

DEFINITIONS

- **Frostbite** – Occurs when the extremities do not get sufficient heat from the central body stores. The fluids around the cells of the body tissues freeze from exposure to low temperatures. This condition can result in damage to, and loss of, tissue. The most vulnerable areas are the nose, cheeks, ears, fingers, and toes.

- **Hypothermia** – This is the most severe form of cold stress and results from a drop in the body's core temperature. Hypothermia can occur in relatively mild temperatures if there is a wind and the person's clothing becomes wet. The signs or symptoms of hypothermia are:
  - First, uncontrollable shivering and the sensation of the cold;
  - Heartbeat slows and may become irregular;
  - Pulse weakens and blood pressure changes;
  - As the body's core temperature drops, other signs may include cool skin, slow irregular breathing, and apparent exhaustion;
  - When core temperatures are in the mid-range, the victim may become listless, confused, exhibit severe shivering, or develop severe pain in the extremities; and
  - Final signs are a significant drop in blood pressure, fatigue, and shallow respiration.

PROCEDURE

A. The Site Safety Officer will implement techniques for preventing cold stress-related health issues. Prevention techniques include:

1. Require the use of additional protective clothing.
2. Allow workers to change clothes that have become wet.
3. Provide thermal insulating materials on metal handles of tools and equipment.
4. In snowy or icy conditions, require the use of UV eye protection, as well as from blowing crystals.
5. Provide a warm and sheltered area for changing clothes and taking breaks.
6. Provide hot liquids, such as soups, warm drinks, etc. in the break area.

7. Use the buddy system and look for signs of cold stress. Any employee observed with signs of cold stress shall immediately proceed to the break area.

B. The Site Safety Officer and the Construction Manager will observe to verify compliance with and effectiveness of prevention techniques.

C. The Site Safety Officer will provide first aid treatment for cold stress related health issues include moving to warm area. Seek medical attention if signs or symptoms of hypothermia or frostbite are present.

REFERENCES

Regulatory References
None.

Technical References
None.

Procedural References
None.

REVISION LOG

DATE	REV. #	APV'D	COMMENTS
12/31/07	0	ELG	Issued for use

SCOPE

This procedure provides guidance for determining appropriate means for handling natural hazards that may be encountered while conducting fieldwork.

DEFINITIONS

None.

PROCEDURE

Potential exposure natural hazards during performance of this project is believed to be minimal. However since the work is performed outside some precautions should be taken to guard against the following hazards. Keep in mind that the hazards may vary depending on the time of year or geographical region. Infrequent hard freezes may allow insects and snakes to be active all year round in some parts of the United States. Refer to Attachments 1 through 3 for photos and more thorough descriptions of the more common natural hazards, which might be encountered.

A. Identify type of natural hazard present.

B. When a natural hazard (such as poisonous plants, feral animals, insects and snakes) is encountered, back away and evaluate the situation.

C. Develop a plan which may include any of the following:

   1. Remove the natural hazard if it can be done safely.
   2. Avoid the natural hazard if it cannot be removed. Additionally, use appropriate PPE or outer clothing for protection from the hazard. Refer to SOP – 8, Personal Protective Equipment.
   3. Get assistance in removing or working around the natural hazard. In some instances, this may require professional help from animal control or an insect expert.

D. In the event there is contact with the natural hazard, if it appears to be a life threatening situation, such as anaphylactic shock or a snake bite, seek medical attention immediately.

- OR -

A. POISONOUS PLANTS

1. Poison ivy is in the form of a vine, while oak and sumac are bush-like.
2. All produce a delayed allergic hypersensitivity.
3. The plant tissues have an oleoresin, which is active in live, dead, and dried parts and may be carried through dust, contaminated articles, and the hair of animals.
4. Symptoms usually occur 24 to 48 hours after exposure resulting in burning or stinging, and weeping and/or crusted blisters.
5. The best antidote for poisonous plants is recognition and avoidance.
6. Should exposure to any of these plants occur, notify the Site Safety Officer and wash the affected area with a mild soap and water, but do not scrub the area.

B. TICKS

1. Ticks attach to their host's skin and intravenously feed on its blood creating an opportunity for disease transmission.
2. Covering exposed areas of the body and the use of tick repellent are two ways to prevent tick bites.
3. Periodically during the workday employees should inspect themselves for the presence of ticks.
4. Notify the Site Safety Officer of any tick bites as soon as possible, medical attention may be required.

C. SPIDERS

1. Black Widow
    a. The black widow is a common venomous spider found in vacant rodent burrows, under stones, logs and long grass, and in hollow stumps and brush piles.
    b. If disturbed, they typically will retreat to a corner of their web but can be induced to bite only if pressed against the skin.
    c. Notify the Site Safety Officer if bitten, because neurotoxins are injected, it is important to seek immediate medical attention.

2. Brown Recluse
    a. The brown recluse or Fiddle Back Spider is another common venomous spider.

b. It hides in dark niches and corners, where it may spin a poorly organized, irregular web.

c. It is shy and will try to run from a threatening situation but will bite if cornered.

d. Check boots and protective clothing for spiders prior to putting them.

e. The bite of the brown recluse is usually painless until 3 to 8 hours later when it may become red, swollen, and tender. Notify the Site Safety Officer if bitten.

f. Prompt medical attention can reduce the extent of ulceration and alleviate other complications that may develop.

D. FIRE ANTS

1. One sure sign of the presence of fire ants is their conical mounds, which are a result of the digging of their chambers.
2. The sting of a fire ant results in localized reddening of the bite area, accompanied by sharp burning sensations.
3. The first ant sting releases a chemical substance that triggers other ants of the colony to sting.
4. Anyone seeing fire ant mounds present at the work site should notify the Site Safety Officer, who will then notify the rest of the crew so the mounds may be avoided if possible.

E. CHIGGERS

1. Chiggers, also known as “red-bugs” or “harvest mites”, are the immature stages of a tiny red mite.
2. They inhabit areas of tall grass, associated with low, wet spots, ponds and stream banks, wild berry patches, and forest underbrush.
3. The larvae attach themselves to the clothing of people or to the fur of passing animals.
4. Wear loose-fitting clothing (if possible) when working outdoors. Apply a repellent containing DEET (N,N-diethyl-meta-toluamide), to shoes, socks, and trousers before entering chigger-infested areas. Caution: some individuals may be sensitive to DEET – always read and follow label directions
5. Vehicles should be frequently vacuumed to reduce the number of chiggers that may have been deposited.

6. Flowers of sulfur is another repellant of chiggers. Sulfur may be more benign to use than DEET on some body parts. Avoid breathing dust during application.

F. FLYING INSECTS

1. Flying insects such as mosquitoes, wasps, hornets, and bees may be encountered while site activities occur.
2. Wear long-sleeved clothes and long pants treated with repellent. Do not treat unexposed skin. Use the repellent according to the manufacturer's recommendations provided on the container.
3. Personnel should report flu-like symptoms to the Site Safety Officer, medical attention may be needed.

G. SNAKES

1. The most effective way to prevent snakebites is to avoid snakes.
2. Personnel should avoid walking in high grass and underbrush.
3. Visual inspection of work areas should be performed prior to activities taking place.
4. The use of leather boots and long pants will be required, since more than half of all bites are on the lower part of the leg.
5. No attempts at killing snakes should be made; many people are bitten in such an attempt.
6. If a snake bites someone, Notify the Site Safety Officer and seek medical services.

H. ALLIGATORS

1. Never approach an alligator. Always stay at least 30 yards away. Never wade or swim in areas that could contain large alligators.
2. Do not dump food or scraps into or near the water. This can attract alligators.
3. Always be aware of your surroundings and use caution and common sense.
4. If at any time personnel observe alligators at the site they will immediately inform the Site Safety Officer or Construction Manager, who will then notify the rest of the employees and local wildlife personnel.

I. FERAL ANIMALS

1. Feral animals such as rats or other wildlife may be encountered during fieldwork.
2. If an animal is diseased, injured or tending a nest, they may become aggressive.
3. Notify the Site Safety Officer or Construction Manager if feral animals are at the site, who will then notify the rest of the employees and local wildlife personnel.

ATTACHMENTS

Attachment 1, Poisonous Plants
Attachment 2, Insects
Attachment 3, Snakes
Attachment 4, Other Natural Hazards

REFERENCES

Regulatory References

None

Technical References

None

Procedural References

SOP – 8, Personal Protective Equipment

REVISION LOG

DATE	REV. #	APV'D	COMMENTS
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Attachment 1

Poisonous Plants

Most species of poison ivy, oak, and sumac have three leaflets; hence, the saying, "Leaves of three, let it be." These plants vary significantly in appearance in different regions of the country, but in most species the flower and fruit structures arise in the angle between the leaf and the twig, the flowers are greenish in spring, and the plant's mature fruit is off-white or pale yellow-green.

Several varieties, including two species each of poison ivy, poison oak, and poison sumac and six subspecies of poison ivy (*Toxicodendron radicans*), are found in the United States. Poison ivy (see figure A below) generally grows east of the Rocky Mountains and poison oak in the West. Both poison ivy and poison sumac are found along the Gulf Coast. Poison oak prefers swampy areas in the Southeast.

Figures A1, A2: Courtesy of Lisa A. Gamer, MD; figure A3: staff photo; figure A4: Janet Robidoux

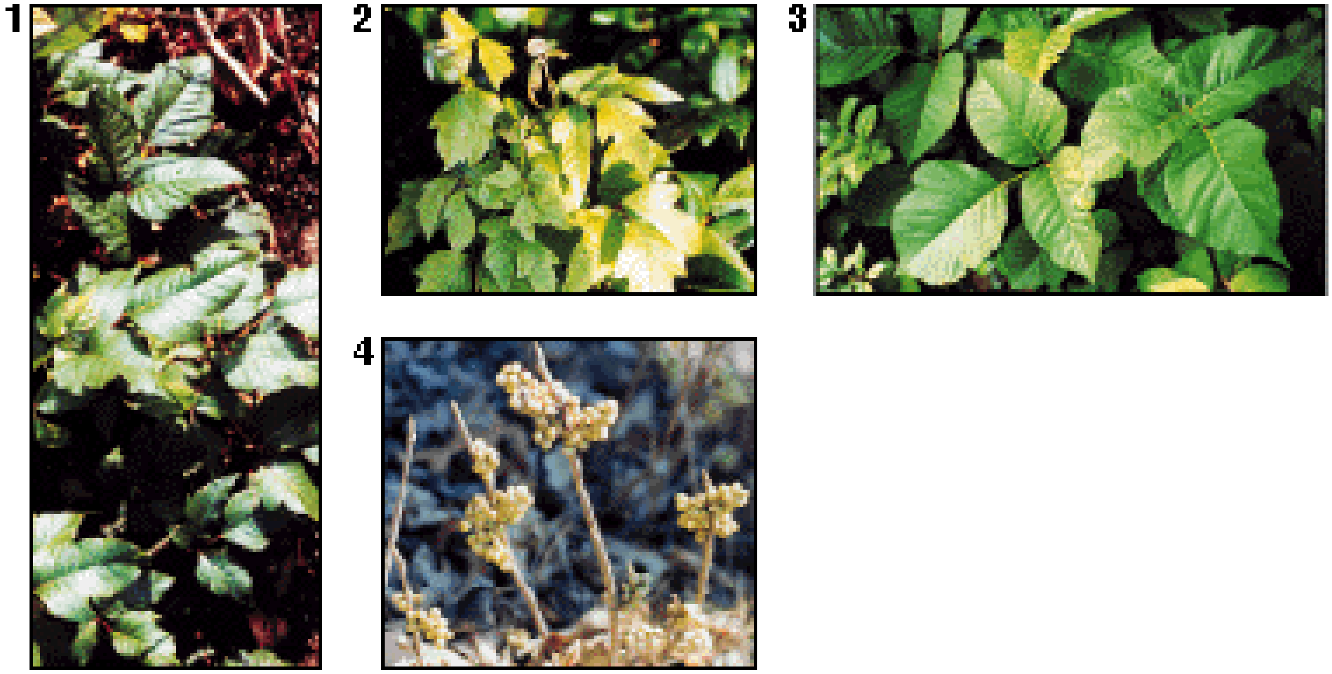


Figure A. Poison ivy (Toxicodendron radicans) can grow as a shrub or vine, but all varieties are characterized by glossy leaves that grow in clusters of three leaflets. The varieties shown here are found in Texas (1,2) and Minnesota (3). The off-white or pale yellow-green berries of poison ivy (4) often remain on the plant through the winter.

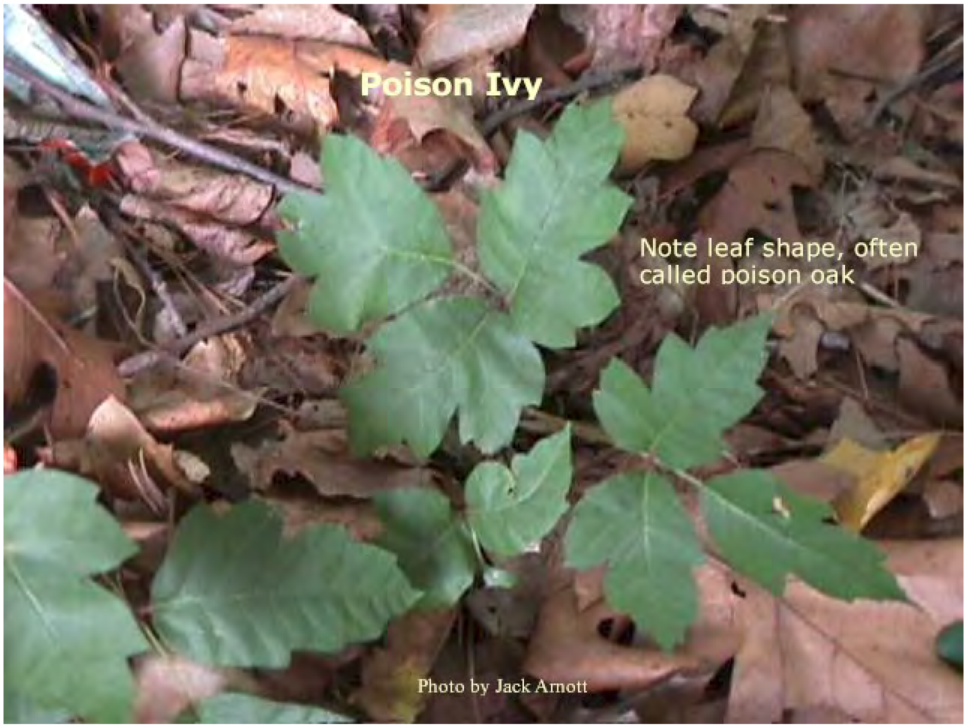
Poison Ivy

A climbing vine with three serrated-edge, pointed leaves grows in the East, Midwest and South. In the northern and western states, poison ivy grows as a non-climbing shrub.

The appearance of these plants is variable. Leaves are alternate and normally consist of three leaflets with the stalk of the central leaflet being longer than those of the other two are but can be found with five or even seven leaflets. The leaflets are two to four inches long, dull or glossy green with pointed tips. The middle leaflet is generally larger than the two laterals. The edges of the leaflets may be toothed, lobed, or smooth. Virginia Creeper (*Parthenocissus quinquefolia*) is non-poisonous vine with five leaflets that is often mistaken for poison ivy.

Poison ivy can be a shrub or a woody vine. Yellowish-green flowers occur in compact clusters in leaf axils, in June or July followed by waxy, gray-white berries about three-sixteenths of an inch in diameter in late summer.

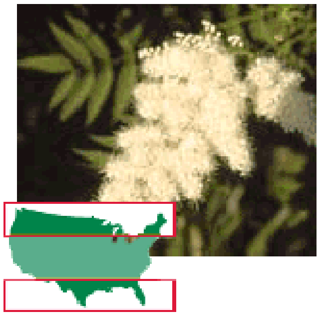

Virginia Creeper
Parthenocissus quinquefolia
Poison Ivy
Toxicodendron radicans
Photo by Jack Arnott


Poison Ivy
Note leaf shape, often called poison oak
Photo by Jack Arnott

Poison Oak

Poison oak also has three leaves. It grows in the sandy soil of the Southeast as a small shrub. In the western United States poison oak is a very large plant that grows as a standing shrub or climbing vine. Eastern poison oak has the most "oak-looking" leaves of any of the species. It usually has multi-lobed leaves, no aerial roots on the stems, and fuzzy fruits and leaves. It loves sandy soils. Western poison oak is found only along the Pacific coast and into the mountains and it usually has aerial roots extending from the main stem.

Poison Sumac



A shrub or bush with two rows of 7-13 leaflets, most common in the peat bogs of the Northern United States and in swampy Southern regions of the country. A water loving swamp shrub (dendritic) or bush with two rows of 7-13 leaflets; growing from 6 to 20 feet in height, the Poison Sumac is found in the east from Quebec to Florida and westward along the coast to far west Texas between Shelby and Hardin counties.

Listed below are recommended actions to take to reduce the potential exposure to poisonous plant:

- Determine what types of poisonous plants may be present at the specific site.
- Use repellant sprays and coatings.
- Use netting or long sleeves with cuffs and long pants.
- Regularly inspect skin.
- Maintain a first aid kit on hand.

Attachment 2
Insects

Chiggers

Chiggers, also known as "red-bugs" or "harvest mites", are the immature stages of a tiny red mite. They inhabit areas of tall grass, associated with low, wet spots, ponds and stream banks, wild berry patches, and forest underbrush. The larvae attach themselves to the clothing of people or to the fur of passing animals. Before settling down to feed, chiggers move to a constriction, such as sock tops, waistbands, or armpits. Feeding chiggers inject a salivary fluid, which dissolves the host's cells, and then they suck up the liquefied tissue. Within a few hours, small, reddish, intensely itching welts appear. These bites may continue to itch for several days up to two weeks after the chigger is dislodged. Following are suggestions that should provide some protection from chiggers:

- Stay out of areas where chiggers are likely to be present including wood lots, pastures, roadside ditches, or other areas with tall grasses and weeds. Chiggers are especially common in moist low-lying areas.

- Wear loose-fitting clothing (if possible) when working outdoors. Vehicles should be frequently vacuumed to reduce the number of chiggers that may have been deposited.

- Apply a repellent containing DEET to shoes, socks, and trousers before entering chigger-infested areas. Caution: some individuals may be sensitive to DEET – always read and follow label directions.

- Another repellant of chiggers is flowers of sulfur. Flowers of sulfur is powdered elemental sulfur available at a drug store or pharmacy as an over-the-counter preparation. It has a slight, rotten egg smell. Areas on the body that have tight clothing up against them such as socks, waistbands, etc. may be dusted with sulfur powder. Surveyors and other field personnel state that they fill a sock with sulfur and are able to dust these areas efficiently.

Sulfur may be more benign to use than DEET on some body parts. Avoid breathing dust during application.

- Immediately after possible exposure to chiggers, take a bath, thoroughly scrubbing the body with hot soapy water. This will kill or dislodge many of the chiggers. The clothes that were worn when the bite(s) occurred should be placed in a plastic bag for temporary storage until they can be laundered.
- When bites begin to itch, one course of treatment is to apply rubbing alcohol, followed by one of the nonprescription local anesthetics. A baking soda paste, calamine lotion, or product such as "After-Bite" also will help reduce discomfort. Avoid scratching bites since this only increases irritation and may lead to a secondary infection of the bite.

Ticks

Ticks are vectors of many different diseases including Rocky Mountain spotted fever, Q fever, tularemia, Colorado tick fever, and Lyme disease. They attach to their host's skin and intravenously feed on its blood creating an opportunity for disease transmission. Covering exposed areas of the body and the use of tick repellent are two ways to prevent tick bites. Periodically during the workday employees will inspect themselves for the presence of ticks. If a tick is discovered, the following procedure should be used to remove it:

- Do not try to detach a tick with your bare fingers; bacteria from a crushed tick may be able to penetrate even unbroken skin. Fine-tipped tweezers should be used.
- Grip the tick as close to your skin as possible and gently pull it straight away from you until it releases its hold.
- Do not twist the tick as you pull and do not squeeze its bloated body. That may actually inject bacteria into your skin.
- Thoroughly wash your hands and the bite area with soap and water. Then apply an antiseptic to the bite area.
- Save the tick in a small container with the date, the body location of the bite, and where you think the tick came from.
- Notify the SSO of any tick bites as soon as possible.

Recently, Lyme disease has been the most prevalent type of disease transmitted by ticks in the United States.

Spiders

A common venomous spider is the Black Widow. The adult female is glossy black with short, almost microscopic hairs and a crimson hourglass marking on the underside of the abdomen. They are found in dark corners of barns, stables, garages and piles of boxes and crates. They have also been known to reside in vacant rodent burrows, under stones, logs and long grass, and in hollow stumps and brush piles. Generally, Black Widows are not aggressive and usually can be induced to bite only if pressed against the skin. If disturbed, they typically will retreat to a corner of their web. However, these spiders are more aggressive if they are protecting an egg sac. After a bite, a dull numbing pain in the affected extremity occurs. In addition, pain and some muscular rigidity in the abdomen or the shoulder, back, and chest may occur. The bite may also produce headache, dizziness, skin rash, nausea, vomiting, anxiety and weakness, and increased skin temperature over the affected area may be observed. Ice may be placed over the bite to reduce the pain. Bites are rarely fatal to adults, but because the black widow spider injects neurotoxins, it is important to seek immediate medical attention.

Another venomous spider common in the southern United States is the Brown Recluse or Fiddle Back Spider. The Brown Recluse is about 1/4 to 1/2 inches in body length (most adults are about the size of a United States dime to a US quarter with legs extended). Coloration ranges from tan to dark brown, with the abdomen often darker than the rest of the body. The feature that most distinguishes the brown recluse from many other harmless spiders is a somewhat darker violin-shaped marking on top of the leg-bearing section of the body. The neck of the violin "silhouette" points towards the rear (abdomen) of the spider. The brown recluse roams at night seeking its prey. During the day, it hides in dark niches and corners, where it may spin a poorly organized, irregular web. Eggs are deposited in 1/2 inch long off-white silken egg sacs, often appearing flattened beneath and convex above. It is shy and will try to run from a threatening situation but will bite if cornered. People are sometimes bitten while they are asleep because they roll onto a brown recluse spider while it is hunting in the bed. More often the victim is bitten while putting on a shoe or piece of clothing that a spider has selected for its daytime hiding place. The bite of the brown recluse is usually painless until 3 to 8 hours later when it may become red, swollen, and tender. Later the area around the bite site may develop into an ulcerous sore from 1/2 to 10 inches in diameter. Healing often requires a month or longer, and the victim may be left with a deep scar. Prompt medical attention can reduce the extent of ulceration and alleviate other complications that may develop. It should be noted that not all brown recluse bites result in ulcerations or scarring.[1]

Fire Ants

Fire ants are approximately 1/4-inch long and live in underground chambers that typically contain over 1,000 ants. One sure sign of the presence of fire ants is their conical mounds, which are a result of the digging of their chambers. The sting of a fire ant results in localized reddening of the bite area, accompanied by sharp burning sensations. The first ant sting releases a chemical substance that triggers other ants of the colony to sting. Anyone seeing fire ant mounds present at the work site should notify the SSHO, who will then notify the rest of the crew so the mounds may be avoided if possible.

Flying Insects

Flying insects such as mosquitoes, wasps, hornets, and bees may be encountered while site activities occur. Section 3.4.4 discusses problems associated with them. Mosquitoes can be the vectors for diseases such as the West Nile Virus and Saint Louis Encephalitis, reports of which appear in the media periodically. Avoiding mosquito bites is the best way to avoid potential exposure to mosquito-borne disease. Apply insect repellant containing DEET (N,N-diethyl-meta-toluamide), wear long-sleeved clothes and long pants treated with repellent and stay indoors during peak mosquito feeding hours (dusk until dawn) to further reduce your risk.

There is currently no vaccine to protect humans against Saint Louis Encephalitis or West Nile Virus. Individuals at project sites can reduce their risk from being infected with West Nile Virus by taking the following actions to protect against mosquito bites:

- Review the hazards of West Nile Virus periodically in morning safety meetings.
- Increase protective measures when working at dawn, dusk, and in the early evening.
- Reduce the area of exposed skin when working outdoors. Long-sleeved shirts with sleeves rolled down are recommended. Understand that mosquitoes may bite through thin clothing, so personnel should evaluate the actual Level D clothing worn, for example, heavy, long

sleeve work shirts and heavy dungarees/jeans may be indicated. Activity at projects where disposable coverall use (i.e., Tyvek®) is specified, further reduces the risk of mosquito bites.

- For activities where only Level D PPE is specified, consider using disposable coveralls when working in wooded, highly vegetated, or swampy areas.
- Use an insect repellent containing approximately 30 percent DEET. In concentrations greater than 35 percent, DEET provides no additional protection. Use the repellent according to the manufacturer's directions provided on the container. Use just enough repellent to cover exposed skin and clothing. Do not treat unexposed skin. Frequent reapplication or saturation is unnecessary for effectiveness. Avoid prolonged and excessive use of DEET.
- When additional protection against mosquitoes is necessary, commercially prepared "clothing and gear" insect repellants containing 0.5 percent permethrin may be used. These repellants, such as Repel Permanone™ are available in the sporting goods departments at major retailers. Clothing and gear insect repellants are not for use on skin. Use the repellent according to the manufacturer's recommendations provided on the container.
- After returning from outdoor field activities, wash treated skin with soap and water.
- Personnel should report flu-like symptoms to the SSO.

West Nile Virus

The Centers for Disease Control and Prevention report that human illness from West Nile virus is rare, even in areas where the virus has been reported. The chance that any one person is going to become ill from a mosquito bite is low. West Nile virus is spread by the bite of an infected mosquito, and can infect people, horses, many types of birds, and some other animals. Most people who become infected with West Nile virus will have either no symptoms or only mild ones. On rare occasions, West Nile virus infection can result in a severe and sometimes fatal illness known as West Nile encephalitis (an inflammation of the brain). The risk of severe disease is higher for persons 50 years of age and older. There is no evidence to suggest that West Nile virus can be spread from person to person or from animal to person.

Saint Louis Encephalitis

The Centers for Disease Control and Prevention report mild infections occur without apparent symptoms other than fever with headache. More severe infection is marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, occasional convulsions (especially in infants) and spastic paralysis. There is no evidence to suggest that Saint Louis encephalitis can be spread from person to person or from animal to person.

Table 1

Flying Insect Information

Organism	Description	Habitat	Problem	Severity	Protection
Hornet	One inch long with some body hair. Abdomen is mostly black.	Round, paper like nest hanging from trees, shrubs, or under eaves of buildings.	One nest may contain up to 100,000 hornets that will attack in force at the slightest provocation.	Severe pain, allergic reactions similar to bees.	Do not come near or disturb nest. If a hornet investigates you, do not move.
Mosquito	Small, dark, fragile body with transparent wings. From 1/8 to 1/4 inch long.	Where water is available for breeding.	Bites and sucks blood. Itching and swelling result.	Can transmit encephalitis and other diseases. Scratching causes secondary infections.	Use plenty of insect repellant and wear gloves. Stay in windy areas.
Wasp	Very thin waist. Color can be black, yellow or orange with stripes.	Underground nest. Paper-like honeycomb nest in abandoned buildings hollow trees, etc.	Stings. Some species will attack if you get too close to the nest.	Severe pain, allergic reactions similar to bees. Can be fatal.	Avoid Nest. Do not swat at them.
Bee	Generally have yellow and black stripes and two pair of wings.	Hollow logs, underground nest, old buildings,	Stings when annoyed. Leaves venom sac in victim.	If person is allergic, nausea, shock, constriction of the airway can result. Death may result.	Be careful and watch where you walk. Cover exposed skin. Avoid areas where bees are swarming. Avoid wearing sweet fragrances and bright clothing. Move slowly or stand still when bees are swarming about you.

Attachment 3
Snakes

Copperhead


Coral

Cottonmouth


Diamondback Rattlesnake


Water Moccasin

The most effective way to prevent snakebites is to avoid snakes in the first place. Personnel should avoid walking at night or in high grass and underbrush. Visual inspection of work areas should be performed prior to activities taking place. The use of leather boots and long pants will be required, since more than half of all bites are on the lower part of the leg. No attempts at killing snakes should be made; many people are bitten in such an attempt.

If a snake bites someone, the following treatment should be initiated:

- Keep patient calm

- Notify emergency medical services
- Wash the wound and keep the affected body part still
- Apply direct pressure to site of bite if bleeding is extreme
- Keep the affected area lower than the heart
- Carry a victim who must be transported, or have him/her walk slowly
- Transport to closest medical facility

Attachment 4
Other Natural Hazards

Alligators

Alligators live in nearly all Louisiana parishes but are most common in the major river drainage basins and large lakes in the southern portion of the state. Most attacks involve animals over six feet long. Alligators become more active in the beginning of March, peaking in May, which is their mating season. Females will nest in June - July, and the eggs will hatch in August and September. Even a small amount of impounded water may contain a large alligator. Twilight and night are prime times for alligator attacks. Never approach an alligator. Always stay at least 30 yards away. Never wade or swim in areas that could contain large alligators. Do not dump food or scraps into or near the water. This can attract alligators. Always be aware of your surroundings and use caution and common sense. If at any time personnel observe alligators at the site they will immediately inform the SSO, who will then notify the rest of the crew and local wildlife personnel.

Feral Animals

Feral animals such as rats or other wildlife may be encountered during fieldwork. Typically, feral animals are as afraid or more afraid of humans and when encountered will run away from human contact. However, if an animal is diseased, injured or tending a nest, they may become aggressive. The most common disease encountered with feral animals is rabies. Signs of a rabies-infected animal include:

- Changes in an animal's behavior;
- General sickness;
- Difficulty swallowing;
- An increase in drool or saliva;
- Wild animals that appear abnormally tame or sick;
- Animals that may bite at everything if excited;
- Difficulty moving or paralysis; and
- Death.

Animals in the early stage of rabies may not have any signs, although they can still infect you if they bite you. The incubation period is the time from the animal bite to when signs appear. In rabies, it is usually 1-3 months. However, it can last as long as several years. Once the virus reaches the brain or spinal cord, signs of the disease appear. **In the event**

an animal is encountered on the site, do not approach it. If it exhibits one or more of the signs listed above, call local wildlife personnel to get as

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SCOPE

This procedure provides guidance for determining appropriate Personal Protective Equipment (PPE) to be worn at the job site, based on new tasks and chemical or physical agents identified in the field. The initial determination for proper PPE is completed as part of development of the HASP.

DEFINITIONS

None.

PROCEDURE

A. The Site Safety Officer will complete a hazard assessment of the tasks involved and identify the appropriate PPE based on the task and the chemical or physical agents involved. The written hazard assessment certification must be documented in the HASP.

B. The Site Safety Officer will communicate to employees the PPE requirements for the tasks involved.

C. The Site Safety Officer will provide PPE that properly fits the employee(s).

D. The site Safety Officer will conduct daily site walks to verify appropriate use of PPE.

E. RCM Health & Safety Coordinator or the Site Safety Officer will provide training to the employees which includes at least the following:

1. When PPE is necessary;
2. What PPE is necessary;
3. How to properly don, doff, adjust and wear PPE;
4. The limitations of the PPE; and
5. The proper care, maintenance, useful life and disposal of the PPE.

F. Re-training by the Site Safety Officer may be required if:

1. Changes at the job site make previous training obsolete.
2. Changes in the types of PPE make previous training obsolete.
3. Inadequacies in an affected employee’s knowledge or use of PPE indicate the employee requires additional training.

G. Types of PPE include the following:

1. Eye and Face Protection

a. All eye and face protection must comply with ANSI Z87.1-1989.

b. Safety glasses
  - Side shields must be worn when there is a hazard of flying objects.
  - Prescription glasses must meet the ANSI Z87.1-1989 requirements or must have eye protection over them meeting the ANSI standard requirements.

c. Chemical goggles

d. Face shield

2. Head Protection
   a. All head protection (hard hats) must comply with ANSI Z89.1-1989.

3. Foot Protection

   All foot protection must comply with ANSI Z41-1991.
   a. Safety-toed shoes
   b. Rubber boots or rubber safety-toed boots

4. Hand Protection

   Hand protection must be selected based on the performance characteristics of the hand protection relative to the task(s) to be performed, conditions present, duration of use and the hazards and potential hazards identified. The RCM Health and Safety Coordinator must verify and document selection of appropriate chemical resistant gloves.

   a. Work gloves, such as leather or cotton
   b. Chemical gloves, such as nitrile, neoprene, Viton, butyl rubber
   c. Cut-resistant gloves, such as Kevlar

5. Hearing Protection
   a. Ear plugs
   b. Ear muffs

6. Respiratory Protection (Refer to SOP – 9)

7. Other PPE
   a. Disposable Coveralls
   b. Fire Resistant Clothing

REFERENCES

Regulatory References

- 29 CFR 1910.132, Personal Protective Equipment, General Requirements
- 29 CFR 1910.133, Eye and Face Protection
- 29 CFR 1910.135, Head Protection

- 29 CFR 1910.136, Foot Protection
- 29 CFR 1910.138, Hand Protection

Technical References

- ANSI Z87.1-1989, American National Standard Practice for Occupational and Educational Eye and Face Protection
- ANSI Z89.1-1989, American National Standard for Personal Protection – Protective headwear for Industrial Workers – Requirements
- ANSI Z41-1991, American National Standard for Personal Protection – Protective Footwear

Procedural References

- SOP – 9, Respiratory Protection

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	SOP #:	9
	Title:	Respiratory Protection
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SCOPE

This procedure identifies the work practices and regulatory requirements with regard to respiratory protection.

DEFINITIONS

- **Escape Respirators** – Respiratory devices providing protection only during escape from hazardous atmospheres.

- **Hazardous Atmosphere** - (1) Any atmosphere containing a toxic or disease-producing gas, vapor, dust, fume, or mist, either immediately or not immediately dangerous to life or health; or (2) Any oxygen-deficient atmosphere.

- **Immediately Dangerous to Life or Health (IDLH)** – A condition that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate, or delayed, permanent adverse healths effects, or prevent escape from such an environment.

- **Oxygen Deficient Atmosphere** – An atmosphere containing less than 19.5 percent oxygen by volume.

PROCEDURE

A. The Site Safety Officer must verify that all employees required to wear respiratory protection at the jobsite are qualified (i.e., have completed a medical evaluation, been fit-tested and are trained.)

B. The RCM Health and Safety Coordinator will select respiratory protection based on the hazards at the jobsite. Selection of respiratory protection will be completed as part of the hazard assessment when completing the HASP. If unanticipated conditions are encountered at the jobsite requiring a change in respiratory protection, follow the respiratory protection upgrade process defined Section 5 of in the site specific HASP. Additionally , the Site Safety Officer should contact the RCM Health and Safety Coordinator to re-evaluate PPE requirements

C. Inspection

    1. All workers must inspect all non-emergency respirators before each use and during cleaning.
    2. The Site Safety Officer must inspect respirators used for emergency use, at least monthly and in accordance with the manufacturer’s recommendations, and must check for proper function before and after each use. See Section G of this SOP for situations requiring emergency use respirators.

3. Respirator inspection shall include:
   - Check for tightness of connections.
   - Check condition of inlet coverings, head harness, valves, connecting tubes, harness assembly, hoses, filter, cartridges, canisters, end-of-service-life indicator, electrical components, and shelf-life date(s).
   - Check all rubber and elastomeric parts.
   - Check all air cylinders for proper charge.
   - For respirators maintained for emergency use, the inspection must be documented with the date of the inspection, the name of the inspector, the findings, remedial action taken, and a serial number or other means if identifying the respirator. A tag or label must be affixed to the storage compartment and replaced with a subsequent inspection tag/label.
4. Any respirator that does not pass inspection shall be immediately removed from service to be repaired or replaced.

D. Use

1. No facial hair is allowed which could come between the sealing surface of the face piece and the face, or interfere with the valve function.
2. Eye protection must be worn such that it does not interfere with the face piece seal.
3. Conduct a seal-check (positive and negative pressure) every time the respirator is donned.
4. The Site Safety Officer must evaluate continuing respirator effectiveness
   - Maintain surveillance of work area to assess jobsite conditions and respirator wearer(s) exposure or stress levels have not changed;
   - Direct respirator wearers to leave the work area:
     - – to wash their faces and face pieces to prevent eye or face irritation associated with respirator use;
     - – if a respirator wearer detects vapor or gas breakthrough, changes in breathing resistance or leakage of the face piece;
     - – to replace the respirator filter, cartridge or canister elements.
   - If a respirator wearer detects breakthrough, changes in breathing resistance or leakage, they must replace or repair the respirator before returning to the work area. Change schedules for substances other than particulates will be addressed in the HASP or Job Hazard Analysis.

E. Maintenance

1. Clean and sanitize respirator after each use.
2. If respirators are not assigned, each respirator must be cleaned and sanitized before being used by a different employee.

3. Respirators being used for emergency use shall be cleaned after being used. These respirators must contain a tag or label on them telling the last date they were inspected and who inspected them.
4. Each respirator shall be cleaned in warm water (not exceeding 110^0F or 43^0C) with sanitizers that effectively clean the respirator and contain an antibacterial agent. For additional cleaning procedures, refer to 29 CFR 1910.134, Appendix B-2, Respirator Cleaning Procedures (Mandatory).
5. Replacement of parts or repairs may be done only by persons trained in proper respirator maintenance and assembly.
6. Replacement parts used shall be only those designated specifically for the respirator being repaired.
7. Any respiratory equipment not repairable, must be destroyed and discarded.

F. Site workers must store respirators to protect them from:

1. physical damage including face piece or valve deformation;
2. contamination;
3. dust;
4. sunlight;
5. extreme temperatures;
6. excessive moisture; and
7. damaging chemicals.

G. Special Circumstances (including but not limited to Immediately Dangerous to Life and Health (IDLH) or unknown concentrations)

If the Site Safety Officer or Construction Manager encounters special circumstances in the field which were not anticipated in the HASP, such as an IDLH atmosphere or an atmosphere with unknown concentrations or unknown constituents, contact your RCM Health and Safety Coordinator for assistance. Conditions requiring Self-Contained Breathing Apparatus (SCBA) or airline respiratory protection may require additional medical evaluation, fit-test of a different face piece and additional training. Additionally, when using supplied air, additional criteria apply regarding breathing air quality, quantity and flow. For additional information, refer to 29 CFR 1910.134(i).

REFERENCES

Regulatory References

- 29 CFR 1910.134, Respiratory Protection

Technical References

None

Procedural References

- RCM Health and Safety Program, Appendix B, Section 1

REVISION LOG

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12/31/07	0	ELG	Issued for use

	STANDARD OPERATING PROCEDURE	
RCM ERM Remediation & Construction Management	SOP #:	10
	Title:	Confined Space Entry
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SCOPE

This procedure provides work practices to meet regulatory requirements for working in confined spaces and to ensure that proper planning has occurred as part of development of the HASP. There are two types of confined spaces covered by this procedure: a permit-required confined space and a non-permit confined space.

DEFINITIONS

- **Confined Space** – An area which:
    - Has adequate size and configuration for employee entry;
    - Has limited means of access or egress; and
    - Is not designed for continuous employee occupancy.

- **Entry into a Confined Space** – The action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

- **Non-permit Confined Space** - A confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

- **Permit-Required Confined Space** – A confined space that has one or more of the following characteristics:
    - Contains or has a potential to contain a hazardous atmosphere;
    - Contains a material that has the potential for engulfing an entrant;
    - Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
    - Contains any other recognized serious safety or health hazard.

PROCEDURE

A. It is RCM's standard policy and practice to never enter into a confined space, as defined above. However, there may be situations which require entry into a confined space. In those situations, a detailed written Confined Space Entry Program must be developed for the specific site and specific conditions anticipated to be encountered. Under these circumstances, he RCM Health and Safety Coordinator will develop the Confined Space Entry Program as part of the site specific HASP.

B. Additionally, specific training must be completed for any individual(s) involved in confined space entry.

REFERENCES

Regulatory References

- 29 CFR 1910.146, Permit-Required Confined Spaces

Technical References

None

Procedural References

- ERM Corporate Health and Safety Program, Tanks, Vaults and Manholes

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ERM

SAFE WORK PRACTICE	
SOP #:	13
Title:	Excavation
Last Rev.:	12/31/07
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SCOPE

This procedure provides requirements and safe work practices for personnel involved in excavation work. Please review the Excavation Safety Checklist (Attachment 1) in verifying that this procedure is being followed.

DEFINITION

- **Accepted Engineering Practices** – those requirements, which are compatible with standards of practice required by a registered professional engineer.
- **Benching (Bench System)** – a method of protecting employees from cave-ins by excavating the sides of an excavation from one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.
- **Cave-in** –the separation of a mass of soil or rock from the sides of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity to entrap, bury, or otherwise injure and immobilize a person.
- **Competent Person** - one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them
- **Excavation** - any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.
- **Face or Sides** – the vertical or inclined earth surfaces formed as a result of excavation work.
- **Hazardous Atmosphere** – an atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.
- **Protective System** –a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective Systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.
- **Registered Professional Engineer** – a person who is registered as a professional engineer in the state where the work is to be performed.
- **Shield (Shield System)** –a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect workers with in the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses.

- **Shoring (Shoring System)** – a structure such as a metal hydraulic lift, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.
- **Sloping (Sloping System)** –a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation. The angle of incline required to prevent a cave-in varies with differences in factors such as the soil type, environmental conditions of exposure, and application of surcharge loads.
- **Support System** – means a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

PROCEDURE

A. Prior to the start of excavation, the Construction Manager must complete the ERM subsurface clearance procedure to verify clearance of subsurface hazards at the excavation site. Subcontractor Contact should identify the location of utility installations (e.g., sewer, telephone, electric, water lines, etc.) that may be expected to be encountered during excavation.

  1. Contact the utility company (-ies) and advise of proposed work requesting them to establish the location of the underground installations.
  2. Underground installations must be protected, supported, or removed as necessary to safeguard employees.

B. When equipment is operated adjacent to an excavation or is required to approach the edge of an excavation, a warning system, such as barricades, hand or mechanical signals, or stop logs must be utilized. The system should be inspected:

  1. Prior to the start of work and as needed throughout the shift.
  2. After every rainstorm or other site condition change that could increase the instability of the excavation.

C. To prevent exposure to harmful levels of atmospheric contaminants or oxygen deficiency (atmospheres containing less than 19.5% oxygen), the following requirements apply:

  1. The atmospheres in the excavation must be tested before employees enter excavations greater than 4 feet in depth per SOP 10 Confined Space Entry
  2. The proper respiratory protection should be provided per SOP – 9 Respiratory Protection.

   3. When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing must be conducted as often as necessary to verify that the atmosphere remains safe.

D. Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, must be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. The equipment should be attended when in use.

E. Employees should not work in excavations where water has accumulated or is accumulating, unless protective measures such as special support or shield systems to protect from cave-ins have been implemented to protect the employees against the hazards posed by water accumulation.

   1. If water is controlled or prevented from accumulating by the use of water removal equipment, a competent person must monitor the water removal equipment and operations.
   2. Diversion ditches, dikes, or other suitable means must be used to prevent surface water from entering the excavation and to provide drainage of the area adjacent to the excavation.
   3. Excavations subject to runoff from heavy rains require an inspection by a competent person.

I. Stability of other structures endangered by excavation operations must be stabilized by support systems such as shoring, bracing, or underpinning for the protection of employees. A registered professional engineer should be consulted for determination of stability of structures that may be affected during the excavation work.

K. Subcontractor Contact should verify materials and equipment are free from damage or defects that might impair their proper function.

L. Daily inspections of excavations, the adjacent areas, and protective systems must be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. A helpful excavation safety checklist is provided as Attachment 1.

ATTACHMENT

- Excavation Safety Checklist

REFERENCES

Regulatory References

- 29 CFR 1926.650 Scope,Application, and Definitions Aapplicable to this Subpart (Subpart P).
- 29 CFR 1926.651 Specific Excavation Requirements.
- 29 CFR 1926.652 Requirements for Portective Systems.

Technical References

None

Procedural References

ERM's Subsurface Clearance Procedure

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ATTACHMENT 1: EXCAVATION SAFETY CHECKLIST

Job Site	Yes	No	NA
Prior to starting the job, were utilities notified and underground services located?	☐	☐	☐
Were overhead transmission lines noted and precautions taken to ensure that equipment does not come in contact with them?	☐	☐	☐
Have adequate signs been posted and barricades provided?	☐	☐	☐
Are the workers wearing reflective vests, if necessary?	☐	☐	☐
Are vehicles, equipment, and spoil piles correctly placed to allow for the safe passage of traffic and the progress of the construction?	☐	☐	☐
Has traffic control (fire depts., etc.) been notified?	☐	☐	☐

Excavation	Yes	No	NA
Have the supervisors and workers been trained in excavation safety laws and procedures?	☐	☐	☐
Have building, utility poles, trees and any other surface encumbrances or destabilizing forces been taken into consideration?	☐	☐	☐
Has soil classification been done?	☐	☐	☐
Has the appropriate means of safeguarding the excavation by OSHA requirements been determined by a Competent Person?	☐	☐	☐
For excavations 4 feet (1.2 meters) deep or more, are ladders, steps or ramps available within25 feet (7.6 meters) of lateral travel?	☐	☐	☐
Are all open pits or shafts either covered or barricaded?	☐	☐	☐

Job Site	Yes	No	NA
Is the appropriate safety gear on site?	☐	☐	☐
Have undermined structures been shored, braced or underpinned, or has a registered Prof. Engineer determined that such measures are not necessary?	☐	☐	☐
Are utilities crossing the excavation supported from above and does protection from falling materials exist?	☐	☐	☐

Excavation	Yes	No	NA
Are spoil piles at least 2 feet from the edge of the excavation and properly sloped?	☐	☐	☐
Have confined-space atmospheric hazards been considered?	☐	☐	☐
Do bridges and walkways have standard guardrails?	☐	☐	☐
Have means been provided to remove water from the excavation?	☐	☐	☐
Competent person available on site at all times.	☐	☐	☐

NOTE: Shoring and shielding must be removed in a manner that ensures the safety of workers, and excavations must be back filled as soon as work is completed.

ERM	STANDARD OPERATING PROCEDURE	
	SOP #:	14
	Title:	Fall Prevention and Fall Protection
	Last Rev.:	12/31/07
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SCOPE

This procedure provides work practices to meet regulatory requirements regarding fall prevention/fall protection for all employees working 6 feet or more above a lower level.

DEFINITIONS

None.

PROCEDURE

A. Fall prevention/protection is required when there is an unprotected side or edge which is 6 feet or more above a lower level. Example situations include but are not limited to:

1. Horizontal walking/working surfaces;
2. Leading edges;
3. Holes in flooring or walls;
4. Formwork and reinforcing steel;
5. Ramps, runways and other walkways;
6. Excavations;
7. Roof work;
8. Precast concrete erection; and
9. Walking/working surfaces not otherwise addressed.

B. In addition, protection from falling objects must also be provided to employees working below, by requiring the use of head protection as well as one of the following methods:

1. Erect toeboards, screens or guardrail systems to prevent objects from falling from higher levels; or
2. Erect a canopy structure and keep potential objects far enough from the edge so they would not go over if they were accidentally misplaced; or
3. Barricade the area into which the objects could fall and prohibit employees from entering into the barricaded area.

C. Where fall prevention, in the form of a physical barrier, is not feasible, and a fall hazard exists, fall protection is mandatory. Fall protection can take on many forms depending on the job task being performed, i.e., permanent and temporary vertical and horizontal lifeline systems, full body harness, shock absorbing lanyards, nets, retractable devices, etc. These are some of the most common methods of fall protection available.

D. In the event work is to be conducted at a height greater than 6 feet, fall prevention and/or fall protection requirements must be incorporated into the HASP. The RCM Health and Safety Coordinator must develop a fall prevention/protection plan which will incorporate the use of physical barriers, administrative controls or fall protection equipment.

E. Additionally, training must be completed for any individual who will be using fall prevention / fall protection equipment. The Site Safety officer must verify all workers have received the appropriate training relative to fall prevention / fall protection.

REFERENCES

Regulatory References

- 29 CFR 1926.501, Duty to Have Fall Protection
- 29 CFR 1926.502, Fall Protection Systems Criteria and Practices

Technical References

None

Procedural References

None

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RCM **ERM** Remediation & Construction Management	**STANDARD OPERATING PROCEDURE**	
	SOP #:	16
	Title:	Forklift /Truck Operations
	Last Rev.:	12/31/07
	Page:	1 of 2

SCOPE

This procedure provides guidance on meeting regulatory requirements and provides expectations for the safe use, and handling of forklift/ trucks.

DEFINITIONS

None.

PROCEDURE

A. TRAINING

1. The Construction Manager should verify that each forklift/ truck operator is trained and certified to operate a fork lift /truck per the requirements of 29 CFR 1910.178 Powered Industrial Trucks .
2. Refresher training in relevant topics shall be provided when the operator:
   a. Is assigned to drive a different type of truck
   b. Operates the forklift in an unsafe manner
   c. Experience an incident
3. Operators shall be required to be re-evaluated at least once every three years.

B. INSPECTIONS

1. Prior to operating a forklift, the operator shall examine the unit for conditions that adversely affect the safety of the vehicle.
2. A lift truck found to be unsafe to operate shall have the ignition key removed and a "OUT OF SERVICE" tag attached to the steering wheel, noting the unsafe condition or reason it has been taken out of service.
3. Any truck found with a tag must be repaired before being used.

C. OPERATION

1. Forklift/ truck shall be operated in accordance with the manufacturer's operating procedures and regulatory requirements.
2. The lifting capacity of the forklift/ truck should not be exceeded. Capacities are located on a plate attached to the truck.
3. An unstable load should never be lifted.
4. Obey all signs and warnings.
5. Lifting personnel for repairs or maintenance shall be done only in approved cages or platforms.
6. Forklifts have a high center of gravity and should be driven slowly around turns and curves to prevent rollover.
7. Spread the forks out as far as they will go when picking up material. Also, if the forks are longer than the load, be careful not to disturb what is behind the load.
8. Never allow anyone to stand or walk under a raised load.

9. Before moving the truck, check to make sure that there are no obstacles in your way.
10. Always turn your head when backing up. Mirrors are to see what is behind you while moving forward.
11. Come to a complete stop before changing directions.
12. Drive extra slow on wet and slippery surfaces.
13. The seatbelt must be worn at all times.
14. Never dismount the forklift while it is running.
15. Never leave a load raised.
16. Never drive on a slope with a raised load.
17. Always drive perpendicular to a slope
18. Always verify the ability of surfaces to support the equipment before operating the forklift/truck non non-paved surfaces

REFERENCES

Regulatory References

- 29 CFR 1910.178 Powered Industrial Trucks

Technical References

None

Procedural References

None

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SCOPE

This procedure defines minimum expectationse for the safe use and maintanence of tools and equipment, including tools and equipment which may be furnished by employees.

DEFINITIONS

Torque: The circular or rotating motion in tools such as drills, impact wrenches, saws, etc. which results in a strong twisting force

PROCEDURE

A. HAND TOOLS

1. Every tool was designed to do a certain job and employees should use tools only for their intended purpose.
2. Maintain hand tools in good condition - sharp, clean, oiled. .
3. Do not force tools beyond their capacity or use "cheaters" to increase their capacity. Do not use tools for pry bars.

B. PORTABLE POWER TOOLS

1. GUARDING

Guards or shields must be installed on all power tools before issue. Do not use improper tools or tools without guards in place.

C. OPERATING PRACTICES

1. Loose clothing, rings, and other jewelry must not be worn around operating machines. Keep sleeves buttoned or rolled up.
2. Keep fingers away from moving parts. Shut off machines to remove waste. Use a brush to clean up and debur. Be sure machine is fully stopped and not coasting.
3. Inspect at least daily before start-up. Look for loose or damaged parts and inadequate lighting.
4. Use clamps or vise to hold work.
5. Many machines have Safety Interlocking devices. Verify their operation prior to use , and NEVER BYPASS SAFETY INTINTERLOCK DEVICES.
6. Examine each power tool before using it. Look for damaged parts, loose fittings, frayed or cut electric cords. Tag and return defective tools for repairs.

7. Some machines use both pneumatic and electric power. Both must be shut off to make repairs or to adjust moving parts. Bleed down tool to remove any stored energy left in the system.
8. Be prepared in case of jamming**.** Maintain good footing; and use two hands, Circular saws, chain saws and percussion tools shall not be equipped with a locking switch or trigger
9. Flying objects can result from operating almost any power tool. Be aware of others working around you and use proper eye protection.
10. Keep moving parts directed away from your body. Never touch a powered part unless power source is disconnected (such as drill chucks, blades, and bits).
11. Ground Fault Circuit Interrupters (GFCI) are required when using electrical power tools.

REFERENCES

Regulatory References

- 29 CFR 1910.241 Definitions.
- 29 CFR 1910.242 Hand and Portable Powered Tools and Equipment, General.
- 29 CFR 1910.243 Guarding of Portable Power Tools.
- 29 CFR 1910.244 Other Portable Tools and Equipment.
- 29 CFR 1926.300 General Requirements.
- 29 CFR 1926.301 Hand Tools.
- 29 CFR 1926.302 Power-operated Hand Tools.

Technical References

None

Procedural References

SOP 08 Personnel Protective Equipment

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RCM **ERM** Remediation & Construction Management	**STANDARD OPERATING PROCEDURE**	
	SOP #:	19
	Title:	Heavy and Material Handling Equipment
	Last Rev.:	12/31/07
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SCOPE

This procedure defines requirements for safe operation of heavy equipment operation. Heavy equipment includes backhoes, cranes, derricks, dozers, loaders, skid steers, and trucks.

DEFINITIONS

- **Crane** - means a mechanical device, intended for lifting or lowering a load and moving it horizontally, in which the hoisting mechanism is an integral part of the machine. A crane may be a fixed or mobile machine.
- **Derrick** - A "derrick" is an apparatus consisting of a mast or equivalent member held at the head by guys or braces, with or without a boom, for use with a hoisting mechanism and operating ropes.

PROCEDURE

A. TRAINING

1. Equipment operators must demonstrate training and experience with each piece of equipment before receiving authorization to begin work.

B. INSPECTION

1. All heavy equipment must meet applicable design standards (i.e., ANSI, etc.).
2. The equipment must have a copy of the most recent annual and periodic inspections onboard.
3. The Subcontractor Contact or a designated qualified person must inspect all heavy equipment prior to operation (See Crane and Derrick Inspection Checklist), to verify proper working condition.
4. A copy of the manufacturer’s operating manual must be carried on all heavy equipments. The manual must include a load-rating chart that indicates safe loads in various configurations, wire and cable minimums and maximums, and any special operating considerations.

C. OPERATION

1. The Subcontractor must have a standard operating procedure that is implemented for heavy equipment operation.
2. Equipment must be operated in accordance with the manufacturer's instructions and recommendations.

3. Before starting equipment, the equipment operator must make sure no one is working on or near the machinery. If equipment must be operated in close proximity to other operations, a spotter will be required to work with the equipment operator. The spotter and equipment operator must be in radio communication
4. Equipment operators must wear seatbelts and operate equipment in accordance with safe operating speeds and loading
5. When working on slopes, the equipment should be positioned perpendicular to the slope with the center of gravity of the equipment on the lower edge of the slope.
6. Dump trucks must lower their beds **PRIOR** to moving from the dump site
7. All employees should wear appropriate personal protective equipment in accordance with SOP – 8 Personal Protective Equipment.
8. Equipment operators should not get on or off a moving machine.

Note: If heavy equipment is located near overhead power lines, refer to SOP – 12 Electrical Safety to determine safe working distances.

ATTACHMENTS

- Crane and Derrick Inspection Checklist

REFERENCES

Regulatory References

- 29 CFR 1910.181 Derricks.
- 29 CFR 1926.550 Cranes and Derricks.
- 29 CFR 1926.600 Equipment.
- 29 CFR 1926.601 Motor Vehicles.
- 29 CFR 1926.602 Material Handling Equipment.

Technical References

None

Procedural References

RCM SOP – 8 Personal Protective Equipment
RCM SOP – 12 Electrical Safety

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ATTACHMENT 1

CRANE AND DERRICK INSPECTION CHECKLIST

Prior to operation each day, inspect:

1. All control mechanisms for maladjustment interfering with proper operation.

2. All control mechanisms for excessive wear of components and contamination by lubricants or other foreign matter.

3. All operator aids, motion and load limiting devices, and other safety devices for malfunction and inaccuracy of settings.

4. All chords and lacing.

5. All hydraulic and pneumatic systems - with particular emphasis given to those which flex in normal operation of the crane.

6. Hooks and latches for deformation, chemical damage, cracks, and wear.

7. Rope for proper spooling onto the drum(s) and sheave(s) and rope reeving for compliance with crane manufacturer’s specifications.

8. Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, and moisture accumulation.

9. Hydraulic system for proper oil level.

10. Tires for recommended inflation pressure (mobile cranes).

11. Wedges and supports for looseness or dislocation (climbing tower cranes).

12. Braces and guys supporting crane masts; anchor bolt base connections for looseness or loss of preload (tower cranes and derricks).

13. Derrick mast fittings and connections for compliance with manufacturer's recommendations.

14. Barge or pontoon ballast compartments for proper ballast; deck loads for proper securing; chain lockers, storage, fuel compartments, and battening of hatches; fire fighting and lifesaving equipment in place and functional; hull void compartments sounded for leakage (floating cranes and derricks).

RCM ERM Remediation & Construction Management	STANDARD OPERATING PROCEDURE	
	SOP #:	20
	Title:	Ladder Safety
	Last Rev.:	12/31/07
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SCOPE

This procedure defines inspection, uses, handling, repair/disposal of defective ladders, and the type of ladders to be purchased.

DEFINITIONS

- **Ladders** - A ladder is an appliance usually consisting of two side rails joined at regular intervals by crosspieces called steps, rungs, or cleats, on which a person may step in ascending or descending.

- **Extension ladder** - An extension ladder is a non-self-supporting portable ladder adjustable in length. It consists of two or more sections traveling in guides or brackets so arranged as to permit length adjustment. Its size is designated by the sum of the lengths of the sections measured along the side rails.

- **Step ladder** - A stepladder is a self-supporting portable ladder, nonadjustable in length, having flat steps and a hinged back. Its size is designated by the overall length of the ladder measured along the front edge of the side rails.

- **Special-purpose ladder** - A special-purpose ladder is a portable ladder, which represents either a modification or a combination of design or construction features in one of the general-purpose types of ladders previously defined, in order to adapt the ladder to special or specific uses.

PROCEDURE

A. The following rules apply to *all ladders:*

1. Maintain ladders free of oil, grease and other slipping hazards.
2. Do not load ladders beyond their maximum intended load nor beyond their manufacturer's rated capacity.
3. Use ladders only for their designed purpose.
4. Use ladders only on stable and level surfaces unless secured to prevent accidental movement.
5. Do not use ladders on slippery surfaces unless secured or provided with slip-resistant feet to prevent accidental movement. Do not use slip-resistant feet as a substitute for exercising care when placing, lashing, or holding a ladder upon slippery surfaces.
6. Secure ladders placed in areas such as passageways, doorways, or driveways, or where they can be displaced by workplace activities or traffic to prevent

accidental movement. Alternatively, use a barricade to keep traffic or activity away from the ladder.

7. Keep areas clear around the top and bottom of ladders.
8. Do not move, shift, or extend ladders while in use.
9. Use ladders equipped with nonconductive side rails if the worker or the ladder could contact exposed energized electrical equipment.
10. Face the ladder when moving up or down.
11. Use at least one hand to grasp the ladder when climbing.
12. Do not carry objects or loads that could cause loss of balance and falling.
13. All ladders shall be inspected prior to use.
    a. Side rails, rungs, and steps.
    b. Safety feet of extension and straight ladders.
    c. Hardware guides, pawls and spreaders of stepladders.
    d. Extension rope and/or tie off rope.
14. It is the user's responsibility to check the ladder each time you use it! Any defective ladder that is repairable will be tagged with a "Dangerous, Do Not Use" tag and taken out of service until repairs are made.
15. When working off a ladder - (Many Sites have policies more stringent than ours. We must always follow the most stringent).
    a. Face the ladder when ascending or descending.
    b. Only one person at a time on the ladder.
    c. Be sure the ladder is stable.
    d. Keep both feet on the ladder rungs. Do not place one foot on a line or piece of equipment and the other on the ladder to keep within reach of the work.
    e. Check overhead for power lines and other obstructions.
    f. Fall protection is required if you must stand backwards on the ladder, and under certain other hazardous conditions.
    g. Protect other persons in the area by barricading/roping off the area.
    h. A person must be tied off to an adequate overhead structure when working the same distance or less from an edge or elevation as the height of the ladder. Example: Working 8′ from an edge while working off an 8′ or higher ladder.

B. The following rules apply to straight and extension ladders.

1. Use help when raising or lowering a ladder. One person should walk the ladder up or down while the second person foots the base of the ladder.
2. Ladders shall not be used in a horizontal position as platforms, runways, or scaffolds.

3. Where portable straight ladders are used, they shall be of sufficient length to extend three feet (36 inches) above the upper landing surface, and be positively secured or held against shifting or slipping.
4. Hand lines shall be used to raise and lower tools and material that cannot be carried in tool belts.
5. Straight and Extension Ladders shall be pitched to assure the ladder base is one-quarter the overall working height of the ladder.
6. Use a safety harness and tie off when you are on the seventh (7) rung or of a ladder or are six (6) feet or more off the ground. Tying off is required when working backwards or when other critical or hazardous work is being performed.
7. All ladders shall be tied off adequately at the top. The only exception is when the ladder is only to be used for inspection or other one-trip activity not involving actual work. If a ladder is climbed without, being tied off, it must be "footed" and held at the base by a ground person.
8. When performing work from a ladder that requires a person to be tied off, the person can be tied off to the rail of the ladder itself. This method may only be used only if there is no other adequate tie off and the ladder is properly tied off.
9. Do Not tie to the rung of the ladder, if the rung breaks, you will fall to the ground. If tying to the ladder, only tie to the rail of the ladder.

C. The following rules apply to step ladders.

1. The top step of any stepladder, 3 feet and over shall not be used to stand on.
2. Stepladders are not to be used as straight ladders.
3. Step ladders 10 feet or higher must be tied off.
4. A person is required to be tied off when working on the seventh (7) step of a stepladder.
5. A person is required to be tied off, when working under (6) foot, when:
    - a. The task is critical or hazardous.
    - b. The person is standing backwards on the ladder.
    - c. Site regulations require tying off.
6. You may step off a stepladder to a suitable safety platform or work area. Good, SAFE, common sense must be utilized. Stepping off is not allowed if:
    - a. Site regulations prohibit this practice.
    - b. It is necessary to step off the top or next to the top step of the ladder.
    - c. The ladder is not stable and firm. Whenever possible, the top of the ladder should be tied off or held by a second person to enhance stability.
    - d. The ladder cannot be secured directly to the platform that the employee is stepping onto.

REFERENCES

Regulatory References

- 29 CFR 1910.25 Portable Wood Ladders
- 29 CFR 1910.26 Portable Metal Ladders
- 29 CFR 1910.27 Fixed Ladders
- 29 CFR 1926.1053 Ladders

Technical References

None

Procedural References

None

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SCOPE

This procedure defines requirements for employees on acquiring a permit prior to line breaking and the process for installing and removing a blank. Refer to Attachment 1 Line Breaking and Blanking Checklist to verify the procedure is being followed.

DEFINITIONS

- **Blanking or Blinding** -the absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.
- **Double Block and Bleed** - the closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.
- **Line Breaking** -the intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

PROCEDURE

A. PERSONAL PROTECTIVE EQUIPMENT

The appropriate type of personal protective equipment (PPE) employed in a given line breaking situation will vary with the hazards associated with the material, equipment, location and ability to verify that the equipment/line is clear.

1. The minimum protective equipment in any line-breaking situation that must be worn is:
    a. Hardhat
    b. Appropriate chemical resistant gloves
    c. Face shield
    d. Goggles
    e. Appropriate chemical protective clothing.
2. Additional PPE, including respiratory protection, should be used as needed per SOP-08 Personnel Protective Equipment and SOP-09 Respiratory Protection.
    a. When the lines, nozzles, fittings, tanks or vessel contains, or has ever contained, hot liquids, hazardous materials, acid at any strength, caustic or poisonous substances.
    b. Where the activity in working on the line is an emergency one resulting from

from a leak or other abnormal situation such as the build-up of pressure.

B. LINE BRAKING OPERATIONS

1. The Subcontractor Contact responsible for the team members making the break must check to assure the break location is physically marked(i.e. Painted, Tagged) prior to the break and verified by the Construction Manager that the break site is correct.

Special Hazard: A competent person must attend at the point of the actual line break whenever a hazardous condition is found or known to exist.

a. The portion of the line being worked on shall be isolated from those preceding and following it in the most effective way. This will usually consist of blanking or shutting valves and locking and tagging them per Lockout / Tagout SOP - 22.

b. Coordination between the Construction Manager and the Subcontractor Contact shall be such that each knows the line is being worked on. No other process work, maintenance or sampling is to be done on the line at the same time without mutual agreement that such work represents no danger to the men working on the line.

2. The Subcontractor should have a permitting process that applies to jobs requiring opening of or working on any process line; permanent or temporary, connected fittings, valve, pump or vessel, including blockages which have ever contained acid, caustic, flammable or other hazardous liquid or gas, no matter how long ago; or presently contains hot materials such as steam.

Examples of such lines are:

a. Acid
b. Caustic
c. Chlorine
d. Anhydrous Ammonia
e. Sulphur
f. Natural Gas and Steam
g. Instrument Air

3. All openings made during the course of the job should be documented and checked for closure before completion of the job and released for resumption of normal use.

4. A qualified gas tester must do a line clearance test, and testing should continue throughout the procedure.

5. Burning off old flange bolts is to be considered the last resort, and should be done only if all other alternative methods have been exhausted, such as splitting nuts with a nut buster, sawing all the way through or partial cutting then wringing off. Using spark proof tools and/or beryllium wrenches is the preferred method.

C. BLANKING OR BLINDING OPERATIONS

1. Blanking can only be performed by qualified and trained personnel.
2. All blank material must be compatible with the parent metal being blanked.
3. All gaskets must be compatible with the product (i.e., acid, caustics, water, etc.).
4. Installation or removal of any blank should follow the Subcontractor's permit process.
5. All product in the line must be retained in a catch basin or pumped to a compatible container. – Draining lines to the ground is prohibited except for potable water lines.
6. When relieving pressure on air or gas line blanks, earplugs must be worn because screaming often occurs due to pressure.
7. When the product in the line has pressure, make sure you are aware of the direction of the bleed-off. The area must be barricaded. Only personnel directly involved in the line breaking should be in the area.
8. The Construction Manager and Subcontractor Contact must be aware of any blanking activity, and must be present on all first breaks.

ATTACHMENT

- Line Breaking and Blanking Checklist

REFERENCES

Regulatory References

- 29 CFR 1910.146 Permit – Required Confined Spaces.

Technical References

None

Procedural References

- SOP – 08 Personnel Protective Equipment
- SOP – 09 Respiratory Protection
- SOP – 10 Confined Space Entry
- SOP – 22 Lockout / Tagout

REVISION LOG

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12/31/07	0	ELG	Issued for use

ATTACHMENT 1

LINE BREAKING AND BLANKING CHECKLIST

Complete this section before signing, by checking off all of the appropriate boxes. Be prepared to discuss and/or answer any questions pertaining to this Line break, before requesting the permit.

YES	NO	N/A		
___	___	___	1.	Does this Line break involve acid, caustic, hazardous material or gas?
___	___	___	2.	Is it necessary to wear an acid suit, acid hood, boots and gloves as required by the blanking and line breaking conditions?
___	___	___	3.	Does the line, tank, vessel, etc., require obtaining a hot work permit, an explosive gas test, or any other type of permit?
___	___	___	4.	Will the opening of this line break cause a change in the area conditions and/or atmospheric conditions?
___	___	___	5.	Is it necessary to steam, purge, or flush out?
___	___	___	6.	Is respiratory protection required? If so, what type must be worn?
___	___	___	7.	Is there an adequate water supply with the adequate pressure at the line break location?
___	___	___	8.	If the hose is valved off, is there a possibility of freezing?
___	___	___	9.	Has the steam tracing been shut off and bled down and locked out?
___	___	___	10.	Is the area roped off and/or barricaded?
___	___	___	11.	Do you have the proper type fire extinguisher nearby?
___	___	___	12.	Have you planned an escape route in the event of an emergency?
___	___	___	13.	Is there a possibility of a spray, do you need to shield?
___	___	___	14.	Has the line, tank, vessel, etc., been properly drained into a suitable container for safe handling and environmental control?
___	___	___	15.	Have all of the vents been opened to prevent the possibility of an air lock?
___	___	___	16.	Does this line break involve a radiation hazard?
___	___	___	17.	Has the proper type scaffolding been erected, including a proper ladder for access and egress?

___ ___ ___ 18. Have all of the valves been properly positioned, (whether opened or closed as required) locked, tagged, and tried as per SOP – 22 Lockout / Tagout?

___ ___ ___ 19. Have all pumps, starters, hydraulic, electric or other forms of energy been brought to a zero state of energy, then locked, tagged, or blocked?

___ ___ ___ 20. Do you have all of the necessary equipment such as tools, blanks, bolts, gaskets, etc. on hand before the actual break begins?

STANDARD OPERATING PROCEDURE	
SOP #:	22
Title:	Lockout/Tagout
Last Rev.:	12/31/07
Page:	1 of 3

SCOPE

This procedure provides guidance on the control hazardous of energy to prevent injury to employees due to unexpected start-up or release of stored energy.

DEFINITIONS

- **Affected Employee**

  Any employee whose job requires them to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout/tagout or whose job requires them to work in an area in which such servicing or maintenance is being performed.

- **Authorized Employee**

  Any employee who locks out or initiates a tagout procedure on machines or equipment in order to perform servicing or maintenance on that machine or equipment. An affected employee becomes an authorized employee when that employee's duties include performing servicing or maintenance covered under this procedure.

- **Circuit Breaker**

  Switch (housed in a distribution panel) controlling the flow of electricity (on/off) to the electrical equipment.

- **Control Switch**

  The switch controlling the flow or electricity between the disconnect switch source and the electrical equipment. Also called:

  a. Start-Stop button.
  b. Butterfly switch.
  c. Control station.

- **Disconnect Switch**

  Switch (normally housed in an electrical control room) controlling the flow of electricity (on/off) to the equipment and its control switch. This switch is also called:

  a. Combination starter switch.
  b. Switch and starter.

- **Zero Mechanical or Energy State**

  That state of a machine in which every power source that can produce machine member movement has been locked out. This includes blocking, controlling or isolation of electric, kinetic or potential energy sources

- **Multi-Lockout Devices**

  A multi-lockout hasp mechanism which can be used so more than one lock can be attached during a lockout. Lock boxes are another alternative for using multiple locks.

- **Personal Lock**

  A safety lock used by authorized personnel that is durable and capable of withstanding excessive force. Any authorized employee uses it to lock out equipment. All locks will be on a "One Lock, One Key, One Employee" system.

- **Tags**

  A standard tag signed and dated shall be attached to the individual's lock. The tag shall be attached by passing the grommet through the lock shackle. The legend on the tag shall read, "DANGER, DO NOT OPERATE". Tags shall be capable of withstanding the environment to which they are exposed for a maximum period of time that exposure is expected.

PROCEDURE

1. The Construction Manager shall inform the affected party responsible for the machinery or equipment being repaired or serviced that the equipment needs to be shut down so it can be locked out, tagged out and tried (electrical only).
2. The authorized party shall be responsible for the de-energizing switches, circuit breakers, pneumatic valves, or hydraulic valves, which control the operations of machinery or equipment that contains or ever contained hazardous energy.
3. Prior to the start of any work, all machines and equipment must be brought to a "zero mechanical/energy state. The Authorized Employee conducting the lockout should attempt to activate ("Try") the equipment with the starting device, to verify the equipment does not show any sign of stored energy.
4. Each authorized employee shall remove their personal lock and tag when they have completed their job and are no longer required to perform any other task on the equipment.
5. When work continues beyond the shift, an individual's lock and tag may remain in place if the Site allows. However, when returning to continue the work, each individual shall check their own lock and tag prior to starting work. Each individual must re-date their tag daily through out the duration of the job. The re-dating will confirm that the individual checked their personal lock, assuring the equipment remains locked out.
6. Shift change and new crews coming in requires the change-out of locks and tags.

A. GROUP LOCKOUT

1. When it is impractical because of the magnitude or complexity of large jobs such as major facility shutdown or overhaul, group lockout can be utilized.

   a. The Construction Manager shall be responsible for arranging the shutdown for energized equipment to be locked and tagged out.
   b. The Subject Matter Expert shall apply locks and tags to all disconnect switches to be worked on.
   c. The keys shall be placed in a group lockbox or comparable mechanism. It shall have a hasp and keeper, which will permit application of a "Lockout Device" so it can accommodate more than one lock.
   d. Each authorized employee shall affix their personal locks and tag with their name and date to the "Lockout Device" on the "Group Lockbox".
   e. Each authorized employee is to test by "Trying" the control switch to assure the equipment has been electrically de-energized before starting work.

REFERENCES

Regulatory References

- 29 CFR 1910.147 The Control of Hazardous Energy (Lockout/Tagout).

Technical References

None

Procedural References

None

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RCM **ERM** Remediation & Construction Management	**STANDARD OPERATING PROCEDURE**	
	SOP #:	23
	Title:	Wall and Floor Penetrations
	Last Rev.:	12/31/07
	Page:	1 of 2

SCOPE

This procedure provides guidance on the minimum safety requirements for wall / floor penetrations. Potential hazards that may exist when wall / floor openings are made (in addition to fall hazards) include but are not limited to, concealed pipes, existing electrical wiring, telephone lines and fire alarms.

PROCEDURE

Prior to cutting into walls/floors, visually survey the area of penetration to see if there are any pipes or electrical services that my present an obstacle. If blueprints are available, the Subcontractor should review the prints to determine if any services are present that may be hidden in the wall/floor. Hidden hazards should be expected. Services may be supplied from adjacent floors, rooms or concealed in floors.

Prior to cutting / penetrating walls / floors:

1. Determine if the wall is bearing or nonbearing.
2. For interior walls, remove the ceiling tiles to help determine what services may be hidden in the wall.
3. Cutting both faces of the wall at the same time is prohibited.
4. Barricade both sides of the wall or floor.
5. When it has been determined that utilities are in the wall or floor, and may present a hazard / interference, SOP 22 "Lockout/Tagout Procedure" must be implemented.
6. All floor or wall openings must comply with OSHA 29 CFR 1910.23 "Guarding Floor and Wall Openings and Holes".
7. Before any power saws are used on masonry walls or floors, a visual inspection of both sides of the surface must be made for all utilities.
8. On hollow core walls, exploratory openings shall be made prior to creating an enlarged opening utilizing power tools.
9. The Subsurface Clearance Process must be followed for poured floors requiring core boring.

REFERENCES

Regulatory References

- 29 CFR 1910.23 Guarding Floor and Wall Openings.

Technical References

None

Procedural References

ERM Subsurface Clearance Procedures

REVISION LOG

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MANDATORY APPENDICES

A	*SITE LOCATION MAP AND MAP TO HOSPITAL*
B	*JOB HAZARD ANALYSES*
C	*SUBSURFACE CLEARANCE REQUIREMENTS*
D	*SITE INSPECTION CHECKLIST*
E	*PERSONAL SAFETY CONTRACT CARDS*
F	*WORK PERMIT FORMS*
G	*PROJECT MATERIAL SAFETY DATA SHEETS*
H	*AIR MONITORING DOCUMENTATION FORM*
I	*EMERGENCY DRILL EVALUATION FORM*
J	*INCIDENT REPORTING & INVESTIGATION FORM*
K	*DAILY SAFETY MEETING DOCUMENTATION FORM*

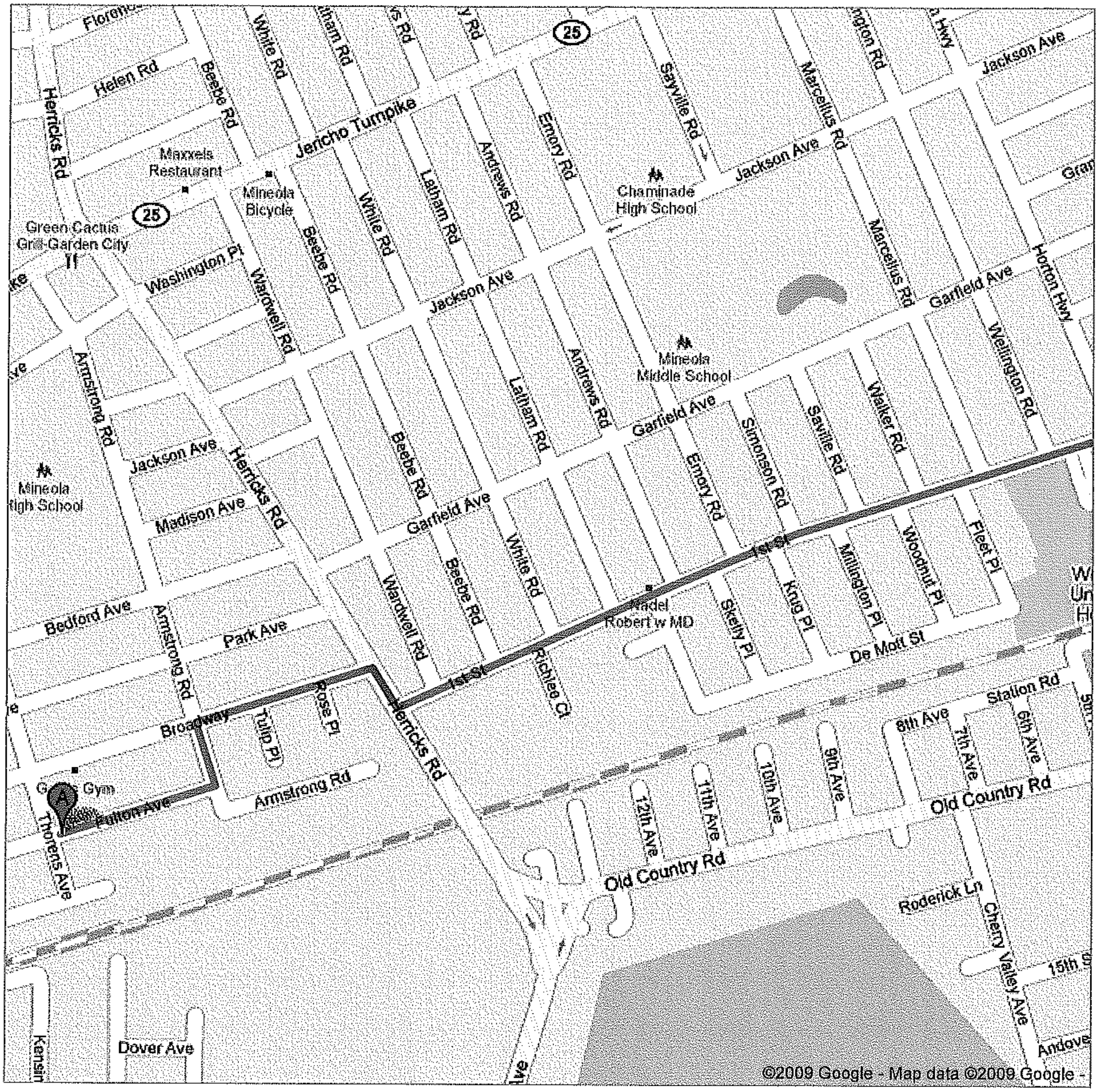
Appendix A
Map To Hospital & Site Map

A 150 Fulton Ave, Garden City Park, NY 11040

	1. Head **east** on **Fulton Ave** toward **Armstrong Rd**	go 0.1 mi total 0.1 mi
↰	2. Turn **left** at **Armstrong Rd**	go 259 ft total 0.2 mi
↱	3. Take the 1st **right** onto **Broadway**	go 0.1 mi total 0.3 mi
↱	4. Turn **right** at **Herricks Rd**	go 184 ft total 0.3 mi
↰	5. Take the 1st **left** onto **1st St** About 2 mins	go 0.6 mi total 0.9 mi

B Winthrop-University Hospital
259 1st Street, Mineola, NY 11501-3987 - (516) 663-0333

Directions to Winthrop-University Hospital
259 1st Street, Mineola, NY 11501-3987 - (516)
663-0333
0.9 mi – about **4 mins**



Appendix B
Job Hazard Analyses

North America Job Hazard Analysis
Heavy Equipment Operations

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Excavation and Trenching
JHA No.: 1	

Document Routing	
FSO	Retain copy in site health & safety file, amend to HASP as necessary.
Project Manager	Retain copy in the office health & safety file, amend to HASP as necessary.

Instructions:	**This JHA has been developed and approved by the North America Safety Team. Prior to conducting fieldwork. site-specific hazards related to this task must be incorporated by the project team. Once completed, the JHA should be reviewed regularly with site personnel who will be performing this task.**

Task Description:

Guidelines for working around heavy equipment during excavation and trenching activities.

Hazard Analysis:

Task Step	Hazard	Control Measures
Offsite Preparation	Untrained workers operating heavy equipment pose potential life-threatening hazards to employees.	ERM policy and practice is that our employees do not operate heavy equipment except in unusual circumstances. If ERM personnel are to operate heavy equipment, this must be stated in the health and safety plan for the project. Only employees with training and/or demonstrated experience operating heavy equipment may do so. Subcontractor personnel operating heavy equipment must be trained and/or have demonstrated experience operating such equipment. ERM must be in possession of evidence of training and/or experience prior to Subcontractor personnel operating such equipment. All heavy equipment must meet applicable design standards (ANSI, etc.). A copy of the operating manual must be carried on all heavy equipment, including a load-rating chart and any special operating considerations.

North America Job Hazard Analysis
Heavy Equipment Operations

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Excavation and Trenching
JHA No.: 1	

Task Step	Hazard	Control Measures
Heavy Equipment Operation	Injury to operator and those in immediate vicinity.	Before starting operations, operators must ensure no one is working on or near machinery. If equipment is to be operated in close proximity to other workers, a spotter must be working in tandem with the operator. All heavy equipment must be inspected daily to ensure good working order. Critical safety items, such as brakes, backup alarms, horns, etc. must be in working order. Machinery with critical safety items in disrepair may not be used until they are fixed. Operators must operate equipment while wearing seatbelts, if provided, and at reasonable speeds. Mounting/dismounting a moving machine is prohibited. Do not transport personnel or equipment in machinery not designed for this purpose. Overhead obstructions must be assessed before operating machinery. If equipment is to be operated in close proximity to overhead obstructions, a spotter must be working in tandem with the operator. Safe working distances must be specified in the health and safety plan or JHA supplied by the subcontractor.
Ending Heavy Equipment Operations	Leaving equipment in a non-neutral position poses contact hazards.	All heavy equipment must be placed in a neutral position when not in operation. Dump truck beds must be lowered, buckets must be at ground level, forklift tines must be at ground level, etc. Keys must be removed from all heavy equipment when not in use4.

North America Job Hazard Analysis
Heavy Equipment Operations

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Excavation and Trenching
JHA No.: 1	

Task Step	Hazard	Control Measures
	Vehicle and Pedestrian Traffic	The equipment operator must be aware of pedestrian and vehicle traffic at all times. When operating equipment in the public roadway the operator must keep the equipment within the work area. The operator may not move the equipment into the vehicle travel area unless signaled to by the Garden City Police officer.

Personal Protective Equipment Required for this Task:

Type	Description
High-visibility safety vest	Vest worn by equipment operators and those working in the area impacted by moving machinery
Hardhat	All personnel in the area must wear a hardhat whenever there is a possibility of flying or falling debris. The FSO may make the determination that hardhats are not required based on site conditions at the time.
Safety Glasses	All personnel in the area must wear safety glasses whenever there is a possibility of flying or falling debris. The FSO may make the determination that safety glasses are not required based on site conditions at the time.
Hearing Protection	The FSO will determine the need for hearing protection based on the equipment being used.

Training Required for this Task:

Type	Description
Heavy Equipment Operation	Operators must be trained and/or have demonstrated experience for each type of heavy equipment they will operate.

Forms Associated with this Task:

Type	Description
Heavy Equipment Inspection	Form for documenting daily heavy equipment inspections

North America Job Hazard Analysis
Heavy Equipment Operations

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Excavation and Trenching
JHA No.: 1	

form	

Site-Specific Job Hazard Analysis Completed by:

Name	Date
Justin Bunton	1/11/10

North America Job Hazard Analysis
Natural Hazards

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	All Outdoor Tasks
JHA No.: 10	

Document Routing	
FSO	Retain copy in site health & safety file, amend to HASP as necessary.
Project Manager	Retain copy in the office health & safety file, amend to HASP as necessary.

Instructions:	**This JHA has been developed and approved by the North America Safety Team. Prior to conducting fieldwork. site-specific hazards related to this task must be incorporated by the project team. Once completed, the JHA should be reviewed regularly with site personnel who will be performing this task.**

Task Description:

Guidelines for mitigating natural hazards such as poisonous animals and plants, and terrain-related hazards.

Hazard Analysis:

Task Step	Hazard	Control Measures
Performing fieldwork in the presence of various natural hazards	Exposure to natural hazards can lead to injuries such as twisted ankles or to more complex medical emergencies such as poisonous plant or insect encounters.	Identify the expected types of natural hazards during the safety planning/HASP-writing stage of a project and verify conditions once onsite. If conditions differ, put protective steps in-place to mitigate the natural hazard if possible. Mitigation of natural hazards may involve removal of the hazard prior to work beginning, or avoiding the hazard during work.
Working around poisonous plants	Poisonous plant exposure	Poison ivy, oak, and sumac are common in North America and should be avoided. For sites with these hazards present, have a poison ivy wash available for employees on-site. If exposure occurs and no poison ivy wash is available, employees should wash in cool water and use soap.

North America Job Hazard Analysis
Natural Hazards

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	All Outdoor Tasks
JHA No.: 10	

Task Step	Hazard	Control Measures
Working around poisonous insects	Danger to health from bites, stings, and/or disease transmission	Liberally use insect repellant containing DEET at all times on the jobsite. Periodically throughout the day and at the end of the day, perform a thorough "tick-check" to ensure ticks or other insects are found and removed promptly. Avoid obvious conical mounds of dirt that may indicate ants, wasps, or other flying insects. Before reaching into dark or damp spaces such as monitoring well-heads, inspect the area thoroughly to ensure spiders are not present. Always take a shower as soon as possible after leaving a jobsite for the day to remove any insects, such as chiggers.
Working around snakes	Snake bites and potential poisoning	Visually inspect the work are prior to beginning any work to located areas with high grass and underbrush. Do not walk through these areas if at all possible to avoid snakes. Wear leather steel-toe boots and snake chaps in areas where snakes are suspected or confirmed to be present. Do not attempt to kill snakes, as people are commonly bitten attempting this.
Working around feral animals	Animal bites and possible transmission of disease	High rat populations within an enclosed space present a hazard of Hanta virus. Spray such areas with bleach solution prior to performing any work in the area (10 parts water to 1 part household bleach). Feral dogs may become aggressive, especially if guarding their young or if they become very hungry. If dogs or other animals are spotted that are acting strangely, do not approach them. Contact the local animal control center for assistance.

North America Job Hazard Analysis
Natural Hazards

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	All Outdoor Tasks
JHA No.: 10	

Task Step	Hazard	Control Measures
Working on uneven terrain	Slip, trip, and fall injuries may occur when working on uneven terrain or terrain with holes	At a minimum, wear ankle-height steel-toed boots when working on project sites. Keep work areas free from clutter so that ground surfaces can be easily seen by employees. Do not read phone emails or text while walking. Identify all scattered materials presenting a slip, trip, or fall hazard with high visibility paint markings if possible, or cordon the area off with caution tape. Keep all heavy equipment as low to the ground as possible when being stored, such as forklift tines, excavator buckets, etc. Place ladder bases on even, non-slippery ground. If this is not possible obtain help when going up or down the ladder.

Personal Protective Equipment Required for this Task:

Type	Description
Ankle-height boots	ERM standard steel-toe boot requirement specified ankle-height, chemical-resistant boots.
Long sleeves and pants	Protects exposed areas of skin from contact with insects, animals and poisonous plants

Site-Specific Job Hazard Analysis Completed by:

Name	Date
Justin Bunton	1/12/2010

North America Job Hazard Analysis
ERM Actions During Subsurface Clearance and Drilling

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Excavation and Trenching
JHA No.: 2	

Document Routing	
FSO	Retain copy in site health & safety file, amend to HASP as necessary.
Project Manager	Retain copy in the office health & safety file, amend to HASP as necessary.

Instructions:	**This JHA has been developed and approved by the North America Safety Team. Prior to conducting fieldwork. site-specific hazards related to this task must be incorporated by the project team. Once completed, the JHA should be reviewed regularly with site personnel who will be performing this task.**

Task Description:

General guidelines for working safely when performing any ground penetrating activities (excluding surface soil sampling) and ERM personnel activities during overseeing drilling.

Hazard Analysis:

Task Step	Hazard	Control Measures
Identify a Client Contact Person	Client contacts that are not familiar with the site layout could cause critical information to be missed during safety planning.	Determine degree of knowledge of our client contact by evaluating their current job duties at the site, length of time they have worked at the site, and time in their current job. If the ERM team does not feel comfortable with the level of experience of our client contact, take additional measures to ensure all pertinent subsurface utilities and services information is gathered.
Engage Subcontractors	Subcontractors who have not been evaluated against ERM minimum safety standards or who do not meet minimum safety standards may pose more risk.	Use only ERM subcontractors who are identified as having met our minimum safety standards. In cases where using an already-qualified subcontractor is not possible, ensure extra precautions are taken to provide safety oversight to the work.
Appoint an ERM Subsurface Clearance "Experienced Person" to the project	ERM employees who are not experienced with SSC issues may not recognize critical zones or clues to other site utilities/services.	Ensure a "SSC Experienced Person" is assigned to the project to provide oversight of ground penetrations and to mentor less experienced ERM employees.

North America Job Hazard Analysis
ERM Actions During Subsurface Clearance and Drilling

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Excavation and Trenching
JHA No.: 2	

Task Step	Hazard	Control Measures
Gather site-specific subsurface information	Incomplete or inaccurate site utility/service drawings may lead the ERM project team to incorrect conclusions regarding what utilities/services are onsite.	Obtain the most recent "as-built" drawings and additional site information such as easements, rights-of-way, historical plot plans, etc. to assist making decisions about other actions that will be required at the site.
Develop the HASP	Using incorrect documents in safety planning may lead to not considering all pertinent information.	A Level 2 WARN HASP for Intrusive Work (minimum) must be used when performing any ground penetrations, with the exception of surface soil sampling. The Level 2 HASP contains a "Site Services Model" that ERM uses to evaluate SSC hazards.
Develop the Site Services Model	Critical zones and a whole-site view of utilities and services at the site are more difficult to do if not put into the Site Services Model.	Use the Site Services Model to identify gaps in knowledge from all drawings and other verbal information from our client contact. Identify locations of key isolation and shutoffs closest to the work area for each type of utility/service.
Make Preliminary Determinations	Not recognizing or identifying critical zones poses great hazard to ERM employees in the field from contact with electricity or other utilities.	Establish critical zones and excavation buffers (if needed) for the work. Initial critical zone determinations may change in the field but are a good starting point in hazard identification.
Identify Preliminary Ground Disturbance Locations	Planning ground disturbance locations inside critical zones poses great hazard to ERM employees in the field from contact with electricity or other utilities.	Ensure critical zones have been identified using the Site Services Model and then identify locations outside those critical zones up-front, if possible. If a ground disturbance inside a critical zone is absolutely necessary, notify the site PIC and obtain guidance from him/her before proceeding.
Public and/or Private Utility Markout	Not having utilities marked may lead to a subsurface clearance strike.	Contact public and private utility markout services giving them enough time to respond. A minimum of 24-hour notification to utility locators is required in most states, and may vary higher in some states.

North America Job Hazard Analysis
ERM Actions During Subsurface Clearance and Drilling

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Excavation and Trenching
JHA No.: 2	

Task Step	Hazard	Control Measures
Conduct the Site Walk	Inexperienced people conducting the site walk may miss pertinent information regarding utilities and/or services. Vehicle Traffic	The "SSC Experienced Person" must lead the site walk and should be accompanied by our client contact. Each ground disturbance location should be approved by our client contact (written approval preferred, verbal approval acceptable). Excavation and trenching locations are located in a public roadway. Coordinate with Garden City Police to provide traffic control.
Inspect Each Ground Disturbance Location	Inexperienced people conducting inspection may miss pertinent information regarding utilities and/or services.	The "SSC Experienced Person" must lead inspection of each Ground Disturbance Location. Any visual clues of subsurface obstruction/utilities should be documented. Critical zones may have to be reassessed at this point. Use the SSC Checklist to document this inspection for each point inside a critical zone, at a minimum.
Finalize Critical Zone Determinations	Not performing this verification step in the field may lead to a SSC strike.	Use information gathered during pre-planning, utility markout, and site walk/inspection to verify critical zones that have been previously established. Revise critical zones as necessary. Use the SSC Checklist to document points inside critical zones. If points are confirmed inside critical zones, either step out and relocate the ground disturbance location, or contact the PIC for additional guidance.

North America Job Hazard Analysis
ERM Actions During Subsurface Clearance and Drilling

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Excavation and Trenching
JHA No.: 2	

Task Step	Hazard	Control Measures
Oversee setup of drilling equipment	Overhead electrical/other lines may come in contact with drill rigs.	Ensure drill rigs are set up in areas where they will not contact overhead lines when being positioned. The minimum distance for drill rig clearance is 25 feet unless special permission is granted by the utility company. When a drill rig must be maneuvered in tight quarters, the presence of a second person is required to ensure adequate clearance. If backing-up is required, two ground guides will be used: one in the direction the rig is moving and the other in the operator's normal field of vision.
	Materials stored in the vicinity of drill rigs may pose various hazards to employees.	Move tools, materials, cords, hoses, and debris to prevent trip hazards and contact with moving drill rig parts. Secure tools and equipment subject to displacement or falling. Store any flammable materials away from ignition sources and in approved containers.
Physically Clear all Ground Disturbance Locations	Employees performing physical clearance could contact underground utility/service lines.	Use cable avoidance tools at each location that must be physically cleared (OSHA requirement). If using a hand-auger, ensure insulated handles are in-place before their use.
	Drill rig could damage electrical/utility/service lines if not physically cleared first.	Mechanical ground penetration should not commence until a ground disturbance location is physically cleared. In certain situations drilling may occur without physical clearance – consult with the project PIC prior to making this determination.

North America Job Hazard Analysis
ERM Actions During Subsurface Clearance and Drilling

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Excavation and Trenching
JHA No.: 2	

Task Step	Hazard	Control Measures
Commence Drilling Operations	Rotating equipment could pull employees into equipment.	Do not wear loose or frayed clothing, loose long hair, or loose jewelry while working around rotating equipment. Tuck shirt-tails into pants. Never walk directly behind or beside drill rigs without the drill rig operator's knowledge. Keep all non-essential personnel out of the drill rig work area.
	Poorly functioning drill-rig equipment could expose employees to hazardous conditions.	Ensure drill rigs and other machinery used is inspected daily by competent, qualified individuals. Instruct drill rig operators to report any abnormalities such as equipment failure, oozing liquids or unusual odors so they can be dealt with before proceeding with work. Do not eat, drink, or smoke near the drill rig.
	Noisy environments may make it difficult to communicate by vocal means.	Wear hearing protection at all times when in the vicinity of the drill rig, or when you must raise your voice to be heard by co-workers. Maintain visual contact with the drill rig operator at all times and establish hand-signal communications for use when verbal communication is difficult.
	Vehicle Traffic	Mark off work areas using cones and fences to keep personnel from entering into traffic areas. ERM must coordinate with Garden City Police to provide traffic control before excavating or trenching operations can proceed.
Complete Drilling Operations	Equipment allowed to remain running poses pinch-point and potential explosion hazards to employees.	Shut down drill rigs before repairing or lubricating parts (except those that must be in motion for lubrication). Shut down mechanical equipment prior to and during fueling operations. When refueling or transferring fuel, containers and equipment must be bonded to prevent the buildup of static electricity.

North America Job Hazard Analysis
ERM Actions During Subsurface Clearance and Drilling

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Excavation and Trenching
JHA No.: 2	

Personal Protective Equipment Required for this Task:

Type	Description
Insulated hand-augers	Hand-augers fitted with rubber handles, or other non-conductive material.
High Visibility Traffic Vest	Drilling will take place in a public roadway, all personnel are required to wear a traffic vest at all times
Hardhat	All personnel in the area must wear a hardhat whenever there is a possibility of flying or falling debris. The FSO may make the determination that hardhats are not required based on site conditions at the time.
Safety Glasses	All personnel in the area must wear safety glasses whenever there is a possibility of flying or falling debris. The FSO may make the determination that safety glasses are not required based on site conditions at the time.
Hearing Protection	The FSO will determine the need for hearing protection based on the equipment being used.

Training Required for this Task:

Type	Description
SSC Classroom Training	Initial classroom training detailing the ERM subsurface clearance process, tools, and forms.
SSC Experienced Person	At least one must be present on all sites involving SSC. The Experienced Person will both give SSC expertise in project execution and mentor less experienced employees.

Forms Associated with this Task:

Type	Description
SSC Checklist	Checklist detailing the ERM SSC process, and providing tools to ensure critical zones and excavation buffers are properly identified and validated in the field.

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Excavation and Trenching
JHA No.: 2	

SSC Mentorship Card	The SSC Mentorship Card provides Experienced Persons with topics to be covered with less experienced employees on SSC sites, and also documents mentoring of the less experienced employees.
Daily Drill Rig Inspection Form	Form required to be used by ERM subcontractors to document daily inspection of drill rigs. This form should be provided by the drill rig operating company. Completed forms should be kept with the HASP and filed in project files.

Site-Specific Job Hazard Analysis Completed by:

Name	Date
Justin Bunton	1/11/2010

North America Job Hazard Analysis
ERM Actions During Subsurface Clearance and Drilling

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Recovery Well Installation
JHA No.: 3	

Document Routing	
FSO	Retain copy in site health & safety file, amend to HASP as necessary.
Project Manager	Retain copy in the office health & safety file, amend to HASP as necessary.

Instructions:	**This JHA has been developed and approved by the North America Safety Team. Prior to conducting fieldwork. site-specific hazards related to this task must be incorporated by the project team. Once completed, the JHA should be reviewed regularly with site personnel who will be performing this task.**

Task Description:

General guidelines for working safely when performing any ground penetrating activities (excluding surface soil sampling) and ERM personnel activities during overseeing drilling.

Hazard Analysis:

Task Step	Hazard	Control Measures
Identify a Client Contact Person	Client contacts that are not familiar with the site layout could cause critical information to be missed during safety planning.	Determine degree of knowledge of our client contact by evaluating their current job duties at the site, length of time they have worked at the site, and time in their current job. If the ERM team does not feel comfortable with the level of experience of our client contact, take additional measures to ensure all pertinent subsurface utilities and services information is gathered.
Engage Subcontractors	Subcontractors who have not been evaluated against ERM minimum safety standards or who do not meet minimum safety standards may pose more risk.	Use only ERM subcontractors who are identified as having met our minimum safety standards. In cases where using an already-qualified subcontractor is not possible, ensure extra precautions are taken to provide safety oversight to the work.
Appoint an ERM Subsurface Clearance "Experienced Person" to the project	ERM employees who are not experienced with SSC issues may not recognize critical zones or clues to other site utilities/services.	Ensure a "SSC Experienced Person" is assigned to the project to provide oversight of ground penetrations and to mentor less experienced ERM employees.

North America Job Hazard Analysis
ERM Actions During Subsurface Clearance and Drilling

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Recovery Well Installation
JHA No.: 3	

Task Step	Hazard	Control Measures
Gather site-specific subsurface information	Incomplete or inaccurate site utility/service drawings may lead the ERM project team to incorrect conclusions regarding what utilities/services are onsite.	Obtain the most recent "as-built" drawings and additional site information such as easements, rights-of-way, historical plot plans, etc. to assist making decisions about other actions that will be required at the site.
Develop the HASP	Using incorrect documents in safety planning may lead to not considering all pertinent information.	A Level 2 WARN HASP for Intrusive Work (minimum) must be used when performing any ground penetrations, with the exception of surface soil sampling. The Level 2 HASP contains a "Site Services Model" that ERM uses to evaluate SSC hazards.
Develop the Site Services Model	Critical zones and a whole-site view of utilities and services at the site are more difficult to do if not put into the Site Services Model.	Use the Site Services Model to identify gaps in knowledge from all drawings and other verbal information from our client contact. Identify locations of key isolation and shutoffs closest to the work area for each type of utility/service.
Make Preliminary Determinations	Not recognizing or identifying critical zones poses great hazard to ERM employees in the field from contact with electricity or other utilities.	Establish critical zones and excavation buffers (if needed) for the work. Initial critical zone determinations may change in the field but are a good starting point in hazard identification.
Identify Preliminary Ground Disturbance Locations	Planning ground disturbance locations inside critical zones poses great hazard to ERM employees in the field from contact with electricity or other utilities.	Ensure critical zones have been identified using the Site Services Model and then identify locations outside those critical zones up-front, if possible. If a ground disturbance inside a critical zone is absolutely necessary, notify the site PIC and obtain guidance from him/her before proceeding.
Public and/or Private Utility Markout	Not having utilities marked may lead to a subsurface clearance strike.	Contact public and private utility markout services giving them enough time to respond. A minimum of 24-hour notification to utility locators is required in most states, and may vary higher in some states.

North America Job Hazard Analysis
ERM Actions During Subsurface Clearance and Drilling

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Recovery Well Installation
JHA No.: 3	

Task Step	Hazard	Control Measures
Conduct the Site Walk	Inexperienced people conducting the site walk may miss pertinent information regarding utilities and/or services. Vehicle Traffic	The "SSC Experienced Person" must lead the site walk and should be accompanied by our client contact. Each ground disturbance location should be approved by our client contact (written approval preferred, verbal approval acceptable). Drilling locations are located in a public roadway. coordinate with Garden City Police to provide traffic control.
Inspect Each Ground Disturbance Location	Inexperienced people conducting inspection may miss pertinent information regarding utilities and/or services.	The "SSC Experienced Person" must lead inspection of each Ground Disturbance Location. Any visual clues of subsurface obstruction/utilities should be documented. Critical zones may have to be reassessed at this point. Use the SSC Checklist to document this inspection for each point inside a critical zone, at a minimum.
Finalize Critical Zone Determinations	Not performing this verification step in the field may lead to a SSC strike.	Use information gathered during pre-planning, utility markout, and site walk/inspection to verify critical zones that have been previously established. Revise critical zones as necessary. Use the SSC Checklist to document points inside critical zones. If points are confirmed inside critical zones, either step out and relocate the ground disturbance location, or contact the PIC for additional guidance.

North America Job Hazard Analysis
ERM Actions During Subsurface Clearance and Drilling

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Recovery Well Installation
JHA No.: 3	

Task Step	Hazard	Control Measures
Oversee setup of drilling equipment	Overhead electrical/other lines may come in contact with drill rigs.	Ensure drill rigs are set up in areas where they will not contact overhead lines when being positioned. The minimum distance for drill rig clearance is 25 feet unless special permission is granted by the utility company. When a drill rig must be maneuvered in tight quarters, the presence of a second person is required to ensure adequate clearance. If backing-up is required, two ground guides will be used: one in the direction the rig is moving and the other in the operator's normal field of vision.
	Materials stored in the vicinity of drill rigs may pose various hazards to employees.	Move tools, materials, cords, hoses, and debris to prevent trip hazards and contact with moving drill rig parts. Secure tools and equipment subject to displacement or falling. Store any flammable materials away from ignition sources and in approved containers.
Physically Clear all Ground Disturbance Locations	Employees performing physical clearance could contact underground utility/service lines.	Use cable avoidance tools at each location that must be physically cleared (OSHA requirement). If using a hand-auger, ensure insulated handles are in-place before their use.
	Drill rig could damage electrical/utility/service lines if not physically cleared first.	Mechanical ground penetration should not commence until a ground disturbance location is physically cleared. In certain situations drilling may occur without physical clearance – consult with the project PIC prior to making this determination.

North America Job Hazard Analysis
ERM Actions During Subsurface Clearance and Drilling

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Recovery Well Installation
JHA No.: 3	

Task Step	Hazard	Control Measures
Commence Drilling Operations	Rotating equipment could pull employees into equipment.	Do not wear loose or frayed clothing, loose long hair, or loose jewelry while working around rotating equipment. Tuck shirt-tails into pants. Never walk directly behind or beside drill rigs without the drill rig operator's knowledge. Keep all non-essential personnel out of the drill rig work area.
	Poorly functioning drill-rig equipment could expose employees to hazardous conditions.	Ensure drill rigs and other machinery used is inspected daily by competent, qualified individuals. Instruct drill rig operators to report any abnormalities such as equipment failure, oozing liquids or unusual odors so they can be dealt with before proceeding with work. Do not eat, drink, or smoke near the drill rig.
	Noisy environments may make it difficult to communicate by vocal means.	Wear hearing protection at all times when in the vicinity of the drill rig, or when you must raise your voice to be heard by co-workers. Maintain visual contact with the drill rig operator at all times and establish hand-signal communications for use when verbal communication is difficult.
	Vehicle Traffic	Mark off work areas using cones and fences to keep personnel from entering into traffic areas. ERM must coordinate with Garden City Police to provide traffic control before drilling operations can proceed.
Complete Drilling Operations	Equipment allowed to remain running poses pinch-point and potential explosion hazards to employees.	Shut down drill rigs before repairing or lubricating parts (except those that must be in motion for lubrication). Shut down mechanical equipment prior to and during fueling operations. When refueling or transferring fuel, containers and equipment must be bonded to prevent the buildup of static electricity.

North America Job Hazard Analysis
ERM Actions During Subsurface Clearance and Drilling

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Recovery Well Installation
JHA No.: 3	

Personal Protective Equipment Required for this Task:

Type	Description
Insulated hand-augers	Hand-augers fitted with rubber handles, or other non-conductive material.
High Visibility Traffic Vest	Drilling will take place in a public roadway, all personnel are required to wear a traffic vest at all times
Hardhat	All personnel in the area must wear a hardhat whenever there is a possibility of flying or falling debris. The FSO may make the determination that hardhats are not required based on site conditions at the time.
Safety Glasses	All personnel in the area must wear safety glasses whenever there is a possibility of flying or falling debris. The FSO may make the determination that safety glasses are not required based on site conditions at the time.
Hearing Protection	The FSO will determine the need for hearing protection based on the equipment being used.

Training Required for this Task:

Type	Description
SSC Classroom Training	Initial classroom training detailing the ERM subsurface clearance process, tools, and forms.
SSC Experienced Person	At least one must be present on all sites involving SSC. The Experienced Person will both give SSC expertise in project execution and mentor less experienced employees.

Forms Associated with this Task:

Type	Description
SSC Checklist	Checklist detailing the ERM SSC process, and providing tools to ensure critical zones and excavation buffers are properly identified and validated in the field.

SSC Mentorship Card	The SSC Mentorship Card provides Experienced Persons with topics to be covered with less experienced employees on SSC sites, and also documents mentoring of the less experienced employees.
Daily Drill Rig Inspection Form	Form required to be used by ERM subcontractors to document daily inspection of drill rigs. This form should be provided by the drill rig operating company. Completed forms should be kept with the HASP and filed in project files.

Site-Specific Job Hazard Analysis Completed by:

Name	Date
Justin Bunton	1/11/2010

North America Job Hazard Analysis
Hazard Communication

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	ISCO Injection
JHA No.: 4	

Document Routing	
FSO	Retain copy in site health & safety file, amend to HASP as necessary.
Project Manager	Retain copy in the office health & safety file, amend to HASP as necessary.

Instructions:	**This JHA has been developed and approved by the North America Safety Team. Prior to conducting fieldwork. site-specific hazards related to this task must be incorporated by the project team. Once completed, the JHA should be reviewed regularly with site personnel who will be performing this task.**

Task Description:

Guidelines for communicating hazards posed by the storage and/or use of chemicals.

Hazard Analysis:

Task Step	Hazard	Control Measures
Storing Chemicals in the Office Setting	Chemicals stored in ERM offices or Field Project Offices may lead to employee chemical exposure, chemical spills, or fires from flammable materials.	If at all possible, do not store chemicals in the office environment. For each chemical product used by ERM employees or stored in an ERM field or office location, a MSDS sheet must be obtained and kept on-file. A chemical inventory list must be prepared and updated as new or different chemicals are procured. Chemical containers must be labeled in accordance with OSHA regulations. Train all employees who will use or be present in the general vicinity of chemicals annually about hazard communication. If new or updated chemicals are procured, hazard communication training must be given to affected employees prior to using or storing the chemical.

North America Job Hazard Analysis
Hazard Communication

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	ISCO Injection
JHA No.: 4	

Task Step	Hazard	Control Measures
Using Chemicals	Employees may be exposed to chemical hazards via skin contact, ingestion, inhalation, or punctures in the skin.	Before using any chemical, make sure a jobsite WARN Health and Safety Plan (HASP) has been prepared and taken the chemical being used into account. Wear protective equipment as specified in the HASP. If chemicals are being used by subcontractors, ensure all employees on the jobsite have been told about the chemical in-use and are protected. If chemical exposure occurs, even if medical symptoms are not present, inform the Field Safety Office or Office H&S Contact.
Large Chemical Spills	Large chemicals spills may expose employees to significant health hazards.	For large chemical spills (generally anything larger than 1 gallon in size), HAZWOPER training is required to perform any action other than retreating from the area and contacting appropriately-trained personnel to mitigate the spill. Do not attempt to stop or clean-up a spill without current HAZWOPER training, current medical clearance, current respirator training, and a current respirator fit-test.
	Permanganate Spills	ERM and subcontractor personnel will be prepared at all times to respond to a spill or release of permanganate. Absorbent spill pads, disposal bins or buckets and neutralization spray will be maintained in various locations on site and available at all times.

North America Job Hazard Analysis
Hazard Communication

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	ISCO Injection
JHA No.: 4	

Personal Protective Equipment Required for this Task:

Type	Description
Nitrile gloves, Tyvek suit and booties, goggles or splash shield	All must be worn whenever directly handling and permanganate, cleaning up spills, or adjusting valves while during injection activities.

Training Required for this Task:

Type	Description
Hazard Communication	An annually-required training discussing general chemical hazards, MSDS sheets, and how to respond to general chemical emergency situations.
Site specific permanganate safety	Before injection begins all on site must be made aware of the hazards associated with permanganate, safe handling and spill response procedures.
Site Specific Compressed Gas Safety	Will provide general safe handling and use of compressed gases that will be used on site.

Forms Associated with this Task:

Type	Description
Material Safety Data Sheet (MSDS)	An informational document containing information about chemical composition, hazardous properties, and steps to take in emergency situations involving chemicals. MSDS's for all chemicals that will be used, brought to, or may be encountered at the site will be readily available at all times.

Site-Specific Job Hazard Analysis Completed by:

Name	Date

North America Job Hazard Analysis
Hazard Communication

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	ISCO Injection
JHA No.: 4	

Justin Bunton	1/12/2010

North America Job Hazard Analysis
Personal Protective Equipment

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Excavation, Trenching, System Construction and ISCO Injection
JHA No.: 5	

Document Routing	
FSO	Retain copy in site health & safety file, amend to HASP as necessary.
Project Manager	Retain copy in the office health & safety file, amend to HASP as necessary.

Instructions:	**This JHA has been developed and approved by the North America Safety Team. Prior to conducting fieldwork. site-specific hazards related to this task must be incorporated by the project team. Once completed, the JHA should be reviewed regularly with site personnel who will be performing this task.**

Task Description:

Guidelines for selection and use of personal protective equipment (PPE).

Hazard Analysis:

Task Step	Hazard	Control Measures
Excavation and Trenching	Slips/Trips, Contact with moving equipment, hand and power tool use.	Stay clear of moving equipment, use hand and power tools according to manufactures specifications, don proper PPE at all times. . Maintain clear walking paths, be aware when moving throughout work area.
System Construction	Slips/Trips, Contact with moving equipment, hand and power tool use, ladder use	Stay clear of moving equipment, use hand and power tools according to manufactures specifications, don proper PPE at all times. Maintain clear walking paths, be aware when moving throughout work area.
ISCO Injection	Slips/Trips, Chemical Exposure	Follow established chemical handling and clean up procedures, don proper PPE at all times. . Maintain clear walking paths, be aware when moving throughout work area.
Recovery Well Install	Compressed gas use, welding, torch cutting, ignition sources	Safe handling of compressed gas, don proper PPE at all times, fire watch, removal of combustibles

North America Job Hazard Analysis
Personal Protective Equipment

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Excavation, Trenching, System Construction and ISCO Injection
JHA No.: 5	

Personal Protective Equipment Required for this Task:

Type	Description
High-visibility safety vest	Vest worn by equipment operators and those working in the area impacted by moving machinery
Hardhat	All personnel in the area must wear a hardhat whenever there is a possibility of flying or falling debris. The FSO may make the determination that hardhats are not required based on site conditions at the time.
Safety Glasses	All personnel in the area must wear safety glasses whenever there is a possibility of flying or falling debris. The FSO may make the determination that safety glasses are not required based on site conditions at the time.
Hearing Protection	The FSO will determine the need for hearing protection based on the equipment being used.
Nitrile gloves, Tyvek suit and booties, goggles or splash shield	All must be worn whenever directly handling and permanganate, cleaning up spills, or adjusting valves while during injection activities.
Heat retardant leather gloves, leather chaps or apron, welders mask or goggles.	Proper PPE must be donned at all times during any welding, cutting or brazing activities.

Training Required for this Task:

Type	Description
Heavy Equipment Operation	Operators must be trained and/or have demonstrated experience for each type of heavy equipment they will operate.
Hazard Communication	An annually-required training discussing general chemical hazards, MSDS sheets, and how to respond to general chemical emergency situations.

North America Job Hazard Analysis
Personal Protective Equipment

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Excavation, Trenching, System Construction and ISCO Injection
JHA No.: 5	

Site specific permanganate safety	Before injection begins all on site must be made aware of the hazards associated with permanganate, safe handling and spill response procedures.
Site Specific Compressed Gas Safety	Will provide general safe handling and use of compressed gases that will be used on site

Forms Associated with this Task:

Type	Description
Material Safety Data Sheet (MSDS)	Provide PPE requirements for chemicals present on site.

Site-Specific Job Hazard Analysis Completed by:

Name	Date
Justin Bunton	1/12/2010

North America Job Hazard Analysis
Hot Work

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Recovery Well Install, System Construction
JHA No.: 6	

Document Routing	
FSO	Retain copy in site health & safety file, amend to HASP as necessary.
Project Manager	Retain copy in the office health & safety file, amend to HASP as necessary.

Instructions:	**This JHA has been developed and approved by the North America Safety Team. Prior to conducting fieldwork. site-specific hazards related to this task must be incorporated by the project team. Once completed, the JHA should be reviewed regularly with site personnel who will be performing this task.**

Task Description:

Guidelines for working on jobsites where ERM subcontractors are performing welding, cutting, or brazing operations.

Hazard Analysis:

Task Step	Hazard	Control Measures
Recovery Well Install	Compressed gas use, welding, torch cutting, ignition sources	Safe handling of compressed gas, don proper PPE at all times, fire watch, removal of combustibles, use of hot work permit system

Personal Protective Equipment Required for this Task:

Type	Description
Heat retardant leather gloves, leather chaps or apron, welders mask or goggles.	Proper PPE must be donned at all times during any welding, cutting or brazing activities.

North America Job Hazard Analysis
Hot Work

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	Recovery Well Install, System Construction
JHA No.: 6	

Training Required for this Task:

Type	Description
Site specific compressed gas safety	Safe handling, storage and use of compressed gasses while on site.
Hot work safety	Contractor must have a hot work safety program and hot work permit system that will be followed

Forms Associated with this Task:

Type	Description
None	

Site-Specific Job Hazard Analysis Completed by:

Name	Date
Justin Bunton	1/12/2010

North America Job Hazard Analysis
Work in Cold Environments

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	All Project Tasks
JHA No.: 7	

Document Routing	
FSO	Retain copy in site health & safety file, amend to HASP as necessary.
Project Manager	Retain copy in the office health & safety file, amend to HASP as necessary.

Instructions:	**This JHA has been developed and approved by the North America Safety Team. Prior to conducting fieldwork. site-specific hazards related to this task must be incorporated by the project team. Once completed, the JHA should be reviewed regularly with site personnel who will be performing this task.**

Task Description:

Guidelines for working in areas where cold stress may occur.

Hazard Analysis:

Task Step	Hazard	Control Measures
All Project Steps	Exposure to extreme cold and weather, icy or snowy conditions, hazardous travel, frostbite, hypothermia	Monitor weather reports, dress appropriately for the days conditions, if possible avoid outside activities and travel during extreme weather, have a warm place out of the elements to take work breaks

Personal Protective Equipment Required for this Task:

Type	Description
Warm layered clothing, warm gloves, winter hats	Dress appropriately for the conditions present, wear several layers to allow better air flow of body heat, wear gloves and hats to minimize exposed areas of skin.
Chemical Warmers	Chemical packets that produce heat and can be kept in gloves, pockets, or sleeves

North America Job Hazard Analysis
Work in Cold Environments

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	All Project Tasks
JHA No.: 7	

Training Required for this Task:

Type	Description
Cold stress recognition	Uncontrolled shivering, bluish/purple finger tips, fatigue
Frostbite	• Frostbite will first appear as blanching or whitening of the skin. Areas will become bright red as the tissue warms. • Slowly warm affected areas in warm clothing or water. Warming areas too fast can cause skin and tissue damage. • Don not rub affected areas, rubbing can cause skin and tissue damage.
Hypothermia	• Happens when body temperature drops below 95°F, person will become drowsy, start to shiver uncontrollably and skin color will turn a slight blue color. • To treat move the person to a warm dry area, remove any wet clothing and call for emergency help. If person is alert, give them warm, sweet drinks. Do not give the person caffeine or alcohol. • Have spare clothing available; do not wear wet clothing when working in cold or freezing temperatures.

Site-Specific Job Hazard Analysis Completed by:

Name	Date
Justin Bunton	1/12/2010

North America Job Hazard Analysis
Work in Hot Environments

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	All Project Tasks
JHA No.: 8	

Document Routing	
FSO	Retain copy in site health & safety file, amend to HASP as necessary.
Project Manager	Retain copy in the office health & safety file, amend to HASP as necessary.

Instructions:	**This JHA has been developed and approved by the North America Safety Team. Prior to conducting fieldwork. site-specific hazards related to this task must be incorporated by the project team. Once completed, the JHA should be reviewed regularly with site personnel who will be performing this task.**

Task Description:

Guidelines for working in areas where heat stress may occur.

Hazard Analysis:

Task Step	Hazard	Control Measures
All Project Tasks	Heat exhaustion, heat stress/stroke, dehydration	Drink plenty of fluids take several breaks through out the day, have a cool dry place out of the sun to rest.

Personal Protective Equipment Required for this Task:

Type	Description
None	• Keep plenty of fluids on hand (water or 50/50 water/Gatorade mix) • Have a cool place out of the sun for rest breaks • Stay away from caffeine, alcohol and drinks high in sugar that will further dehydrate your body • Keep in mind the physical intensity of the work, the harder the work the more rest time that will be needed throughout the day

North America Job Hazard Analysis
Work in Hot Environments

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	All Project Tasks
JHA No.: 8	

Training Required for this Task:

Type	Description
Heat Illness recognition	Recognize the signs of heat related illnesses. • pale skin color • nausea and Headaches • disorientation and slurred speech • rapid pulse • flushed, dry ,red skin • unconsciousness

Forms Associated with this Task:

Type	Description
None	

Site-Specific Job Hazard Analysis Completed by:

Name	Date
Justin Bunton	1/12/2010

North America Job Hazard Analysis
Portable Hand and Power Tools

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	System Construction, Excavation and Trenching
JHA No.: 9	

Document Routing	
FSO	Retain copy in site health & safety file, amend to HASP as necessary.
Project Manager	Retain copy in the office health & safety file, amend to HASP as necessary.

Instructions:	**This JHA has been developed and approved by the North America Safety Team. Prior to conducting fieldwork. site-specific hazards related to this task must be incorporated by the project team. Once completed, the JHA should be reviewed regularly with site personnel who will be performing this task.**

Task Description:

Guidelines for working with portable hand and power tools.

Hazard Analysis:

Task Step	Hazard	Control Measures
Gather tools to take to jobsite	An improper tool available at jobsites encourages unsafe behaviors and could lead to injury.	Ensure tools taken to jobsites are kept in optimal condition (sharp, clean, oiled, etc.) to ensure efficient operation. Tools must only be used for their intended purposes – tools should not be used as pry-bars. Ensure power cords attached to powered-equipment are not damaged. Any damaged tool or electrical cord must be tagged and taken out of service.
Using cutting tools	Major and/or minor cuts to personnel	Fixed open-blade knives (such as pocket knives) may not be used on ERM jobsites, with few exceptions. If their use is required, cut-resistant gloves must be worn while using them and the PM or FSO must be informed prior to their use. Employees performing significant amounts of cutting tool use should must high-visibility gloves to encourage awareness of where hands are being placed.

North America Job Hazard Analysis
Portable Hand and Power Tools

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	System Construction, Excavation and Trenching
JHA No.: 9	

Task Step	Hazard	Control Measures
Using screwdrivers	Puncture injuries	Do not hold objects in the palm of your hand and press a screwdriver into it – these objects should be placed on a flat surface. Do not use screwdrivers as hammers, or use screwdrivers with broken handles. Use insulated screwdrivers for work on electrical equipment.
Using hammers	Creation of sparks	Use of brass hammers in areas where creating sparks would pose ignition hazards
	Particles may lodge in employee's eyes	Always use safety glasses when striking any object with a hammer. If hammer-head shows signs of mushrooming, replace it immediately.
	Loose handles may create a projectile hazard	Replace any hammer with a loose handle so the hammer-head does not detach and cause injuries.
Using Saws	Creation of sparks	Use of saws in areas where creating sparks would pose ignition hazards
	Particles may lodge in employee's eyes	Always use safety glasses when cutting any object with a saw.
	Saw Blades	Always wear cut protective gloves. Ensure blades are secure and you have a good grip on the saw before you begin cutting.
Using Shovels	Back Strain	Don not overexert when shoveling materials, take work rests when needed.
	Striking others in the area	Be aware of others working around you at all times. Do not swing or wave tools widely at any time.

North America Job Hazard Analysis
Portable Hand and Power Tools

Project Name:	150 Fulton Ave
Project Number:	0097881
Job / Task Name:	System Construction, Excavation and Trenching
JHA No.: 9	

Personal Protective Equipment Required for this Task:

Type	Description
Cut-resistant glove	Limited protection is afforded by leather gloves from cuts. Kevlar gloves provide more protection when significant cut/puncture hazards exist.
Safety Glasses	Provides eye and some face protection from projectiles and other flying objects

Training Required for this Task:

Type	Description
None	

Forms Associated with this Task:

Type	Description
None	

Site-Specific Job Hazard Analysis Completed by:

Name	Date
Justin Bunton	1/12/2010

ERM

Subsurface Clearance Location Disturbance Permit

Disturbance Location Designation:

ERM Project No.: ____________________

SSC Exp. Person: ____________________

Contact Person Approval of Ground Disturbance Locations (indicate verbal approval by printing “Verbal” in the signature space)

Name (Print)	Company	Name (Sign)	Date / Time

Critical Zone Determination and Clearance Depth (It is not preferred to initiate Ground Disturbance Activities within a Critical Zone)

If the Disturbance Location is known or suspected to fall within a Critical Zone, then a sketch (see reverse) or other map **must be** used to confirm proximal Critical Zones.

This Location Is:

☐ Inside a Critical Zone. Partner-in-Charge is aware & approved disturbance at this location. Physical Clearance will proceed to the deeper of: **0.6m / 2 feet below the frost line, 2.3m / 7 feet below ground level, or 20% deeper than the expected invert elevation of the service**

☐ Outside a Critical Zone.
Physical Clearance will proceed to the deeper of: **0.6m / 2 feet below the frost line or 1.2m / 4 feet below ground level.**

Physical Clearance Technique at This Location

☐ Cleared using the following technique: ____________________

☐ None. Waived by PIC. (Ensure documentation in the HASP.)

Reason: ____________________ Date / Time: ____________________

Physical Clearance Executed & Observed By:

Company	Representative(s)	Date / Time Complete	Notes

Was any Subsurface Structure discovered (damaged or undamaged) during Clearance?

☐ No (Proceed) ☐ Yes If Yes:

Discussed with PIC (Date / Time): ____________________

Agreed Action: ____________________

SSC Process Complete

Name of SSC Experienced Person (Print)	Name (Sign)	Date / Time

(Optional) Critical Zone Determination Sketch

Instructions:

1. Create a sketch of the disturbance (in the space to left or attach) that contains the following information:
    a. The disturbance location
    b. Surface landmarks and overhead obstructions (buildings, roads, overhead lines, etc.)
    c. Critical landmarks and Subsurface Structures (tanks, transformers, wells, racks, etc.)
    d. Underground services:
        i. Identified in the HASP Site Service Model
        ii. Marked by Public or Private utility markouts
        iii. As relayed by the Contact Person
        iv. Nearest shutoff / isolation mechanism for each
    e. Any surface clues as to potential underground services (junction boxes, drains, disturbed concrete, signage, etc.)
    f. The site property boundary
2. Use your sketch to mark Critical Zones (3m or 10 feet) around critical landmarks and underground structures / services.
3. For Excavations, use your sketch to mark Excavation Buffers (0.6m or 2 feet) from Subsurface Structures.
4. If the disturbance location falls inside the Critical Zone, the preferred course of action is step out to a safe location outside a Critical Zone.
5. Disturbance within a Critical Zone can only proceed with PIC approval.

Appendix C
Subsurface Clearance Requirements

Subsurface Clearance Field Process Checklist

Site Name: ____________________

Client: ____________________

ERM Project No.: ____________________

SSC Exp. Person: ____________________

Project Basics	**Yes**	**No**	**N/A**	**Comments**
Contact Person requested and identified				
Subcontractors meet ERM's minimum safety criteria				
Subcontractors understand their role in the SSC Process				
SSC Experienced Person with current SSC training assigned				
Project staff with current SSC training assigned				
UXO / MEC risks assessed: UXO / MEC IS NOT present				

General Field Activity & Site Walk	**Yes**	**No**	**N/A**	**Comments**
HASP read, understood and signed by project team				
Site walk Visual Clues / site features (below) integrated into Site Services Model				

Identified Visual Clue	**Yes**	**No**		**Identified Visual Clue**	**Yes**	**No**
Lights				Pipeline markers		
Signage				Fire hydrants		
Sewer drains / cleanouts				Sprinkler systems		
Cable markers				Water meters		
Utility poles with conduit leading to the ground				Natural gas meters		
Utility boxes				UST fill ports and vent pipes		
Manholes				Steam lines		
Pavement scarring				Remote buildings with no visible utilities		

Comments / Others:

Contact Person Approval of Ground Disturbance Locations (indicate verbal approval by printing "Verbal" in the signature space)

Name (Print)	Company	Name (Sign)	Date / Time

Pre-Clearance	**Yes**	**No**	**N/A**	**Comments**
Public Utility Markout completed				
Private Utility Markout completed				
Final Critical Zone determinations made by the SSC Experienced Person				

Critical Zones

Are there any ground disturbance locations <u>known</u> or <u>suspected</u> to be inside Critical Zones?

☐ **Yes.** PIC must approve work within the Critical Zone. The SSC Location Disturbance Permit or equivalent is required for those locations.

☐ **No.** Physical Clearance will proceed to the deeper of: 0.6m / 2 feet below the frost line or 1.2m / 4 feet below ground level, whichever is deeper.

Clearance for Point Disturbances	**Yes**	**No**	**N/A**	**Comments**
Adequate overhead clearance at ground disturbance locations				
There are disturbance locations known or suspected to be inside Critical Zones				
Physical Clearance successfully completed at all locations				

Clearance for Excavations	**Yes**	**No**	**N/A**	**Comments**
Adequate overhead clearance at ground disturbance locations				
Communicate excavation plan and Excavation Buffer location(s) to subcontractor				
There are disturbance locations known or suspected to be inside Critical Zones				
De-energize below ground services prior to beginning excavation				

SSC Process Completed By (SSC Experienced Person)

Name (Print)	Name (Sign)	Date / Time

ERM

SUBSURFACE CLEARANCE PROCEDURE **FIELD** CHECKLIST

(Use this sheet to document basic field elements of SSC, and keep with project information)

Site Name/Project No.: ______________________________
Walkover Date: ______________________________
By (ERM/Client Names): ______________________________

(ERM-MANAGED SUBSURFACE CLEARANCE ACTIVITIES)	**Yes**	**No**	**N/A**	Comments
Preparation Tasks	Observed?			
1. The potential for unexploded ordnance (UXO) has been assessed and a UXO survey performed	☐	☐	☐	
2. A site walk-over was conducted and above-ground indicators of underground utilities noted or mapped.	☐	☐	☐	
• Telephone Lines	☐	☐	☐	
• Data lines/cable trench	☐	☐	☐	
• Gas pipes/storage tanks	☐	☐	☐	
• Potable water pipes/fire water (sprinklers) pipes and hydrant lines	☐	☐	☐	
• Sewer lines (storm water/process water)	☐	☐	☐	
• Steam lines (district) and heating lines	☐	☐	☐	
• Fuel oil lines/storage tanks (UST), incl. tankfield fill ports, observation wells, vent stacks	☐	☐	☐	
• Lighting (street and traffic)	☐	☐	☐	
• Other underground utilities	☐	☐	☐	
• Hydrants	☐	☐	☐	
• Non-native soil	☐	☐	☐	
• Warning Tape	☐	☐	☐	
• Manholes	☐	☐	☐	
3. “Critical zone” decisions	☐	☐	☐	
• A mark has been placed on the map to limit surface disturbance within 10 feet of:	☐	☐	☐	
o Tanks, dispenser islands	☐	☐	☐	
o Piping manifolds	☐	☐	☐	
o Pumps/pump galleries	☐	☐	☐	
o Loading racks	☐	☐	☐	
o Process equipment	☐	☐	☐	
o On- or below-grade transformers	☐	☐	☐	
o Compressors				
o Underground chemical lines and high voltage utilities	☐	☐	☐	

Form completed by: ______________________________ ______________________
Name Date

Appendix D
Site Inspection Checklist

Site Inspection Checklist

Project Name:
Project Number:
Inspector/Project Role:
Date/Time:

Document Routing	
FSO	Retain copy in site health & safety file, amend to HASP as necessary.

Instructions: Complete the checklist below. Record any observed Unsafe Acts or Unsafe Conditions using a separate form for each. For additional comments use the back of these pages. Start all comments by identify applicable section for reference.

Personnel Administrative

Observation	Yes	No	N/A	Comments
Did all site workers attend site orientation and HASP?				
Are workers attending and signing daily toolbox safety meeting?				
Are workers reporting unsafe acts and conditions?				

Site

Observation	Yes	No	N/A	Comments
Are MSDS'S available for each chemical at the site?				
Are flammable liquids stored away from ignition sources and in a secure place when not in use?				
Are spill kits readily available?				
Are fire extinguishers inspections current and strategically located?				
Are adequate hygiene facilities available for site workers?				
Have smoking and eating areas been established?				
Are JHAs completed and reviewed by workers in accordance with the HASP				
Do workers comply with site speed limits and traffic rules?				
Do workers comply with site cell phone policy?				

Housekeeping

Observation	Yes	No	N/A	Comments
Is site kept clean, neat and orderly?				

Site Inspection Checklist

Project Name:
Project Number:
Inspector/Project Role:
Date/Time:

Are worker hygiene facilities, toilets, hand-wash stations, lunch area maintained and adequately stocked?				
Are warning signs legible?				
Are tools properly stored?				
Is trash picked up regularly and properly disposed?				
Is used PPE properly disposed?				
Are all containers properly labeled?				
Is there accumulated snow or ice over footpaths or roadways?				

Emergency Preparedness

Observation	Yes	No	N/A	Comments
Have workers been informed of the site emergency response procedures?				
Do workers know the nearest assembly point for their work area?				
Do workers know the location/s of the nearest eyewash/shower?				
Do workers know the location of the nearest first-aid kit				
Is there at least one first aid trained person on site at all times?				
Do workers know how to report an emergency?				
Do workers know the type of alarm used to identify an emergency or evacuation at the site?				
Has a site emergency evacuation drill been conducted?				

Site Inspection Checklist

Project Name:
Project Number:
Inspector/Project Role:
Date/Time:

Work Zones

Observation	Yes	No	N/A	Comments
Are exclusion, decontamination and safe zones clearly identified and maintained?				
Are workers following proper decontamination procedures?				
Is equipment decontamination procedures followed?				
Is the decontamination station adequately stocked?				
Is the "Buddy System" adhered to?				

Ambient Work Conditions

Observation	Yes	No	N/A	Comments
Is sufficient lighting available to safely do the work?				
If the temperature is above 85 F (29 C), are there liquids available such as Gatorade / water?				
Is there proper ventilation at the job site?				

General PPE Matters

Observation	Yes	No	N/A	Comments
Are hardhats being worn?				
Are workers utilizing appropriate eye protection for the?				
Are workers utilizing the appropriate foot protection for the task?				
Is hearing protection required and utilized?				
Are workers using and wearing the appropriate hand protection for the task?				

Site Inspection Checklist

Project Name:
Project Number:
Inspector/Project Role:
Date/Time:

Hand and Foot Protection

Observation	Yes	No	N/A	Comments
Are the appropriate gloves being worn by site workers as identified by the HASP or JHA?				
Is the appropriate footwear worn by site workers as identified by the HASP or JHA?				
Are disposable gloves and footwear disposed of properly?				

Respiratory Protection

Observation	Yes	No	N/A	Comments
Are copies of employee respiratory training records, fit test and fit to work statements current and available on site?				
Are workers following respirator cartridge change out schedule?				
Are workers following proper respirator donning procedures?				
Are respirators cleaned and stored properly when not in use?				

Condition of Protective Clothing

Observation	Yes	No	N/A	Comments
Is protective clothing worn by workers in good condition? (no rips or tears)				
Is the type of protective clothing selected appropriate for the task? (see HASP or JHA'S)				
Are workers correctly wearing the protective clothing? (e.g., Zippers zipped, proper taping of sleeves)				
Is contaminated clothing properly disposed?				

Site Inspection Checklist

Project Name:
Project Number:
Inspector/Project Role:
Date/Time:

Ground Disturbance and Excavations

Observation	Yes	No	N/A	Comments
Has the sub-surface checklist been completed and signed off by all appropriate parties?				
Are all sub-surface processes or utility lines clearly identified?				
Is there at least one competent excavation person on site at all times?				
Is a copy of the competent excavation person training records available for review?				
Are excavations properly sloped shored or benched?				
Are excavations properly protected by hard or soft barricade?				

Hand and Powered Hand Tools

Observation	Yes	No	N/A	Comments
Are all hand tools in good working order and appropriate for the task?				
Are electrical cords in good repair and inspected prior to use?				
Are external GFCI'S used and routinely inspected?				
Are guards and other safety devises present and in good working order?				
Are workers wearing hearing protection when using high noise producing tools?				
Are workers wearing appropriate PPE when using electrical or pneumatic tools?				
Are pneumatic hoses in good condition?				
Is/are fire extinguishers located nearby portable compressors or generators?				
Are generators or compressors shut down prior to fueling?				
Are malfunctioning tools tagged and taken out of service?				

Site Inspection Checklist

Project Name:
Project Number:
Inspector/Project Role:
Date/Time:

Heavy Equipment

Observation	Yes	No	N/A	Comments
Are daily equipment inspection checklists completed?				
Are safety deficiencies immediately repaired or has the equipment been taken out of service?				
Do the back-up alarms work?				
Does the operator use three-points of contact when getting on/off equipment?				
Is heavy equipment operated within its design capacity?				
Is equipment operated at safe speeds for site conditions?				
Are fire extinguishers present and in good working order on all equipment?				
Are keys or control panels removed when equipment is not in use?				
Are workers working with or near heavy equipment operations wearing high visibility clothing (i.e. traffic vest?				

Appendix E

Personal Safety Contract (PSC) Cards

Date:

Name:

PPE Requirements

☐ Hardhat
☐ Safety glasses
☐ Steel toed shoes/boots
☐ Hearing protection
☐ Gloves
☐ Tyvek/Protective clothing
☐ Respirator
☐ Traffic vest/orange shirt
☐ Other

Emergency Preparedness

1) Location of nearest fire extinguisher?
2) Location of nearest eyewash station?
3) Location of nearest first-aid kit?
4) Who is the Site Safety Officer?

Task Assigned

List the Hazards & Mitigations Associated with the Assigned Task

Hazard	Mitigation

Date:

Name:

PPE Requirements

☐ Hardhat
☐ Safety glasses
☐ Steel toed shoes/boots
☐ Hearing protection
☐ Gloves
☐ Tyvek/Protective clothing
☐ Respirator
☐ Traffic vest/orange shirt
☐ Other

Emergency Preparedness

1) Location of nearest fire extinguisher?
2) Location of nearest eyewash station?
3) Location of nearest first-aid kit?
4) Who is the Site Safety Officer?

Task Assigned

List the Hazards & Mitigations Associated with the Assigned Task

Hazard	Mitigation

Date:

Name:

PPE Requirements

☐ Hardhat
☐ Safety glasses
☐ Steel toed shoes/boots
☐ Hearing protection
☐ Gloves
☐ Tyvek/Protective clothing
☐ Respirator
☐ Traffic vest/orange shirt
☐ Other

Emergency Preparedness

1) Location of nearest fire extinguisher?
2) Location of nearest eyewash station?
3) Location of nearest first-aid kit?
4) Who is the Site Safety Officer?

Task Assigned

List the Hazards & Mitigations Associated with the Assigned Task

Hazard	Mitigation

Date:

Name:

PPE Requirements

☐ Hardhat
☐ Safety glasses
☐ Steel toed shoes/boots
☐ Hearing protection
☐ Gloves
☐ Tyvek/Protective clothing
☐ Respirator
☐ Traffic vest/orange shirt
☐ Other

Emergency Preparedness

1) Location of nearest fire extinguisher?
2) Location of nearest eyewash station?
3) Location of nearest first-aid kit?
4) Who is the Site Safety Officer?

Task Assigned

List the Hazards & Mitigations Associated with the Assigned Task

Hazard	Mitigation

Daily Safety Observations/Notes

RCM
ERM Remediation &
Construction Management

Personal Safety Contract (PSC) Card

- *A PSC Card must be completed for each assigned task*
- *Keep this PSC Card on your person for the duration of the workday*
- *Turn in all PSC Cards to your supervisor at the end of each day*

You see it, You own it!

Rev.: 05-08

Daily Safety Observations/Notes

RCM
ERM Remediation &
Construction Management

Personal Safety Contract (PSC) Card

- *A PSC Card must be completed for each assigned task*
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You see it, You own it!

Rev.: 05-08

Daily Safety Observations/Notes

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ERM Remediation &
Construction Management

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- *A PSC Card must be completed for each assigned task*
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You see it, You own it!

Rev.: 05-08

Daily Safety Observations/Notes

RCM
ERM Remediation &
Construction Management

Personal Safety Contract (PSC) Card

- *A PSC Card must be completed for each assigned task*
- *Keep this PSC Card on your person for the duration of the workday*
- *Turn in all PSC Cards to your supervisor at the end of each day*

You see it, You own it!

Rev.: 05-08

RCM Personal Safety Contract Card Template
Revision: 04-08

Instructions:

- Print the first two sides front and back on the same sheet of paper.
- Cut along the bold dashed lines
- Fold along the normal dashed lines with the RCM logo on the outside
- One printing makes four PSC Cards

Appendix F
Work Permit Forms

SAFE WORK PERMIT

☐ Confined Space Entry ☐ Hot Work ☐ Line Breaking

Location: ______________________ WO Number ______________

Scope of Work: ______________________

Issued To: ______________________ Issued By: ______________

Date & Time Issued ______________________ Date & Time Expires ______________

Section I General Information (Complete for all permits)

1. Job Specific Hazards

☐ Worksite Chemicals
☐ Corrosives
☐ Ignition Sources
☐ Steam
☐ High Pressure
☐ Atmospheric Hazards
☐ Flammable Liquids
☐ Electrical Hazards
☐ Vehicle Traffic
☐ Radiation
☐ Thermal Burns
☐ Reactive Liquids
☐ Electrical Cords
☐ Adjacent Work
☐ Noise
☐ Chemical Burns
☐ Toxic Substances
☐ Falls above 4’
☐ Heat Stress/Cold Injuries
☐ Pinch Points
☐ Other ______________________

2. PPE/Equipment

☐ Inner Gloves
☐ Outer Gloves
☐ Chemical Suit
☐ Poly Coated Suit
☐ Hearing Protection
☐ Safety Shoes/Boots
☐ Safety Glasses w/ Side Shield
☐ Half-faced Respirator
☐ Full-Faced Respirator
☐ Line Air Respirator
☐ SCBA
☐ Chemical Goggles
☐ Face Shield
☐ Hard Hat
☐ Welding Shield
☐ Spark Proof Tools
☐ Fire Extinguisher(s)
☐ Decon Materials
☐ First Aid Kit
☐ Eyewash Station
☐ Spill Response Equipment
☐ Tripod w/ lifting device
☐ Harness
☐ Ventilation
☐ Work lights
☐ GFCI
☐ Two-way Radio
☐ Barricades/Warning Signals
☐ Other ______________________

3. Rescue and Emergency Services

Service Name: ______________ Contact Name: ______________

Telephone Number: ______________

Section II Confined Space Entry

1. Space to be Entered: ______________________
2. Purpose of Entry: ______________________
3. Describe how the hazards identified in Section I have been addresses/isolated: ______________________
4. Describe Communication Procedures used by Entrant and Attendant during entry: ______________________

Section III Hot Work

1. Equipment to be worked on: ______________________
2. Precautions:

☐ Fire hazards removed from area
☐ Welding equipment inspected
☐ Spark and heat guards in place
☐ Floor/wall openings covered
☐ Fire extinguishers at location
☐ Fire watch posted (> 30 min)
☐ Area inspected by Supervisor
☐ Atmospheric tests complete
☐ Adequate ventilation

3. Name of Fire Watch: ______________ Fire watch start time: ________ Fire watch end time: ________

Section IV Line Breaking

1. Line/Equipment positively identified? ☐ Yes ☐ NA
2. Line/Equipment properly drained/depressurized/purged/blanked? ☐ Yes ☐ NA
3. Line/Equipment cleaned of residual material? ☐ Yes ☐ NA
4. Bonding and grounding required? ☐ Yes ☐ NA
5. Non-sparking tools required? ☐ Yes ☐ NA
6. Atmospheric monitoring required? ☐ Yes ☐ NA
7. Containment/spill control required? ☐ Yes ☐ NA

Section V Atmospheric Monitoring (Complete for Confined Space Entry and Hot Work)

Parameters	Initial Results	Periodic Results	Periodic Results	Periodic Results	Periodic Results	Periodic Results	Periodic Results	Periodic Results
Time Monitored								
Tester’s Initials/Signature								
Oxygen (19.5%-23.5%)								
Flammability (< 10% LEL)								
Other								
Other								

Section VI Personnel Accountability (Complete for all permits)

Issuing Supervisor ____________________ Signature: ____________________ Time: ______________
H&S Lead ____________________ Signature: ____________________ Time: ______________
Entrant ____________________ Signature: ____________________ Time: ______________
Entrant ____________________ Signature: ____________________ Time: ______________
Entrant ____________________ Signature: ____________________ Time: ______________
Attendant ____________________ Signature: ____________________ Time: ______________
Attendant ____________________ Signature: ____________________ Time: ______________
Attendant ____________________ Signature: ____________________ Time: ______________
Employee ____________________ Signature: ____________________ Time: ______________
Employee ____________________ Signature: ____________________ Time: ______________
Employee ____________________ Signature: ____________________ Time: ______________
Employee ____________________ Signature: ____________________ Time: ______________

Section VII Special Instructions (Complete as necessary)

____
____
____

Section VIII Contractors (Complete as necessary)

The following aspects of the permitted work activities have been discussed and coordinated with the contractor:

1. Roles and Responsibilities ☐ Yes ☐ No ☐ NA
2. Job Specific Hazards ☐ Yes ☐ No ☐ NA
3. PPE Requirements ☐ Yes ☐ No ☐ NA
4. Rescue Activities and Emergency Response ☐ Yes ☐ No ☐ NA

Section IX Canceling the Permit (Complete for all permits)

1. Has the job, defined in the scope above been completed? ☐ Yes ☐ No ☐ NA
2. Have affected personnel been informed the job is complete? ☐ Yes ☐ No ☐ NA
3. Has equipment been returned to service? ☐ Yes ☐ No ☐ NA
4. Have safety devices been reinstalled? ☐ Yes ☐ No ☐ NA
5. Have housekeeping/environmental issues been addressed? ☐ Yes ☐ No ☐ NA

Closeout Signature: ______________________ Time: ________ Date: ___________

Appendix G
Project Material Safety Data Sheets

Material Safety Data Sheet

24-Hour Emergency Telephone Numbers
HEALTH : Chevron Emergency Information Center (800) 231-0623 or (510) 231-0623
TRANSPORTATION : CHEMTREC (800) 424-9300 or (703) 527-3887
Emergency Information Centers are located in the U.S.A. International collect calls accepted.

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

TEXACO Havoline DEX-COOL Extended Life Anti-Freeze/Coolant

Product Number(s): CPS227994

Company Identification
ChevronTexaco Global Lubricants
6001 Bollinger Canyon Road
San Ramon, CA 94583

Product Information
Product Information: 800-LUBE-TEK
email : lubemsds@chevron.com

SECTION 2 COMPOSITION/ INFORMATION ON INGREDIENTS

COMPONENTS	CAS NUMBER	AMOUNT
Ethylene Glycol	107-21-1	80 - 96.99 %weight
Diethylene glycol	111-46-6	1 - 4.99 %weight
Potassium 2-ethylhexanoate	3164-85-0	1 - 4.99 %weight
Water	7732-18-5	1 - 2.99 %weight

SECTION 3 HAZARDS IDENTIFICATION

****

EMERGENCY OVERVIEW

Orange liquid. Mild odor.

- HARMFUL OR FATAL IF SWALLOWED
- CAUSES EYE IRRITATION
- MAY CAUSE ADVERSE REPRODUCTIVE EFFECTS BASED ON ANIMAL DATA
- POSSIBLE BIRTH DEFECT HAZARD - CONTAINS MATERIAL THAT MAY CAUSE BIRTH DEFECTS BASED ON ANIMAL DATA
- MAY CAUSE DAMAGE TO:
- KIDNEY

****

IMMEDIATE HEALTH EFFECTS
Eye: Contact with the eyes causes irritation. Symptoms may include pain, tearing, reddening, swelling and impaired vision.
Skin: Contact with the skin is not expected to cause prolonged or significant irritation. Not expected to be harmful to internal organs if absorbed through the skin.
Ingestion: Toxic; may be harmful or fatal if swallowed.
Inhalation: The vapor or fumes from this material may cause respiratory irritation. Symptoms of

respiratory irritation may include coughing and difficulty breathing.

DELAYED OR OTHER HEALTH EFFECTS:
Reproduction and Birth Defects: May cause adverse reproductive effects based on animal data. Contains material that may be harmful to the developing fetus based on animal data.

Target Organs: Repeated ingestion of this material may cause damage to the following organ(s) based on animal data. Kidney

See Section 11 for additional information. Risk depends on duration and level of exposure.

SECTION 4 FIRST AID MEASURES

Eye: Flush eyes with water immediately while holding the eyelids open. Remove contact lenses, if worn, after initial flushing, and continue flushing for at least 15 minutes. Get medical attention if irritation persists.
Skin: To remove the material from skin, use soap and water. Discard contaminated clothing and shoes or thoroughly clean before reuse.
Ingestion: If swallowed, get immediate medical attention. Do not induce vomiting. Never give anything by mouth to an unconscious person.
Inhalation: Move the exposed person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if breathing difficulties continue.

SECTION 5 FIRE FIGHTING MEASURES

FIRE CLASSIFICATION:
OSHA Classification (29 CFR 1910.1200): Not classified by OSHA as flammable or combustible.

NFPA RATINGS: Health: 2 Flammability: 1 Reactivity: 0

FLAMMABLE PROPERTIES:
Flashpoint: (Pensky-Martens Closed Cup) 260 °F (127 °C)
Autoignition: 752 °F (400 °C)
Flammability (Explosive) Limits (% by volume in air): Lower: 3.2 Upper:

EXTINGUISHING MEDIA: Dry Chemical, CO2, AFFF Foam or alcohol resistant foam.

PROTECTION OF FIRE FIGHTERS:
Fire Fighting Instructions: This material will burn although it is not easily ignited. For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment, including self-contained breathing apparatus.
Combustion Products: Highly dependent on combustion conditions. A complex mixture of airborne solids, liquids, and gases including carbon monoxide, carbon dioxide, and unidentified organic compounds will be evolved when this material undergoes combustion. Combustion may form oxides of: Potassium .

SECTION 6 ACCIDENTAL RELEASE MEASURES

Protective Measures: Eliminate all sources of ignition in vicinity of spilled material.
Spill Management: Stop the source of the release if you can do it without risk. Contain release to prevent further contamination of soil, surface water or groundwater. Clean up spill as soon as possible, observing precautions in Exposure Controls/Personal Protection. Use appropriate techniques such as applying non-combustible absorbent materials or pumping. Where feasible and appropriate, remove

contaminated soil. Place contaminated materials in disposable containers and dispose of in a manner consistent with applicable regulations.
Reporting: Report spills to local authorities and/or the U.S. Coast Guard's National Response Center at (800) 424-8802 as appropriate or required.

SECTION 7 HANDLING AND STORAGE

Precautionary Measures: Wash thoroughly after handling. Do not get in eyes. Do not breathe vapor or fumes.
General Handling Information: Do not taste or swallow antifreeze or solution. Keep out of the reach of children and animals.
Static Hazard: Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary but may not, by themselves, be sufficient. Review all operations which have the potential of generating an accumulation of electrostatic charge and/or a flammable atmosphere (including tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing, agitation, and vacuum truck operations) and use appropriate mitigating procedures. For more information, refer to OSHA Standard 29 CFR 1910.106, 'Flammable and Combustible Liquids', National Fire Protection Association (NFPA 77, 'Recommended Practice on Static Electricity', and/or the American Petroleum Institute (API) Recommended Practice 2003, 'Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents'.
General Storage Information: Do not store in open or unlabeled containers.
Container Warnings: Container is not designed to contain pressure. Do not use pressure to empty container or it may rupture with explosive force. Empty containers retain product residue (solid, liquid, and/or vapor) and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death. Empty containers should be completely drained, properly closed, and promptly returned to a drum reconditioner or disposed of properly.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

GENERAL CONSIDERATIONS:

Consider the potential hazards of this material (see Section 3), applicable exposure limits, job activities, and other substances in the work place when designing engineering controls and selecting personal protective equipment. If engineering controls or work practices are not adequate to prevent exposure to harmful levels of this material, the personal protective equipment listed below is recommended. The user should read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances.

ENGINEERING CONTROLS:

Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below the recommended exposure limits.

PERSONAL PROTECTIVE EQUIPMENT

Eye/Face Protection: Wear eye protection such as safety glasses, chemical goggles, or faceshields if engineering controls or work practices are not adequate to prevent eye contact.
Skin Protection: No special protective clothing is normally required. Where splashing is possible, select protective clothing depending on operations conducted, physical requirements and other substances. Suggested materials for protective gloves include: Natural rubber, Neoprene, Nitrile Rubber, Polyvinyl Chloride (PVC or Vinyl).
Respiratory Protection: Determine if airborne concentrations are below the recommended exposure limits. If not, wear an approved respirator that provides adequate protection from measured concentrations of this material, such as: Air-Purifying Respirator for Organic Vapors, Dusts and Mists. Use a positive pressure air-supplying respirator in circumstances where air-purifying respirators may not

provide adequate protection.

Occupational Exposure Limits:

Component	Limit	TWA	STEL	Ceiling	Notation
Ethylene Glycol	ACGIH_TLV			100 mg/m3	
Ethylene Glycol	OSHA_PEL			125 mg/m3	

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance and Odor: Orange liquid. Mild odor.
pH: 8 - 8.6
Vapor Pressure: <0.01 mmHg @ 20 °C
Vapor Density (Air = 1): 2.1
Boiling Point: 228 °F (109 C) (Typical)
Solubility: Miscible
Freezing Point: -34 °F (-37 C)
Melting Point: NDA
Specific Gravity: 1.12 @ 15.6 °C / 15.6 °C
Viscosity: 8 cSt @ 40 °C

SECTION 10 STABILITY AND REACTIVITY

Chemical Stability: This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Incompatibility With Other Materials: May react with strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.
Hazardous Decomposition Products: Aldehydes (Elevated temperatures)
Hazardous Polymerization: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

IMMEDIATE HEALTH EFFECTS

Eye Irritation: The eye irritation hazard is based on evaluation of data for similar materials or product components.
Skin Irritation: The skin irritation hazard is based on evaluation of data for similar materials or product components.
Skin Sensitization: No product toxicology data available.
Acute Dermal Toxicity: The acute dermal toxicity hazard is based on evaluation of data for similar materials or product components.
Acute Oral Toxicity: The acute oral toxicity hazard is based on evaluation of data for similar materials or product components.
Acute Inhalation Toxicity: The acute inhalation toxicity hazard is based on evaluation of data for similar materials or product components.

ADDITIONAL TOXICOLOGY INFORMATION:

This product contains ethylene glycol (EG). The toxicity of EG via inhalation or skin contact is expected to be slight at room temperature. The estimated oral lethal dose is about 100 cc (3.3 oz.) for an adult human. Ethylene glycol is oxidized to oxalic acid which results in the deposition of calcium oxalate crystals mainly in the brain and kidneys. Early signs and symptoms of EG poisoning may resemble those of alcohol intoxication. Later, the victim may experience nausea, vomiting, weakness, abdominal and muscle pain, difficulty in breathing and decreased urine output. When EG was heated above the boiling point of water, vapors formed which reportedly caused unconsciousness, increased lymphocyte count, and a rapid, jerky movement of the eyes in persons chronically exposed. When EG was administered orally to pregnant rats and mice, there was an increase in fetal deaths and birth defects. Some of these effects occurred at doses that had no toxic effects on the mothers. We are not aware of any reports that EG causes reproductive toxicity in human beings.

This product contains diethylene glycol (DEG). The estimated oral lethal dose is about 50 cc (1.6 oz) for an adult human. DEG has caused the following effects in laboratory animals: liver abnormalities, kidney damage and blood abnormalities. It has been suggested as a cause of the following effects in humans: liver abnormalities, kidney damage, lung damage and central nervous system damage.

2-Ethylhexanoic acid (2-EXA) caused an increase in liver size and enzyme levels when repeatedly administered to rats via the diet. When administered to pregnant rats by gavage or in drinking water, 2-EXA caused teratogenicity (birth defects) and delayed postnatal development of the pups. Additionally, 2-EXA impaired female fertility in rats. Birth defects were seen in the offspring of mice who were administered sodium 2-ethylhexanoate via intraperitoneal injection during pregnancy.

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY

The toxicity of this material to aquatic organisms has not been evaluated. Consequently, this material should be kept out of sewage and drainage systems and all bodies of water.

ENVIRONMENTAL FATE

This material is expected to be readily biodegradable.

SECTION 13 DISPOSAL CONSIDERATIONS

Use material for its intended purpose or recycle if possible. This material, if it must be discarded, may meet the criteria of a hazardous waste as defined by US EPA under RCRA (40 CFR 261) or other State and local regulations. Measurement of certain physical properties and analysis for regulated components may be necessary to make a correct determination. If this material is classified as a hazardous waste, federal law requires disposal at a licensed hazardous waste disposal facility.

SECTION 14 TRANSPORT INFORMATION

The description shown may not apply to all shipping situations. Consult 49CFR, or appropriate Dangerous Goods Regulations, for additional description requirements (e.g., technical name) and mode-specific or quantity-specific shipping requirements.

DOT Shipping Name: NOT REGULATED AS A HAZARDOUS MATERIAL FOR TRANSPORTATION UNDER 49 CFR
DOT Hazard Class: NOT APPLICABLE
DOT Identification Number: NOT APPLICABLE
DOT Packing Group: NOT APPLICABLE

SECTION 15 REGULATORY INFORMATION

SARA 311/312 CATEGORIES:		
	1. Immediate (Acute) Health Effects:	YES
	2. Delayed (Chronic) Health Effects:	YES
	3. Fire Hazard:	NO
	4. Sudden Release of Pressure Hazard:	NO
	5. Reactivity Hazard:	NO

REGULATORY LISTS SEARCHED:

4_I1=IARC Group 1
4_I2A=IARC Group 2A
4_I2B=IARC Group 2B
05=NTP Carcinogen
06=OSHA Carcinogen
09=TSCA 12(b)
10=TSCA Section 4
11=TSCA Section 8(a) CAIR
12=TSCA Section 8(a) PAIR
13=TSCA Section 8(d)
15=SARA Section 313
16=CA Proposition 65
17=MA RTK
18=NJ RTK
19=DOT Marine Pollutant
20=PA RTK
21=TSCA Section 5(a)
25=CAA Section 112 HAPs
26=CWA Section 311
28=CWA Section 307
30=RCRA Waste P-List
31=RCRA Waste U-List
32=RCRA Appendix VIII

The following components of this material are found on the regulatory lists indicated.

Diethylene glycol	25
Ethylene Glycol	15, 17, 18, 20, 25

CERCLA REPORTABLE QUANTITIES(RQ)/SARA 302 THRESHOLD PLANNING QUANTITIES(TPQ):

Component	Component RQ	Component TPQ	Product RQ
Ethylene Glycol	5000 lbs	None	5440 lbs

CHEMICAL INVENTORIES:

AUSTRALIA: All the components of this material are listed on the Australian Inventory of Chemical Substances (AICS).

PEOPLE'S REPUBLIC OF CHINA: All the components of this product are listed on the draft Inventory of Existing Chemical Substances in China.

EUROPEAN UNION: All the components of this material are in compliance with the EU Seventh Amendment Directive 92/32/EEC.

KOREA: All the components of this product are on the Existing Chemicals List (ECL) in Korea.

PHILIPPINES: All the components of this product are listed on the Philippine Inventory of Chemicals and Chemical Substances (PICCS).

UNITED STATES: All of the components of this material are on the Toxic Substances Control Act (TSCA) Chemical Inventory.

NEW JERSEY RTK CLASSIFICATION:

Refer to components listed in Section 2.

WHMIS CLASSIFICATION:

Class D, Division 1, Subdivision B: Toxic Material -
Acute Lethality
Class D, Division 2, Subdivision A: Very Toxic Material -
Chronic Toxic Effects
Reproductive Toxicity
Teratogenicity and Embryotoxicity
Class D, Division 2, Subdivision B: Toxic Material -
Skin or Eye Irritation

SECTION 16 OTHER INFORMATION

NFPA RATINGS: Health: 2 Flammability: 1 Reactivity: 0
HMIS RATINGS: Health: 2* Flammability: 1 Reactivity: 0

(0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme, PPE:- Personal Protection Equipment Index recommendation, *- Chronic Effect Indicator). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint and Coating Association (for HMIS ratings).

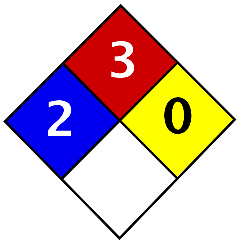
REVISION STATEMENT: This revision updates Section 1 (Product Identification), Section 2 (Composition/Ingredient Information), Section 5 (Fire Fighting Measures), Section 11 (Toxicological Information), and Section 15 (Regulatory Information).

ABBREVIATIONS THAT MAY HAVE BEEN USED IN THIS DOCUMENT:

TLV	-	Threshold Limit Value	TWA	-	Time Weighted Average
STEL	-	Short-term Exposure Limit	PEL	-	Permissible Exposure Limit
			CAS	-	Chemical Abstract Service Number
NDA	-	No Data Available	NA	-	Not Applicable
<=	-	Less Than or Equal To	>=	-	Greater Than or Equal To

Prepared according to the OSHA Hazard Communication Standard (29 CFR 1910.1200) and the ANSI MSDS Standard (Z400.1).

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
1,2-Dichloroethane MSDS

Section 1: Chemical Product and Company Identification

Product Name: 1,2-Dichloroethane

Catalog Codes: SLD2521, SLD3721

CAS#: 107-06-2

RTECS: KH9800000

TSCA: TSCA 8(b) inventory: 1,2-Dichloroethane

CI#: Not available.

Synonym: Ethylene dichloride

Chemical Formula: C2H4CL2

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{1,2-}Dichloroethane	107-06-2	100

Toxicological Data on Ingredients: 1,2-Dichloroethane: ORAL (LD50): Acute: 670 mg/kg [Rat]. 413 mg/kg [Mouse]. DERMAL (LD50): Acute: 2800 mg/kg [Rabbit]. VAPOR (LC50): Acute: 1414.2 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Extremely hazardous in case of ingestion. Very hazardous in case of eye contact (irritant), of inhalation. Hazardous in case of skin contact (irritant). Corrosive to skin and eyes on contact. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
Very hazardous in case of ingestion, of inhalation.
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified 2B (Possible for human.) by IARC. Classified 2 (Reasonably anticipated.) by NTP.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.

The substance is toxic to lungs, the nervous system, liver, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
If the chemical got onto the clothed portion of the body, remove the contaminated clothes as quickly as possible, protecting your own hands and body. Place the victim under a deluge shower. If the chemical got on the victim's exposed skin, such as the hands : Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 413°C (775.4°F)

Flash Points: CLOSED CUP: 13°C (55.4°F). OPEN CUP: 18°C (64.4°F).

Flammable Limits: LOWER: 6.2% UPPER: 15.6%

Products of Combustion: These products are carbon oxides (CO, CO_2).

Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks.
Slightly flammable to flammable in presence of oxidizing materials.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.
Slightly explosive to explosive in presence of oxidizing materials.

Fire Fighting Media and Instructions:

Flammable liquid, soluble or dispersed in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Corrosive liquid.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep container dry. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. Never add water to this product In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Flammable materials should be stored in a separate safety storage cabinet or room. Keep away from heat. Keep away from sources of ignition. Keep container tightly closed. Keep in a cool, well-ventilated place. Ground all equipment containing material. A refrigerated room would be preferable for materials with a flash point lower than 37.8°C (100°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 10 CEIL: 75 (ppm) from ACGIH (TLV)
TWA: 40 CEIL: 300 (mg/m3) from ACGIHConsult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 98.96 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: 83.5°C (182.3°F)

Melting Point: -35.3°C (-31.5°F)

Critical Temperature: Not available.

Specific Gravity: 1.2351 (Water = 1)

Vapor Pressure: 61 mm of Hg (@ 20°C)

Vapor Density: 3.42 (Air = 1)

Volatility: Not available.

Odor Threshold: 26 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, diethyl ether, n-octanol, acetone.

Solubility:
Easily soluble in methanol, diethyl ether, n-octanol, acetone.
Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 413 mg/kg [Mouse].
Acute dermal toxicity (LD50): 2800 mg/kg [Rabbit].
Acute toxicity of the vapor (LC50): 1414.2 ppm 4 hour(s) [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified + (PROVEN) by OSHA. Classified 2B (Possible for human.) by IARC.
Classified 2 (Reasonably anticipated.) by NTP.
The substance is toxic to lungs, the nervous system, liver, mucous membranes.

Other Toxic Effects on Humans:
Extremely hazardous in case of ingestion.
Very hazardous in case of inhalation.
Hazardous in case of skin contact (irritant).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Passes through the placental barrier in animal. Excreted in maternal milk in human.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: Class 3: Flammable liquid.

Identification: : Ethylene dichloride : UN1184 PG: II

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: 1,2-Dichloroethane
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: 1,2-Dichloroethane
Pennsylvania RTK: 1,2-Dichloroethane

Massachusetts RTK: 1,2-Dichloroethane
TSCA 8(b) inventory: 1,2-Dichloroethane
CERCLA: Hazardous substances.: 1,2-Dichloroethane

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).
CLASS E: Corrosive liquid.

DSCL (EEC):
R11- Highly flammable.
R20/22- Harmful by inhalation and if swallowed.
R38- Irritating to skin.
R41- Risk of serious damage to eyes.
R45- May cause cancer.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:17 PM

Last Updated: 11/06/2008 12:00 PM

SCOTT SPECIALTY GASES -- ISOBUTYLENE IN AIR, (SEE SUPPL.) -- 6665-01-449-8454

==================== Product Identification ====================

Product ID:ISOBUTYLENE IN AIR, (SEE SUPPL.)
MSDS Date:11/20/1997
FSC:6665
NIIN:01-449-8454
Status Code:A
Kit Part:Y
MSDS Number: CLFCR
=== Responsible Party ===
Company Name:SCOTT SPECIALTY GASES
Address:2330 HAMILTON BLVD
City:SOUTH PLAINFIELD
State:NJ
ZIP:07080
Country:US
Info Phone Num:908-754-7700
Emergency Phone Num:908-754-7700
Resp. Party Other MSDS Num.:M-704/E-1
CAGE:54262
=== Contractor Identification ===
Company Name:PHOTOVAC INTL INC/DBA PHOTOVAC MONITORING INSTRUMENTS
Address:UNK
Box:UNK
City:DEER PARK
State:NY
ZIP:11729
Country:US
Phone:000-000-0000
CAGE:70123
Company Name:PINE ENVIRONMENTAL SERVICES INC
Address:379 PRINCETON-HIGHTSTOWN RD
Box:City:CRANBURY
State:NJ
ZIP:08512
Country:US
Phone:609-371-9663
Contract Num:SP0200-99-M-T071
CAGE:1JSC4
Company Name:SCOTT SPECIALTY GASES
Address:2330 HAMILTON BLVD
Box:City:SOUTH PLAINFIELD
State:NJ
ZIP:07080
Country:US
Phone:908-754-7700
CAGE:54262

============ Composition/Information on Ingredients ============

Ingred Name:ISOBUTYLENE
CAS:115-11-7
RTECS #:UD0890000
Fraction by Wt: 1-1500% PPM

Ingred Name:AIR
CAS:132259-10-0

Fraction by Wt: BALANCE

==================== Hazards Identification ====================

Reports of Carcinogenicity:NTP:NO   IARC:NO   OSHA:NO
Health Hazards Acute and Chronic:ACUTE EFFECTS: NONE. CHRONIC EFFECTS: NONE KNOWN.
Explanation of Carcinogenicity:CARCINOGENICITY (U.S. ONLY): NTP - NO; IARC MONOGRAPHS - NO; OSHA REGULATED - NO.
Effects of Overexposure:NONE.
Medical Cond Aggravated by Exposure:NONE KNOWN.

====================== First Aid Measures ======================

First Aid:IN EVENT OF EXPOSURE, CONSULT A PHYSICIAN. INHALATION: IMMEDIATELY REMOVE VICTIM TO FRESH AIR. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN. EYE CONTAC T: NONE. SKIN CONTACT: NONE. INGESTION: NONE.

==================== Fire Fighting Measures ====================

Flash Point:NONFLAMMABLE
Extinguishing Media:USE WHAT IS APPROPRIATE FOR SURROUNDING FIRE.
Fire Fighting Procedures:WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECIVE CLOTHING. KEEP FIRE EXPOSED CYLINDERS COOL WITH WATER SPRAY. IF POSSIBLE, STOP THE PRODUCT FLOW.
Unusual Fire/Explosion Hazard:CYLINDER RUPTURE MAY OCCUR UNDER FIRE CONDITIONS. COMPRESSED AIR AT HIGH PRESSURE WILL ACCELERATE THE COMBUSTION OF FLAMMABLE MATERIALS.

================== Accidental Release Measures ==================

Spill Release Procedures:EVACUATE AND VENTILATE AREA. REMOVE LEAKING CYLINDER TO EXHAUST HOOD OR SAFE OUTDOOR AREA. SHUT OFF SOURCE IF POSSIBLE AND REMOVE SOURCE OF HEAT.

====================== Handling and Storage ======================

Handling and Storage Precautions:HANDLING: SECURE CYLINDER WHEN USING TO PROTECT FROM FALLING. USE SUITABLE HAND TRUCK TO MOVE CYLINDERS. STORAGE: STORE IN WELL VENTILATED AREAS. KEEP VALVE PROTECTION CAP ON CYLINDERS WHEN NOT IN USE .
Other Precautions:PROTECT CONTAINERS FROM PHYSICAL DAMAGE. DO NOT DEFACE CYLINDERS OR LABELS. CYLINDERS SHOULD BE REFILLED BY QUALIFIED PRODUCERS OF COMPRESSED GAS. SHIPMENT OF A COMPRESSED GAS CYLINDER WHICH HAS NOT B EEN FILLED BY THE OWNER OR WITH HIS WRITTEN CONSENT IS A VIOLATION OF FEDERAL LAW (49 CFR)

============= Exposure Controls/Personal Protection =============

Respiratory Protection:IN CASE OF LEAKAGE, USE SELF-CONTAINED BREATHING APPARATUS.
Ventilation:PROVIDE ADEQUATE GENERAL AND LOCAL EXHAUST VENTILATION.
Protective Gloves:NONE
Eye Protection:SAFETY GLASSES.
Other Protective Equipment:SAFETY SHOES WHEN HANDLING CYLINDERS.
Supplemental Safety and Health
VENDOR (CAGE 70123) PART NUMBER: 350005. THIS ENTRY DESCRIBES ONE PART, SERIAL NUMBER XXXXX, ISOBUTYLENE IN AIR, OF A FIELD KIT. SEE THIS SAME NSN, SERIAL NUMBER XXXXX, A 10 HOUR RECHARGEABLE BATTERY

PACK, FOR DATA ON SECOND PART OF KIT.

Physical/Chemical Properties

HCC:G3
Vapor Density:.991(AIR=1
Spec Gravity:GAS
Evaporation Rate & Reference:GAS
Solubility in Water:18.68CM3/1@20C
Appearance and Odor:COLORLESS, ODORLESS GAS

Stability and Reactivity Data

Stability Indicator/Materials to Avoid:YES
OXIDIZING AGENTS.
Stability Condition to Avoid:STABLE UNDER NORMAL STORAGE CONDITIONS. AVOID STORAGE IN POORLY VENTILATED AREAS AND STORAGE NEAR A HEAT SOURCE.
Hazardous Decomposition Products:NONE.
Conditions to Avoid Polymerization:WILL NOT OCCUR.

Toxicological Information

Toxicological Information:LETHAL CONCENTRATION (LC50): NONE ESTABLISHED. LETHAL DOSE 50 (LD50): NOT APPLICABLE. TERATOGENICITY : N/A. REPRODUCTIVE EFFECTS:N/A. MUTGENICITY: N/AP.

Ecological Information

Ecological:NO ADVERSE ECOLOGICAL EFFECTS ARE EXPECTED.

Disposal Considerations

Waste Disposal Methods:DISPOSE OF NON-REFILLABLE CYLINDERS IN ACCORDANCE WITH FEDERAL, STATE, AND LOCAL REGULATIONS. ALLOW GAS TO VENT SLOWLY TO ATMOSPHERE IN AN UNCONFINED AREA OR EXHAUST HOOD. IF THE CYLINDERS ARE THE REF ILLABLE TYPE, RETURN CYLINDERS TO SUPPLIER WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PRO TECTION CAPS IN PLACE.

MSDS Transport Information

Transport Information:CONCENTRATION: 1 - 1500 PPM. DOT DESCRIPTION (US ONLY): PROPER SHIPPING NAME: COMPRESSED GASSES, N.O.S.; HAZARD CLASS: 2.2 (NONFLAMMABLE); UN 1956; REPORTABLE QUANTITIES: NONE. LABELING: NONFLAMMABLE GAS. ADR/RID (EU ONLY): CLASS 2, 1A. SPECIAL PRECAUTIONS: CYLINDERS SHOULD BE TRANSPORTATED IN A SECURE UPRIGHT POSITION IN A WELL VENTILATED TRUCK.

Regulatory Information

SARA Title III Information:THE THRESHOLD PLANNING QUANTIRY FOR THES MIXTURE IS 10,000 LBS.
Federal Regulatory Information:OSHA: PROCESS SAFETY MANAGEMENT: MINOR COMPONENT IS NOT LISTED IN APPENDIX A OF 29 CFR 1910.119 AS A HIGHLY HAZARDOUS CHEMICAL. TSCA: MIXTURE IS NOT LISTED IN TSCA INVENTORY. EU NUMBER: N/A. NUMBER IN ANNES 1 OF DIR 67/548: MIXTURE IS NOT LISTED IN ANNES 1. EU CLASSIFICATION: N/AP. R: 20; S: 9.

MSDS Number: **I8840** * * * * * *Effective Date:* ***05/04/07*** * * * * * *Supercedes:* ***08/27/04***

MSDS *Material Safety Data Sheet*

From: **Mallinckrodt Baker, Inc.**
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt
CHEMICALS
J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

ISOPROPYL ALCOHOL (90 - 100%)

1. Product Identification

Synonyms: 2-Propanol; sec-propyl alcohol; isopropanol; sec-propanol; dimethylcarbinol
CAS No.: 67-63-0
Molecular Weight: 60.10
Chemical Formula: $(CH_3)_2CHOH$
Product Codes:
J.T. Baker: 0562, 5082, 9037, 9080, U298
Mallinckrodt: 0562, 3027, 3031, 3032, 3035, 3037, 3043, 4359, 6569, H604, H982, V555, V566, V681

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Isopropyl Alcohol	67-63-0	90 - 100%	Yes
Water	7732-18-5	0 - 10%	No

3. Hazards Identification

Emergency Overview

WARNING! FLAMMABLE LIQUID AND VAPOR. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. MAY CAUSE IRRITATION TO SKIN.

SAF-T-DATA$^{(tm)}$ Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 3 - Severe
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
Inhalation of vapors irritates the respiratory tract. Exposure to high concentrations has a narcotic effect, producing symptoms of dizziness, drowsiness, headache, staggering, unconsciousness and possibly death.
Ingestion:
Can cause drowsiness, unconsciousness, and death. Gastrointestinal pain, cramps, nausea, vomiting, and diarrhea may also result. The single lethal dose for a human adult = about 250 mls (8 ounces).
Skin Contact:
May cause irritation with redness and pain. May be absorbed through the skin with possible systemic effects.
Eye Contact:
Vapors cause eye irritation. Splashes cause severe irritation, possible corneal burns and eye damage.
Chronic Exposure:
Chronic exposure may cause skin effects.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or impaired liver, kidney, or pulmonary function may be more susceptible to the effects of this agent.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Give large amounts of water to drink. Never give anything by mouth to an unconscious person. Get medical attention.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes. Call a physician if irritation develops.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Flash point: 12C (54F) CC
Autoignition temperature: 399C (750F)
Flammable limits in air % by volume:
lel: 2.0; uel: 12.7
Listed fire data is for Pure Isopropyl Alcohol.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire or explosion. Vapors can flow along surfaces to distant ignition source and flash back. Sensitive to static discharge.
Fire Extinguishing Media:
Water spray, dry chemical, alcohol foam, or carbon dioxide. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Small quantities of peroxides can form on prolonged storage. Exposure to light and/or air significantly increases the rate of peroxide formation. If evaporated to a residue, the mixture of peroxides and isopropanol may explode when exposed to heat or shock.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Isopropyl Alcohol (2-Propanol):
-OSHA Permissible Exposure Limit (PEL):
400 ppm (TWA)

-ACGIH Threshold Limit Value (TLV):
200 ppm (TWA), 400 ppm (STEL), A4 - not classifiable as a human carcinogen.
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a full facepiece respirator with organic vapor cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Neoprene and nitrile rubber are recommended materials.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Rubbing alcohol.
Solubility:
Miscible in water.
Specific Gravity:
0.79 @ 20C/4C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
82C (180F)
Melting Point:
-89C (-128F)
Vapor Density (Air=1):
2.1
Vapor Pressure (mm Hg):
44 @ 25C (77F)
Evaporation Rate (BuAc=1):
2.83

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Heat and sunlight can contribute to instability.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Heat, flame, strong oxidizers, acetaldehyde, acids, chlorine, ethylene oxide, hydrogen-palladium combination, hydrogen peroxide-sulfuric acid combination, potassium tert-butoxide, hypochlorous acid, isocyanates, nitroform, phosgene, aluminum, oleum and perchloric acid.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Oral rat LD50: 5045 mg/kg; skin rabbit LD50: 12.8 gm/kg; inhalation rat LC50: 16,000 ppm/8-hour; investigated as a tumorigen, mutagen, reproductive effector.

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--------\Cancer Lists\------------------------------------------------------
                                       ---NTP Carcinogen---
Ingredient                             Known    Anticipated    IARC Category
------------------------------------   -----    -----------    -------------
Isopropyl Alcohol (67-63-0)             No          No              3
Water (7732-18-5)                       No          No             None
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12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to quickly evaporate. When released into the soil, this material may leach into groundwater. When released into the soil, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. When released into water, this material may biodegrade to a moderate extent. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition.
Environmental Toxicity:
The LC50/96-hour values for fish are over 100 mg/l. This material is not expected to be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: ISOPROPANOL
Hazard Class: 3
UN/NA: UN1219
Packing Group: II
Information reported for product/size: 200L

International (Water, I.M.O.)

Proper Shipping Name: ISOPROPANOL
Hazard Class: 3
UN/NA: UN1219
Packing Group: II
Information reported for product/size: 200L

15. Regulatory Information

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  --------\Chemical Inventory Status - Part 1\---------------------------------
  Ingredient                                       TSCA  EC   Japan  Australia
  -----------------------------------------------  ----  ---  -----  ---------
  Isopropyl Alcohol (67-63-0)                       Yes  Yes   Yes      Yes
  Water (7732-18-5)                                 Yes  Yes   Yes      Yes

  --------\Chemical Inventory Status - Part 2\---------------------------------
                                                          --Canada--
  Ingredient                                       Korea  DSL   NDSL  Phil.
  -----------------------------------------------  -----  ---   ----  -----
  Isopropyl Alcohol (67-63-0)                       Yes   Yes   No     Yes
  Water (7732-18-5)                                 Yes   Yes   No     Yes

  --------\Federal, State & International Regulations - Part 1\----------------
                                             -SARA 302-    ------SARA 313------
  Ingredient                                 RQ    TPQ     List  Chemical Catg.
  -----------------------------------------  ---   -----   ----  --------------
  Isopropyl Alcohol (67-63-0)                No    No      Yes         No
  Water (7732-18-5)                          No    No      No          No

  --------\Federal, State & International Regulations - Part 2\----------------
                                                        -RCRA-    -TSCA-
  Ingredient                                 CERCLA     261.33     8(d)
  -----------------------------------------  ------     ------    ------
  Isopropyl Alcohol (67-63-0)                No         No         No
  Water (7732-18-5)                          No         No         No
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Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  Yes
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: Yes Pressure: No
Reactivity: No          (Mixture / Liquid)
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Australian Hazchem Code: 2[S]2
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
WARNING! FLAMMABLE LIQUID AND VAPOR. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. MAY CAUSE IRRITATION TO SKIN.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor or mist.
Avoid contact with eyes, skin and clothing.
Label First Aid:
If swallowed, give large amounts of water to drink. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
No Changes.
Disclaimer:
****
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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

LIQUOX®

Sodium Permanganate

CAS No. 10101-50-5

Fact Sheet

LIQUOX® sodium permanganate is a liquid oxidant recommended for applications that require a concentrated permanganate solution.

Product Specifications

Assay	40% minimum as $NaMnO_4$
Insolubles	$\leq$ 0.005%
pH	6.0 - 8.0
Specific Gravity	1.36 - 1.39
Solubility in Water	Miscible with water in all proportions.

Chemical/Physical Data

Formula	$NaMnO_4$
Appearance	Dark Purple Solution
Potassium	1000 - 2200 ppm
Stability	> 18 Months

Applications

- Printed Circuit Board Desmearing
- Fine Chemical Synthesis
- Soil & Groundwater Remediation
- Metal Cleaning Formulations
- Acid Mine Drainage
- Hydrogen Sulfide Odor Control
    - Remote Locations
    - Unheated Locations

Benefits

- Concentrated liquid oxidant is easily stored and handled. Feed equipment is simplified (no need to transfer and dissolve crystalline product).

- Dust problems associated with handling dry oxidants are eliminated.

- High solubility at room temperature. Reactions requiring a concentrated permanganate solution can be conducted without having to raise the temperature.

- Can be used instead of potassium permanganate whenever the potassium ion cannot be tolerated, or if dusting is a critical issue.

Shipping Containers

5 gallon (18.9L) Tight Head HDPE Jerrican
(UN Specification: 3H1) made of High Density Polyethylene (HDPE), weighs 3.5 lb (1.6 kg). The net weight is 57 lb (25.7 kg). The jerrican stands approximately 15.33 in. tall, 10.2 in. wide and 11.4 in. long (38.94 cm tall, 25.91 cm wide, 28.96 cm long).

5 gallon (18.9L) Tight Head Steel Drum
(UN Specification: 1A1) made of 12 gauge, mild steel, weighs 5 lb (2.3 kg). The net weight is 57 lb (25.7 kg). The drum stands approximately 13.75 in. tall and is 11.5 in. in diameter. (34.93 cm tall, 29.21 cm diameter)

55 gallon (208.2L) Closed Head Steel Drum
(UN Specification: 1A1) made of 16 gauge, mild steel, weighs 53.7 lb (24.4 kg). The net weight is 550 lb (249.5 kg). The drum stands approximately 34.6 in. tall, has an outside diameter of 23.5 in., and an inside diameter of 22.5 in. (87.88 cm tall, OD 59.69 cm, ID 57.15 cm).

Handling and Storage

Like any potent oxidant, LIQUOX® sodium permanganate should be handled with care. Protective equipment during handling should include face shields and/or goggles, rubber or plastic gloves, rubber or plastic apron. If clothing becomes spotted, wash off immediately; spontaneous ignition can occur with cloth or paper. In cases where significant exposure exists, use of the appropriate NIOSH-MSHA dust or mist respirator or an air supplied respirator is advised.

The product should be stored in a cool, dry area in closed containers. Concrete floors are preferred. Avoid wooden decks. Spillage should be collected and disposed of properly. Contain and dilute spillage to approximately 6% with water and reduce with sodium thiosulfate, a bisulfite, or ferrous salt. The bisulfite or ferrous salt may require dilute sulfuric acid to promote reduction. Neutralize any acid used with sodium bicarbonate. Deposit sludge in an approved landfill or, where permitted, drain into sewer with large quantities of water.

As an oxidant, the product itself is non-combustible, but will accelerate the burning of combustible materials. Therefore, contact with all combustible materials and/or chemicals must be avoided. These include, but are not limited to: wood, cloth, organic chemicals, and charcoal. Avoid contact with acids, peroxides, sulfites, oxalates, and all other oxidizable inorganic chemicals. With hydrochloric acid, chlorine is liberated.

CARUS CHEMICAL COMPANY

Shipping

LIQUOXò sodium permanganate is classified as an oxidizer. Sodium permanganate is shipped domestically as Class 70 and has a Harmonized Code for export of 2841.69.0000.

Proper Shipping Name:	Permanganates, Inorganic, Aqueous solution, n.o.s. (Contains Sodium Permanganate)
Hazard Class:	5.1
Identification Number:	UN 3214
Packaging Group:	II
Label Requirements:	Oxidizer, 5.1
Special Provisions:	T8-Intermodal transportation in IM 101 portable tanks
Packaging Requirement:	49 CFR Parts 171 to 180 Sections: 173.152, 173.202, 173.242
Quantity Limitations:	1 liter net for passenger aircraft or railcar. 5 liters net for cargo aircraft.
Vessel Stowage:	D-material must be stowed "ondeck" on a cargo vessel, but is prohibited on a passenger vessel. Other provisions, stow "separated from" ammonium compounds, hydrogen peroxide, peroxides and superperoxides, cyanide compounds, and powdered metal.

Repackaging

When LIQUOXò sodium permanganate is repackaged, the packaging, markings, labels, and shipping conditions must meet applicable federal regulations. See Code of Federal Regulations-49, Transportation, parts 171-180, and the Federal Hazardous Materials Transportation Act (HMTA).

Corrosive Properties

LIQUOXò sodium permanganate is compatible with many metals and synthetic materials. Natural rubbers and fibers are often incompatible. Solution pH and temperature are also important factors. The material selected for use with sodium permanganate must also be compatible with any acid or alkali being used.

In neutral and alkaline solutions, sodium permanganate is not corrosive to carbon steel and 316 stainless steel. However, chloride corrosion of metals may be accelerated when an oxidant such as sodium permanganate is present in solution. Plastics such as teflon, polypropylene, HDPE and EDPM are also compatible with sodium permanganate.

Aluminum, zinc, copper, lead, and alloys containing these metals may be slightly affected by sodium permanganate solutions. Actual corrosion or compatibility studies should be made under the conditions in which the permanganate will be used prior to use.

Carus Value Added

LABORATORY SUPPORT

Carus Chemical Company has technical assistance available to its potential and current customers to answer questions or perform laboratory and field testing including:

*Feasibility Studies * Toxicity Evaluations *Treatability Studies *Analytical Services *Field Trials

CARUS CHEMICAL COMPANY

During its more than 80-year history, Carus' ongoing reliance on research and development, as well as its emphasis on technical support and customer service, have enabled the company to become the world leader in permanganate, manganese, oxidation, and catalyst technologies.

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E-Mail: salesmkt@caruschem.com

CARUS

Responsible Care®
Good Chemistry at Work

Form #LX1501

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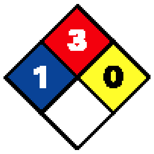
AMERADA HESS CORPORATION

MATERIAL SAFETY DATA SHEET

Gasoline, All Grades **MSDS No. 9950**

EMERGENCY OVERVIEW
DANGER!
EXTREMELY FLAMMABLE - EYE AND MUCOUS MEMBRANE IRRITANT - EFFECTS CENTRAL NERVOUS SYSTEM - HARMFUL OR FATAL IF SWALLOWED - ASPIRATION HAZARD



NFPA 704 (Section 16)

High fire hazard. Keep away from heat, spark, open flame, and other ignition sources.

If ingested, do NOT induce vomiting, as this may cause chemical pneumonia (fluid in the lungs). Contact may cause eye, skin and mucous membrane irritation. Harmful if absorbed through the skin. Avoid prolonged breathing of vapors or mists. Inhalation may cause irritation, anesthetic effects (dizziness, nausea, headache, intoxication), and respiratory system effects.

Long-term exposure may cause effects to specific organs, such as to the liver, kidneys, blood, nervous system, and skin. Contains benzene, which can cause blood disease, including anemia and leukemia.

1. CHEMICAL PRODUCT and COMPANY INFORMATION (rev. Jan-04)

Amerada Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095-0961

EMERGENCY TELEPHONE NUMBER (24 hrs):	**CHEMTREC (800)424-9300**
COMPANY CONTACT (business hours):	Corporate Safety (732)750-6000
MSDS Internet Website	www.hess.com/about/environ.html

SYNONYMS: Hess Conventional (Oxygenated and Non-oxygenated) Gasoline; Reformulated Gasoline (RFG); Reformulated Gasoline Blendstock for Oxygenate Blending (RBOB); Unleaded Motor or Automotive Gasoline

See Section 16 for abbreviations and acronyms.

2. COMPOSITION and INFORMATION ON INGREDIENTS * (rev. Jan-04)

INGREDIENT NAME (CAS No.)	CONCENTRATION PERCENT BY WEIGHT
Gasoline (86290-81-5)	100
Benzene (71-43-2)	0.1 - 4.9 (0.1 - 1.3 reformulated gasoline)
n-Butane (106-97-8)	< 10
Ethyl Alcohol (Ethanol) (64-17-5)	0 - 10
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Tertiary-amyl methyl ether (TAME) (994-05-8)	0 to 17.2
Toluene (108-88-3)	1 - 25
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 - 15

A complex blend of petroleum-derived normal and branched-chain alkane, cycloalkane, alkene, and aromatic hydrocarbons. May contain antioxidant and multifunctional additives. Non-oxygenated Conventional Gasoline and RBOB do not have oxygenates (Ethanol or MTBE and/or TAME). Oxygenated Conventional and Reformulated Gasoline will have oxygenates for octane enhancement or as legally required.

3. HAZARDS IDENTIFICATION (rev. Dec-97)

EYES

Moderate irritant. Contact with liquid or vapor may cause irritation.

SKIN

Practically non-toxic if absorbed following acute (single) exposure. May cause skin irritation with prolonged or repeated contact. Liquid may be absorbed through the skin in toxic amounts if large areas of skin are exposed repeatedly.

INGESTION

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.

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.

INHALATION

Excessive exposure may cause irritations to the nose, throat, lungs and respiratory tract. Central nervous system (brain) effects may include headache, dizziness, loss of balance and coordination, unconsciousness, coma, respiratory failure, and death.

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.

CHRONIC EFFECTS and CARCINOGENICITY

Contains benzene, a regulated human carcinogen. Benzene has the potential to cause anemia and other blood diseases, including leukemia, after repeated and prolonged exposure. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with systemic toxicity. See also Section 11 - Toxicological Information.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Irritation from skin exposure may aggravate existing open wounds, skin disorders, and dermatitis (rash). Chronic respiratory disease, liver or kidney dysfunction, or pre-existing central nervous system disorders may be aggravated by exposure.

4. FIRST AID MEASURES (rev. Dec-97)

EYES

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.

SKIN

Remove contaminated clothing. Wash contaminated areas thoroughly with soap and water or waterless hand cleanser. Obtain medical attention if irritation or redness develops.

INGESTION

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. Small amounts of material which enter the mouth should be rinsed out until the taste is dissipated.

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.

5. FIRE FIGHTING MEASURES (rev. Dec-97)

FLAMMABLE PROPERTIES:

FLASH POINT:	-45 °F (-43°C)
AUTOIGNITION TEMPERATURE:	highly variable; > 530 °F (>280 °C)
OSHA/NFPA FLAMMABILITY CLASS:	1A (flammable liquid)
LOWER EXPLOSIVE LIMIT (%):	1.4%
UPPER EXPLOSIVE LIMIT (%):	7.6%

FIRE AND EXPLOSION HAZARDS

Vapors may be ignited rapidly 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.

EXTINGUISHING MEDIA

SMALL FIRES: Any extinguisher suitable for Class B fires, dry chemical, CO2, water spray, fire fighting foam, or Halon.

LARGE FIRES: Water spray, fog or fire fighting foam. Water may be ineffective for fighting the fire, but may be used to cool fire-exposed containers.

During certain times of the year and/or in certain geographical locations, gasoline may contain MTBE and/or TAME. Firefighting foam suitable for polar solvents is recommended for fuel with greater than 10% oxygenate concentration - refer to NFPA 11 “Low Expansion Foam - 1994 Edition.”

FIRE FIGHTING INSTRUCTIONS

Small fires in the incipient (beginning) stage may typically be extinguished using handheld portable fire extinguishers and other fire fighting equipment.

Firefighting activities that may result in potential exposure to high heat, smoke or toxic by-products of combustion should require NIOSH/MSHA- approved pressure-demand self-contained breathing apparatus with full facepiece and full protective clothing.

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 fire fighting foam.

See Section 16 for the NFPA 704 Hazard Rating.

6. ACCIDENTAL RELEASE MEASURES (rev. Dec-97)

ACTIVATE FACILITY SPILL CONTINGENCY or EMERGENCY PLAN.

Evacuate nonessential personnel and remove or secure all ignition sources. Consider wind direction; stay upwind and uphill, if possible. Evaluate the direction of product travel, diking, sewers, etc. to confirm spill areas. Spills may infiltrate subsurface soil and groundwater; professional assistance may be necessary to determine the extent of subsurface impact.

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 fire fighting 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 sand or other oil absorbing materials. Carefully shovel, scoop or sweep up into a waste container for reclamation or disposal - caution, flammable vapors may accumulate in closed containers. Response and clean-up crews must be properly trained and must utilize proper protective equipment (see Section 8).

7. HANDLING and STORAGE (rev. Dec-97)

HANDLING PRECAUTIONS

******USE ONLY AS A MOTOR FUEL******
******DO NOT SIPHON BY MOUTH******

Handle as a flammable liquid. Keep away from heat, sparks, and open flame! Electrical equipment should be approved for classified area. Bond and ground containers during product transfer to reduce the possibility of static-initiated fire or explosion.

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 Publication 2003, "Protection Against Ignitions Arising Out Of Static, Lightning and Stray Currents.

STORAGE PRECAUTIONS

Keep away from flame, sparks, excessive temperatures and open flame. Use approved vented containers. Keep containers closed and clearly labeled. Empty product containers or vessels may contain explosive vapors. Do not pressurize, cut, heat, weld or expose such containers to sources of ignition.

Store in a well-ventilated area. This storage area should comply with NFPA 30 "Flammable and Combustible Liquid Code". Avoid storage near incompatible materials. 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 "Cleaning Petroleum Storage Tanks".

WORK/HYGIENIC PRACTICES

Emergency eye wash capability should be available in the near proximity to operations presenting a potential splash exposure. Use good personal hygiene practices. Avoid repeated and/or prolonged skin exposure. 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.

8. EXPOSURE CONTROLS and PERSONAL PROTECTION (rev. Jan-04)

EXPOSURE LIMITS

Component (CAS No.)	Exposure Limits			
	Source	**TWA (ppm)**	**STEL (ppm)**	**Note**
Gasoline (86290-81-5)	ACGIH	300	500	A3
Benzene (71-43-2)	OSHA	1	5	Carcinogen
	ACGIH	0.5	2.5	A1, skin
	USCG	1	5	
n-Butane (106-97-8)	ACGIH	800	--	2003 NOIC: 1000 ppm (TWA) Aliphatic Hydrocarbon Gases Alkane (C1-C4)
Ethyl Alcohol (ethanol) (64-17-5)	OSHA	1000	--	
	ACGIH	1000	--	A4
Ethyl benzene (100-41-4)	OSHA	100	--	
	ACGIH	100	125	A3

Component (CAS No.)	Exposure Limits			
	Source	**TWA (ppm)**	**STEL (ppm)**	**Note**
n-Hexane (110-54-3)	OSHA	500	--	
	ACGIH	50	--	skin
Methyl-tertiary butyl ether [MTBE] (1634-04-4)	ACGIH	50		A3
Tertiary-amyl methyl ether [TAME] (994-05-8)				None established
Toluene (108-88-3)	OSHA	200		Ceiling: 300 ppm; Peak: 500 ppm (10 min.)
	ACGIH	50	--	A4 (skin)
1,2,4- Trimethylbenzene (95-63-6)	ACGIH	25	--	
Xylene, mixed isomers (1330-20-7)	OSHA	100	--	
	ACGIH	100	150	A4

ENGINEERING CONTROLS

Use adequate ventilation to keep vapor concentrations of this product below occupational exposure and flammability limits, particularly in confined spaces.

EYE/FACE PROTECTION

Safety glasses or goggles are recommended where there is a possibility of splashing or spraying.

SKIN PROTECTION

Gloves constructed of nitrile or neoprene are recommended. Chemical protective clothing such as that made of of E.I. DuPont Tychem ®, products or equivalent is 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. Consult manufacturer specifications for further information.

RESPIRATORY PROTECTION

A NIOSH-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, 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.

9. PHYSICAL and CHEMICAL PROPERTIES (rev. Jan-04)

APPEARANCE

A translucent, straw-colored or light yellow liquid

ODOR

A strong, characteristic aromatic hydrocarbon odor. Oxygenated gasoline with MTBE and/or TAME may have a sweet, ether-like odor and is detectable at a lower concentration than non-oxygenated gasoline.

ODOR THRESHOLD

	Odor Detection	Odor Recognition
Non-oxygenated gasoline:	0.5 - 0.6 ppm	0.8 - 1.1 ppm
Gasoline with 15% MTBE:	0.2 - 0.3 ppm	0.4 - 0.7 ppm
Gasoline with 15% TAME:	0.1 ppm	0.2 ppm

BASIC PHYSICAL PROPERTIES

BOILING RANGE:	85 to 437 ^{o}F (39 to 200 ^{o}C)
VAPOR PRESSURE:	6.4 - 15 RVP @ 100 ^{o}F (38 ^{o}C) (275-475 mm Hg @ 68 ^{o}F (20 ^{o}C)
VAPOR DENSITY (air = 1):	AP 3 to 4
SPECIFIC GRAVITY (H_2O = 1):	0.70 – 0.78
EVAPORATION RATE:	10-11 (n-butyl acetate = 1)
PERCENT VOLATILES:	100 %

SOLUBILITY (H_2O):	Non-oxygenated gasoline - negligible (< 0.1% @ 77 ^oF). Gasoline with 15% MTBE - slight (0.1 - 3% @ 77 ^oF); ethanol is readily soluble in water

10. STABILITY and REACTIVITY (rev. Dec-94)

STABILITY: Stable. Hazardous polymerization will not occur.

CONDITIONS TO AVOID

Avoid high temperatures, open flames, sparks, welding, smoking and other ignition sources

INCOMPATIBLE MATERIALS

Keep away from strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke). Contact with nitric and sulfuric acids will form nitrocresols that can decompose violently.

11. TOXICOLOGICAL PROPERTIES (rev. Dec-97)

ACUTE TOXICITY

Acute Dermal LD50 (rabbits): > 5 ml/kg	Acute Oral LD50 (rat): 18.75 ml/kg
Primary dermal irritation (rabbits): slightly irritating	Draize eye irritation (rabbits): non-irritating
Guinea pig sensitization: negative	

CHRONIC EFFECTS AND CARCINOGENICITY

Carcinogenicity: OSHA: NO IARC: YES - 2B NTP: NO ACGIH: YES (A3)

IARC has determined that gasoline and gasoline exhaust are possibly carcinogenic in humans. Inhalation exposure to completely vaporized unleaded gasoline caused kidney cancers in male rats and liver tumors in female mice. The U.S. EPA has determined that the male kidney tumors are species-specific and are irrelevant for human health risk assessment. The significance of the tumors seen in female mice is not known. Exposure to light hydrocarbons in the same boiling range as this product has been associated in animal studies with effects to the central and peripheral nervous systems, liver, and kidneys. The significance of these animal models to predict similar human response to gasoline is uncertain.

This product contains benzene. Human health studies indicate that prolonged and/or repeated overexposure to benzene may cause damage to the blood-forming system (particularly bone marrow), and serious blood disorders such as aplastic anemia and leukemia. Benzene is listed as a human carcinogen by the NTP, IARC, OSHA and ACGIH.

This product may contain methyl tertiary butyl ether (MTBE): animal and human health effects studies indicate that MTBE may cause eye, skin, and respiratory tract irritation, central nervous system depression and neurotoxicity. MTBE is classified as an animal carcinogen (A3) by the ACGIH.

12. ECOLOGICAL INFORMATION (rev. Jan-04)

Keep out of sewers, drainage areas and waterways. Report spills and releases, as applicable, under Federal and State regulations. If released, oxygenates such as ethers and alcohols will be expected to exhibit fairly high mobility in soil, and therefore may leach into groundwater. The API (www.api.org) provides a number of useful references addressing petroleum and oxygenate contamination of groundwater.

13. DISPOSAL CONSIDERATIONS (rev. Dec-97)

Consult federal, state and local waste regulations to determine appropriate disposal options.

14. TRANSPORTATION INFORMATION (rev. Jan-04)

PLACARD:

DOT PROPER SHIPPING NAME:	Gasoline
DOT HAZARD CLASS and PACKING GROUP:	3, PG II
DOT IDENTIFICATION NUMBER:	UN 1203
DOT SHIPPING LABEL:	FLAMMABLE LIQUID

15. REGULATORY INFORMATION (rev. Jan-04)

U.S. FEDERAL, STATE, and LOCAL REGULATORY INFORMATION

This product and its constituents listed herein are on the EPA TSCA Inventory. 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.

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 crude oil, refined, and unrefined petroleum products and any indigenous components of such. However, other federal reporting requirements (e.g., SARA Section 304 as well as the Clean Water Act if the spill occurs on navigable waters) may still apply.

SARA SECTION 311/312 - HAZARD CLASSES

ACUTE HEALTH	CHRONIC HEALTH	FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVE
X	X	X	--	--

SARA SECTION 313 - SUPPLIER NOTIFICATION

This product contains the following toxic 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:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION WT. PERCENT
Benzene (71-43-2)	0.1 to 4.9 (0.1 to 1.3 for reformulated gasoline)
Ethyl benzene (100-41-4)	< 3
n-Hexane (110-54-3)	0.5 to 4
Methyl-tertiary butyl ether (MTBE) (1634-04-4)	0 to 15.0
Toluene (108-88-3)	1 to 15
1,2,4- Trimethylbenzene (95-63-6)	< 6
Xylene, mixed isomers (1330-20-7)	1 to 15

US EPA guidance documents (www.epa.gov/tri) for reporting Persistent Bioaccumulating Toxics (PBTs) indicate this product may contain the following deminimis levels of toxic chemicals subject to Section 313 reporting:

INGREDIENT NAME (CAS NUMBER)	CONCENTRATION - Parts per million (ppm) by weight
Polycyclic aromatic compounds (PACs)	17
Benzo (g,h,i) perylene (191-24-2)	2.55
Lead (7439-92-1)	0.079

CANADIAN REGULATORY INFORMATION (WHMIS)

Class B, Division 2 (Flammable Liquid)
Class D, Division 2A (Very toxic by other means) and Class D, Division 2B (Toxic by other means)

16. OTHER INFORMATION (rev. Jan-04)

NFPA® HAZARD RATING	HEALTH:	1	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
HMIS® HAZARD RATING	HEALTH:	1 *	Slight
	FIRE:	3	Serious
	REACTIVITY:	0	Minimal
	* CHRONIC		

SUPERSEDES MSDS DATED: 12/30/97

ABBREVIATIONS:

AP = Approximately
< = Less than
> = Greater than
N/A = Not Applicable
N/D = Not Determined
ppm = parts per million

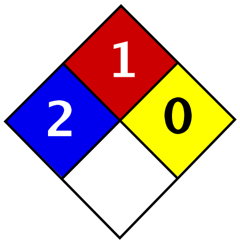
ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute (212)642-4900
API	American Petroleum Institute (202)682-8000
CERCLA	Comprehensive Emergency Response, Compensation, and Liability Act
DOT	U.S. Department of Transportation [General Info: (800)467-4922]
EPA	U.S. Environmental Protection Agency
HMIS	Hazardous Materials Information System
IARC	International Agency For Research On Cancer
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association (617)770-3000
NIOSH	National Institute of Occupational Safety and Health
NOIC	Notice of Intended Change (proposed change to ACGIH TLV)
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
REL	Recommended Exposure Limit (NIOSH)
SARA	Superfund Amendments and Reauthorization Act of 1986 Title III
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.)
WEEL	Workplace Environmental Exposure Level (AIHA)
WHMIS	Workplace Hazardous Materials Information System (Canada)

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.



Health	2
Fire	1
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
1,1,1-Trichloroethane MSDS

Section 1: Chemical Product and Company Identification

Product Name: 1,1,1-Trichloroethane

Catalog Codes: SLT4180, SLT2167, SLT3460

CAS#: 71-55-6

RTECS: KJ2975000

TSCA: TSCA 8(b) inventory: 1,1,1-Trichloroethane

CI#: Not available.

Synonym:

Chemical Formula: CH3CCl3

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
{1,1,1-}Trichloroethane	71-55-6	100

Toxicological Data on Ingredients: 1,1,1-Trichloroethane: ORAL (LD50): Acute: 9600 mg/kg [Rat]. 6000 mg/kg [Mouse]. DERMAL (LD50): Acute: 15800 mg/kg [Rabbit]. VAPOR (LC50): Acute: 18000 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of eye contact (irritant), of ingestion. Hazardous in case of skin contact (irritant, permeator), of inhalation. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance is toxic to lungs, the nervous system, liver, mucous membranes.
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: 537°C (998.6°F)

Flash Points: Not available.

Flammable Limits: LOWER: 7.5% UPPER: 12.5%

Products of Combustion: These products are carbon oxides (CO, CO_2), halogenated compounds.

Fire Hazards in Presence of Various Substances: Slightly flammable to flammable in presence of oxidizing materials, of acids, of alkalis.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.
Slightly explosive to explosive in presence of oxidizing materials, of acids, of alkalis.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapour/spray. In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Keep container tightly closed. Keep in a cool, well-ventilated place. Combustible materials should be stored away from extreme heat and away from strong oxidizing agents.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 350 STEL: 440 CEIL: 440 (ppm) from ACGIH (TLV) [1995]
TWA: 1900 STEL: 2460 CEIL: 2380 (mg/m3) from ACGIH [1995]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: 133.41 g/mole

Color: Not available.

pH (1% soln/water): Not available.

Boiling Point: 74.1°C (165.4°F)

Melting Point: -32.5°C (-26.5°F)

Critical Temperature: Not available.

Specific Gravity: 1.3376 (Water = 1)

Vapor Pressure: 100 mm of Hg (@ 20°C)

Vapor Density: 4.6 (Air = 1)

Volatility: Not available.

Odor Threshold: 400 ppm

Water/Oil Dist. Coeff.: The product is equally soluble in oil and water; log(oil/water) = 0

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 6000 mg/kg [Mouse].
Acute dermal toxicity (LD50): 15800 mg/kg [Rabbit].
Acute toxicity of the vapor (LC50): 18000 ppm 4 hour(s) [Rat].

Chronic Effects on Humans: The substance is toxic to lungs, the nervous system, liver, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of ingestion.
Hazardous in case of skin contact (irritant, permeator), of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Detected in maternal milk in human.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : 1,1,1-Trichloroethane : UN2831 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: 1,1,1-Trichloroethane
Massachusetts RTK: 1,1,1-Trichloroethane
TSCA 8(b) inventory: 1,1,1-Trichloroethane
SARA 313 toxic chemical notification and release reporting: 1,1,1-Trichloroethane
CERCLA: Hazardous substances.: 1,1,1-Trichloroethane

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada): CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC).

DSCL (EEC):
R38- Irritating to skin.
R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:31 PM

Last Updated: 11/06/2008 12:00 PM

MSDS SUMMARY SHEET

Manufacturer:
Name: PHILLIPS PETROLEUM COMPANY
Address 1:
Address 2:
Address 3:
CSZ: BARTLESVILLE **State:** OK **Zipcode:** 74004
Emergency phone: (800) 424-9300
Business phone: 800-762-0942

Product:

Ferndale MSDS#: 1354 **Version # :** 6
Manufacturer MSDS#: 0041
Current? : 2002
Name:

NO. 2 DIESEL FUEL

Synonyms:

CARB **Diesel** TF3
CARB **Diesel**
CARB **Diesel** 10%
Diesel Fuel Oil
EPA Low Sulfur **Diesel** Fuel
EPA Low Sulfur **Diesel** Fuel – Dyed
EPA Off Road High Sulfur **Diesel –** Dyed
Fuel Oil No. 2 – CAS # 68476-30-2
No. 2 **Diesel** Fuel Oil
No. 2 Fuel Oil – Non Hiway – Dyed
No. 2 High Sulfur **Diesel –** Dyed
No. 2 Low Sulfur **Diesel** - Dyed
No. 2 Low Sulfur **Diesel** - Undyed
Crude column 3rd IR
Crude column 3rd side cut
Atmospheric tower 3rd side cut
Ultra Low Sulfur **Diesel** No. 2
Finished **Diesel**
DHT Reactor Feed
Straight Run **Diesel**
Diesel
Middle Distillate

Product/Catalog Numbers:
MSDS Date: 01/01/2002 **(received:** 01/14/2002**)**

NFPA codes:
Health: 0 **Flammability:** 2 **Reactivity:** 0

MATERIAL SAFETY DATA SHEET
No. 2 Diesel Fuel

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name:	No. 2 Diesel Fuel
Product Code:	Multiple
SAP Code:	
Synonyms:	1354 CARB Diesel TF3 CARB Diesel CARB Diesel 10% Diesel Fuel Oil EPA Low Sulfur Diesel Fuel EPA Low Sulfur Diesel Fuel – Dyed EPA Off Road High Sulfur Diesel – Dyed Fuel Oil No. 2 – CAS # 68476-30-2 No. 2 Diesel Fuel Oil No. 2 Fuel Oil – Non Hiway – Dyed No. 2 High Sulfur Diesel – Dyed No. 2 Low Sulfur Diesel - Dyed No. 2 Low Sulfur Diesel – Undyed No. 2 Ultra Low Sulfur Diesel – Dyed No. 2 Ultra Low Sulfur Diesel - Undyed
Intended Use:	Fuel
Chemical Family:	
Responsible Party:	Phillip’s Petroleum Company Bartlesville, Oklahoma 74004
For Additional MSDSs:	800-762-0942
Technical Information:	

The intended use of this product is indicated above. If any additional use is known, please contact us at the Technical Information number listed.

EMERGENCY OVERVIEW

24 Hour Emergency Telephone Numbers:

Spill, Leak, Fire or Accident
Call CHEMTREC
North America: (800) 424-9300
Others: (703) 527-3887 (collect)

California Poison Control System: 800-356-3120

Health Hazards/Precautionary Measures: Causes severe skin irritation. Aspiration hazard if swallowed. Can enter lungs and cause damage. Use with adequate ventilation. Avoid contact with eyes, skin and clothing. Do not taste or swallow. Wash thoroughly after handling.

Physical Hazards/Precautionary Measures: Flammable liquid and vapor. Keep away from heat, sparks, flames, static electricity or other sources of ignition.

Appearance:	Straw-colored to dyed red
Physical Form:	Liquid
Odor:	Characteristic petroleum

HFPA Hazard Class:		**HMIS Hazard Class**
Health:	0 (Least)	Not Evaluated
Flammability:	2 (Moderate)	
Reactivity:	0 (Least)	

2. COMPOSITION/INFORMATION ON INGREDIENTS

HAZARDOUS COMPONENTS	**% VOLUME**		**EXPOSURE GUIDELINE**	
		Limits	**Agency**	**Type**
Diesel Fuel No. 2 CAS# 68476-34-6	100	100* mg/m3	ACGIH	TWA-SKIN
Naphthalene CAS# 91-20-3	<1	10ppm	ACGIH	TWA
		15ppm	ACGIH	STEL
		10ppm	OSHA	TWA
		250ppm	NIOSH	IDLH

All components are listed on the TSCA inventory

Tosco Low Sulfur No. 2 Diesel meets the specifications of 40 CFR 60.41 for low sulfur diesel fuel.

Note: State, local or other agencies or advisory groups may have established more stringent limits. Consult an industrial hygienist or similar professional, or your local agencies, for further information.

*Proposed ACGIH (1999)

3. HAZARDS IDENTIFICATION

Potential Health Effects:

Eye: Contact may cause mild eye irritation including stinging, watering, and redness.

Skin: Severe skin irritant. Contact may cause redness, itching, burning, and severe skin damage. Prolonged or repeated contact can worsen irritation by causing drying and cracking of the skin, leading to dermatitis (inflammation). Not actually toxic by skin absorption, but prolonged or repeated skin contact may be harmful (see Section 11).

Inhalation (Breathing): No information available. Studies by other exposure routes suggest a low degree of toxicity by inhalation.

Ingestion (Swallowing): Low degree of toxicity by ingestion. ASPIRATION HAZARD – This material can enter lungs during swallowing or vomiting and cause lung inflammation and damage.

Signs and Symptoms: Effects of overexposure may include irritation of the nose and throat, irritation of the digestive tract, nausea, diarrhea and transient excitation followed by signs of nervous system depression (e.g., headache, drowsiness, dizziness, loss of coordination, disorientation and fatigue).

Cancer: Possible skin cancer hazard (see Sections 11 and 14).

Target Organs: There is limited evidence from animal studies that overexposure may cause injury to the kidney (see Section 11).

Developmental: Inadequate data available for this material.

Pre-Existing Medical Conditions: Conditions aggravated by exposure may include skin disorders and kidney disorders.

4. FIRST AID MEASURES

Eye: If irritation or redness develops, move victim away from exposure and into fresh air. Flush eyes with clean water. If symptoms persist, seek medical attention.

Skin: Immediately remove contaminated shoes, clothing, and constrictive jewelry and flush affected area(s) with large amounts of water. If skin surface is damaged, apply a clean dressing and seek immediate medical attention. If skin surface is not damaged, cleanse affected area(s) thoroughly by washing with mild soap and water. If irritation or redness develops, seek immediate medical attention.

Inhalation (Breathing): If respiratory symptoms develop, move victim away from source of exposure and into fresh air. If symptoms persist, seek medical attention. If victim is not breathing, clear airway and immediately begin artificial respiration. If breathing difficulties develop, oxygen should be administered by qualified personnel. Seek immediate medical attention.

Ingestion (Swallowing): Aspiration hazard; Do not induce vomiting or give anything by mouth because this material can enter the lungs and cause severe lung damage. If victim is drowsy or unconscious and vomiting, place on the left side with the head down. If possible, do not leave victim unattended and observe closely for adequacy of breathing. Seek medical attention.

5. FIRE FIGHTING MEASURES

Flammable Properties:

Flash Point: >125°F/>52°
OSHA Flammability Class: Combustible liquid
LEL %: 0.3 / UEL %; 10.0
Autoignition Temperature: 500°F/260°C

Unusual Fire & Explosion Hazards: This material is flammable and can be ignited by heat, sparks, flames, or other sources of ignition (e.g., static electricity, pilot lights, or mechanical/electrical equipment, and electronic devices such as cell phones, computers, calculators, and pagers which have not been certified as intrinsically safe). Vapors may travel considerable distances to a source of ignition where they can ignite, flash back, or explode. May create vapor/air explosion hazard indoors, in confined spaces, outdoors, or in sewers. Vapors are heavier than air and can accumulate in low areas. If container is not properly cooled, it can rupture in the heat of a fire.

Extinguishing Media: Dry chemical, carbon dioxide, or foam is recommended. Water spray is recommended to cool or protect exposed materials or structures. Carbon dioxide can displace oxygen. Use caution when applying carbon dioxide in confined spaces. Water may be ineffective for extinguishment, unless used under favorable conditions by experienced fire fighters.

Fire Fighting Instructions: For fires beyond the incipient stage, emergency responders in the immediate hazard area should wear bunker gear. When the potential chemical hazard is unknown, in enclosed or confined spaces, or when explicitly required by DOT, a self contained breathing apparatus should be worn. In addition, wear other appropriate protective equipment as conditions warrant (see Section 8).

Isolate immediate hazard area, keep unauthorized personnel out. Stop spill/release if it can be done with minimal risk. Move undamaged containers from immediate hazard area if it can be done with minimal risk.

Water spray may be useful in minimizing or dispersing vapors and to protect personnel. Cool equipment exposed to fire with water, if it can be done with minimal risk. Avoid spreading burning liquid with water used for cooling purposes.

6. ACCIDENTAL RELEASE MEASURES

Flammable. Keep all sources of ignition and hot metal surfaces away from spill/release. The use of explosion-proof equipment is recommended.

Stay upwind and away from spill/release. Notify persons down wind of the spill/release, isolate immediate hazard area and keep unauthorized personnel out. Stop spill/release if it can be done with minimal risk. Wear appropriate protective equipment including respiratory protection as conditions warrant (see Section 8).

Prevent spilled material from entering sewers, storm drains, other unauthorized drainage systems, and natural waterways. Dike far ahead of spill for later recovery or disposal. Use foam on spills to minimize vapors (see Section 5). Spilled material may be absorbed into an appropriate material.

Notify fire authorities and appropriate federal, state, and local agencies. Immediate cleanup of any spill is recommended. If spill of any amount is made into or upon navigable waters, the contiguous zone, or adjoining shorelines, notify the National Response Center (phone number 800-424-8802).

7. HANDLING AND STORAGE

Handling: Open container slowly to relieve any pressure. Bond and ground all equipment when transferring from one vessel to another. Can accumulate static charge by flow or agitation. Can be ignited by static discharged. The use of explosion-proof equipment is recommended and may be required (see appropriate fire codes). Refer to NFPA-704 and/or API RP 2003 for specific bonding/grounding requirements.

Do not enter confined spaces such as tanks or pits without following proper entry procedures such ASTM D-4276 and 29CFR 1910.146. The use of appropriate respiratory protection is advised when concentrations exceed any established exposure limits (see Sections 2 and 8).

Do not wear contaminated clothing or shoes. Keep contaminated clothing away from sources of ignition such as sparks or open flames. Use good personal hygiene practices.

High pressure injection of hydrocarbon fuels, hydraulic oils or greases under the skin may have serious consequences even though no symptoms or injury may be apparent. This can happen accidentally when using high pressure equipment such as high pressure grease guns, fuel injection apparatus or from pinhole leaks in tubing or high pressure hydraulic oil equipment.

“Empty” containers retain residue and may be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, or other sources of ignition. They may explode and cause injury or death. “Empty” drums should be completely drained, properly bunged, and promptly shipped to the supplier or a drum reconditioner. All containers should be disposed of in an environmentally safe manner and in accordance with governmental regulations.

Before working on or in tanks which contain or have contained this material, refer to OSHA regulations, ANSIZ49.1 and other references pertaining to cleaning, repairing, welding, or other contemplated operations.

Storage: Keep container(s) tightly closed. Use and store this material in cool, dry, well-ventilated areas away from heat, direct sunlight, hot metal surfaces, and all sources of ignition. Post area “No Smoking or Open Flame.” Store only in approved containers. Keep away from incompatible material (see Section 10). Protect container(s) against physical damage. Outdoor or detached storage is preferred. Indoor storage should meet OSHA standards and appropriate fire codes.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering controls: If current ventilation practices are not adequate to maintain airborne concentration below the established exposure limits (see Section 2), additional ventilation or exhaust systems may be required. Where explosive mixtures may be present, electrical systems safe for such locations must be used (see appropriate electrical codes).

Personal Protective Equipment (PPE):

Respiratory: A NIOSH certified air purifying respirator with an organic vapor cartridge maybe used under conditions where airborne concentrations are expected to exceed exposure limits (see Section 2).

Protection provided by air purifying respirators is limited (see manufacturer's respirator selection guide). Use a positive pressure air supplied respirator if there is a potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air purifying respirators may not provide adequate protection.

A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrants a respirator's use.

Skin: The use of gloves impervious to the specific material handled is advised to prevent skin contact, possible irritation and skin damage (see glove manufacturer literature for information on permeability). Depending on conditions of use, apron and/or arm covers may be necessary.

Eyes/Face: Approved eye protection to safeguard against potential eye contact, irritation, or injury is recommended. Depending on conditions of use, a face shield may be necessary.

Other Protective Equipment: Eye wash and quick-drench shower facilities should be available in the work area. Thoroughly clean shoes and wash contaminated clothing before reuse. It is recommended that impervious clothing be worn when skin contact is possible.

9. PHYSICAL AND CHEMICAL PROPERTIES

Note: Unless otherwise stated, values are determined at 20°C (68°F) and 760 mm Hg (1atm).

Appearance: Straw-colored to dyed red
Physical State: Liquid
Odor: Characteristic petroleum
pH: unavailable
Vapor Pressure (mm Hg): 0.40
Vapor Densisty (air=1):>3
Boiling Point/Range: 320-700°F /160-371°C
Freezing/Melting Point: No Data
Solubility in Water: Negligible
Specific Gravity: 0.81-0.88 @ 60°F
Percent Volatile: Negligible
Evaporation Rate (nBuAc=1): <1
Viscosity: 32.6-40.0 SUS @ 100°F
Bulk Density: 7.08 lbs/gal
Flash Point: >125°F / >52°C
Flammable/Expolsive Limits (%): LEL: 0.3 / UEL: 10.0

10. STABILITY AND REACTIVITY

Stability: Stable under normal ambient and anticipated storage and handling conditions of temperature and pressure. Flammable liquid and vapor. Vapor can cause flash fire.

Conditions To Avoid: Avoid all possible sources of ignition (see Sections 5 and 7).

Materials to Avoid (Incompatible Materials): Avoid contact with strong oxidants such as liquid chlorine, concentrated oxygen, sodium hypochlorite, calcium hypochlorite, etc.

Hazardous Decomposition Products: The use of hydrocarbon fuels in an area without adequate ventilation may result in hazardous levels of combustion products (e.g., oxides of carbon, sulfur and nitrogen, benzene and other hydrocarbons) and/or dangerously low oxygen levels. ACGIH has included a TLV of 0.05 mg/m3 TWA for diesel exhaust particulate on its 1999 Notice of Intended Changes. See Section 11 for additional information on hazards of engine exhaust.

Hazardous Polymerization: Will not occur.

11. TOXICOLOGICAL INFORMATION

Diesel Fuel No. 2 (CAS# 68476-34-6)

Carcinogenicity: Chronic dermal application of certain middle distillate streams contained in diesel fuel No. 2 resulted in an increased incidence of skin tumors in mice. This material has not been identified as carcinogen by NTP, IARC, or OSHA. Diesel exhaust is a probable cancer hazard based on tests with laboratory animals.

Target Organ(s): Limited evidence of renal impairment has been noted from a few case reports involving excessive exposure to diesel fuel No. 2.

Naphthalene (CAS# 91-20-3)

Carcinogenicity: Naphthalene has been evaluated in two year inhalation studies in both rats and mice. The National Toxicology Program (NTP) concluded that there is clear evidence of carcinogenicity in male and female rats based on increased incidences of respiratory epithelial adenomas and olfactory epithelial neuroblastomas of the nose. NTP found some evidence of carcinogenicity in female mice (alveolar adenomas) and no evidence of carcinogenicity in male mice. Naphthalene has not been identified as a carcinogen by IARC or OSHA.

12. ECOLOGICAL INFORMATION

Not evaluated at this time

13. DISPOSAL CONSIDERATIONS

This material, if discarded as produced, would be a RCRA “characteristic” hazardous waste due to the characteristic(s) of ignitability (D001) and benzene (D018). If the material is spilled to soil or water, characteristic testing of the contaminated materials is recommended. Further, this material, once it becomes a waste, is subject to the land disposal restrictions in 40 CFR 268.40 and may require treatment prior to disposal to meet specific standards. Consult state and local regulations to determine whether they are more stringent then the federal requirements.

Container contents should be completely used and containers should be emptied prior to discard. Container ?insate? could be considered a RCRA hazardous waste and must be disposed of with care and in compliance with federal, state and local regulations. Large empty containers, such as drums, should be returned to the distributor or to a drum reconditioner. To assure proper disposal of smaller containers, consult with state and local regulations and disposal authorities.

14. TRANSPORT INFORMATION

DOT Shipping Description:	Diesel Fuel, NA1983
Non-Bulk Package Marking:	Diesel Fuel, 3, NA 1993, III

15. REGULATORY INFORMATION

EPA SARA 311/312 (Title III Hazard Categories):

Acute Health:	Yes
Chronic Health:	Yes
Fire Hazard:	Yes
Pressure Hazard:	No
Reactive Hazard:	No

SARA 313 and 40 CFR 372:
This material contains the following chemicals subject to the reporting requirements of SARA 313 and 40 CFR 372:

Component	CAS Number	Weight %
-- None known --		

California Proposition 65:
Warning: This material contains the following chemicals which are known to the state of California to cause cancer, birth defects or other reproductive harm, and are subject to the requirements of California Proposition 65 (CA Health & Safety Code Section 25249.5):

Component	Effect
Benzene	Cancer, Developmental and Reproductive Toxicant
Toluene	Developmental Toxicant

Diesel engine exhaust, while not a component of this material, is on the Proposition 65 list of chemicals known to the State of California to cause cancer.

Carcinogen Identification:
This material has not been identified as a carcinogen by NTP, IARC, or OSHA. See Section 11 for carcinogenicity information of individual components, if any. Diesel exhaust is a probable cancer hazard based on tests in laboratory animals. It has been identified as carcinogen by IARC.

EPA (CERCLA Reportable Quantity: None

16. OTHER INFORMATION

Issue Date: 01/01/02
Previous Issue Date: 05/15/01
Product Code: Multiple
Revised Sections: None
Previous Product Code: Multiple
MSDS Number: 0041

Disclaimer of Expressed and Implied Warranties:

The information presented in this Material Data Safety Sheet is based on data believed to be accurate as of the date this Material Data Sheet was prepared. HOWEVER, NO WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR ANY OTHER WARRANTY IS EXPRESSED OR IS TO BE IMPLIED REGARDING THE ACCURACY OR COMPLETENESS OF THE INFORMATION PROVIDED ABOVE, THE RESULTS TO BE OBTAINED FROM THE USE OF THIS INFORMATION OR THE PRODUCT, THE SAFETY OF THE PRODUCT, OR THE HAZARDS RELATED TO ITS USE. No responsibility is assumed for any damage or injury resulting from abnormal use or from any failure to adhere to recommended practices. The information provided above, and the product, are furnished on the condition that the person receiving them shall make their own determination as to the suitability of the product for their particular purpose and on the condition that they assume the risk of their use. In addition, no authorization is given nor implied to practice any patented invention without a license.

UltraLow Sulfur Diesel Product Specification

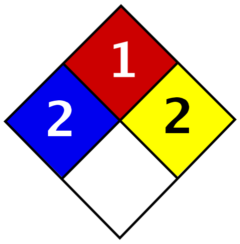
Ferndale Product Code:34380xx (5) Product Code: ULSD2

(COMETS)

Specification	Unit	Limit	Test Procedure	Typical
Appearance				
Water & Sediment	Vol %	0.05 Max	D 2709	
Color	Number	3.0 Max	D 1500	
Haze Rating	Rating	2 Max	D 4176	
Composition				
Carbon Residue (Ramsbottom)	Wt %	0.35 Max	D 524, D 189	
Volatility				
90% Recovered	Deg; F	540 Min	D 86	
	Deg; F	640 Min	D 86	
Flash Point	Deg; F	125 Min (1)	D 93	130 F
Gravity	API	30 Min	D 287, D4052	
Fluidity				
Pour Point	Deg; F	See Season Table (6)	D 97	
Cloud Point	Deg; F	See Season Table (6)	D 2500	10 F
Viscosity @ 104F	cSt	1.9 Min	D 445	
	cSt	4.1 Max	D 445	
Lubricity, SLBOCLE	grams	3100 Min	D 6078	3300gm
Lubricity, HFRR	mm	.45	D 6079	
Combustion				
Cetane Index or Cetane Number (3,4)	Number	40.0 Min	D 976, D613	47.0
Corrosion				
Copper Strip, 3hr @ 50 deg C	Number	3 Max (2)	D 130	
Aromatics (4)	Vol %	35 Max	D 1319	25 %
Contaminants				
Total Sulfur	PPM	30 Max	D 2622, D4294	15-20ppm
Water & Sediment	Vol %	0.05 Max	D 1796	
Ash	Wt %	0.01 Max	D 482	
Additives				
Cetane Improver	Lb/MBbl	675 Max		
Dye		Undyed		

1. Minimum release specification is 125 deg. F. The refinery should target 135 deg. F.
2. Test result reported as a number and letter (e.g. 1a). Any letter is allowable as long as the number meets the spec shown.
3. Either specification must be met.
4. Either cetane index minimum or aromatics maximum must be met.
5. Winter cloud and pour specifications may be relaxed to the summer specifications by agreement with the customer.
6. Season Table

Month	Product Code	Pour Point	Cloud Point
Jan, Feb, Nov, Dec	WI	0 max (5)	14 max (5)
Mar - Oct	SU	15 max	24 max



Health	2
Fire	1
Reactivity	2
Personal Protection	E

Material Safety Data Sheet
Sodium permanganate monohydrate MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sodium permanganate monohydrate

Catalog Codes: SLS4345

CAS#: 10101-50-5

RTECS: SD6650000

TSCA: TSCA 8(b) inventory: Sodium permanganate monohydrate

CI#: Not applicable.

Synonym: Permanganic acid, sodium salt

Chemical Name: Sodium permanganate monohydrate

Chemical Formula: $NaMnO4.H2O$

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sodium permanganate monohydrate	10101-50-5	100

Toxicological Data on Ingredients: Sodium permanganate monohydrate: ORAL (LD50): Acute: 9000 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant). Hazardous in case of skin contact (permeator), of ingestion, of inhalation. Prolonged exposure may result in skin burns and ulcerations.
Over-exposure by inhalation may cause respiratory irritation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cold water may be used. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of combustible materials.
Flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Oxidizing material.
Do not use water jet. Use flooding quantities of water. Avoid contact with organic materials.

Special Remarks on Fire Hazards: When heated to decomposition it emits toxic fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Oxidizing material.
Stop leak if without risk. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Keep away from combustible material Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as reducing agents, organic materials, metals, acids, moisture.

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Oxidizing materials should be stored in a separate safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 5 (mg/m3) from ACGIH (TLV) [1995]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Powdered solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 159.94 g/mole

Color: Red.

pH (1% soln/water): 7 [Neutral.]

Boiling Point: Not available.

Melting Point: Decomposes.

Critical Temperature: Not available.

Specific Gravity: 2.47 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Soluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances:
Highly reactive with reducing agents, organic materials, metals, acids.
Reactive with moisture.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 9000 mg/kg [Rat].

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant).
Hazardous in case of skin contact (permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Exposure can cause nausea, headache and vomiting. Material is corrosive to the mucous membranes.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 5.1: Oxidizing material.

Identification: : Sodium permanganate : UN1503 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Sodium permanganate monohydrate
Massachusetts RTK: Sodium permanganate monohydrate
TSCA 8(b) inventory: Sodium permanganate monohydrate
SARA 313 toxic chemical notification and release reporting: Sodium permanganate monohydrate

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS C: Oxidizing material.
CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R38- Irritating to skin.
R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 2

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987.
-Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec.
-SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984.
-Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

Created: 10/09/2005 06:34 PM

Last Updated: 11/06/2008 12:00 PM

AIR PRODUCTS

MATERIAL SAFETY DATA SHEET

SECTION 1. PRODUCT IDENTIFICATION

PRODUCT NAME:	**Nitrogen, compressed**
CHEMICAL NAME:	Nitrogen
FORMULA:	N_2
SYNONYMS:	Nitrogen gas, Gaseous Nitrogen, GAN
MANUFACTURER:	**Air Products and Chemicals, Inc.** 7201 Hamilton Boulevard Allentown, PA 18195 - 1501
PRODUCT INFORMATION:	1-800-752-1597

MSDS NUMBER: 1011 **REVISION:** 5

REVISION DATE: March 1994 **REVIEW DATE:** August 1997

SECTION 2. COMPOSITION/INFORMATION ON INGREDIENTS

Nitrogen is sold as pure product > 99%.

CAS NUMBER: 7727-37-9

EXPOSURE LIMITS:

OSHA: Not established **ACGIH:** Simple asphyxiant **NIOSH:** Not established

SECTION 3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

Nitrogen is a nontoxic, odorless, colorless, nonflammable compressed gas stored in cylinders at high pressure. It can cause rapid suffocation when concentrations are sufficient to reduce oxygen levels below 19.5%. Self Contained Breathing Apparatus (SCBA) may be required.

EMERGENCY TELEPHONE NUMBERS

800-523-9374 Continental U.S. , Canada and Puerto Rico

610-481-7711 other locations

POTENTIAL HEALTH EFFECTS INFORMATION:

INHALATION: Simple asphyxiant. Nitrogen is nontoxic, but may cause suffocation by displacing the oxygen in air. Lack of sufficient oxygen can cause serious injury or death.

EYE CONTACT: No adverse effect.

SKIN CONTACT: No adverse effect.

EXPOSURE INFORMATION:

ROUTE OF ENTRY: Inhalation

TARGET ORGANS: None

EFFECT: Asphyxiation (suffocation)

SYMPTOMS: Exposure to an oxygen deficient atmosphere (<19.5%) may cause dizziness, drowsiness, nausea, vomiting, excess salivation, diminished mental alertness, loss of consciousness and death. Exposure to atmospheres containing 8-10% or less oxygen will bring about unconsciousness without warning and so quickly that the individuals cannot help themselves.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None

CARCINOGENIC POTENTIAL: Nitrogen is not listed as a carcinogen or potential carcinogen by NTP, IARC, or OSHA .

SECTION 4. FIRST AID

INHALATION: Persons suffering from lack of oxygen should be moved to fresh air. If victim is not breathing, administer artificial respiration. If breathing is difficult, administer oxygen. Obtain prompt medical attention.

EYE CONTACT: Not applicable.

SKIN CONTACT: Not applicable.

SECTION 5. FIRE AND EXPLOSION

FLASH POINT:	**AUTOIGNITION:**	**FLAMMABLE LIMITS:**
Not applicable	Nonflammable	Nonflammable

EXTINGUISHING MEDIA: Nitrogen is nonflammable and does not support combustion. Use extinguishing media appropriate for the surrounding fire.

HAZARDOUS COMBUSTION PRODUCTS: None

SPECIAL FIRE FIGHTING INSTRUCTIONS: Nitrogen is a simple asphyxiant. If possible, remove nitrogen cylinders from fire area or cool with water. SCBA may be required by rescue workers.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Upon exposure to intense heat or flame cylinder may vent rapidly and/or rupture violently. Most cylinders are designed to vent contents when exposed to elevated temperatures. Pressure in a container can build up due to heat and it may rupture if pressure relief devices should fail to function.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Evacuate all personnel from affected area. Increase ventilation to release area and monitor oxygen level. Use appropriate protective equipment (SCBA). If leak is from container or its valve, call the Air Products emergency telephone number. If leak is in user’s system close cylinder valve and vent pressure before attempting repairs.

SECTION 7. HANDLING AND STORAGE

STORAGE: Cylinders should be stored upright in a well-ventilated, secure area, protected from the weather. Storage area temperatures should not exceed 125 °F (52 °C) and area should be free of combustible materials. Storage should be away from heavily traveled areas and emergency exits. Avoid areas where salt or other corrosive materials are present. Valve protection caps and valve outlet seals should remain on cylinders not connected for use. Separate full from empty cylinders. Avoid excessive inventory and storage time. Use a first-in first-out system. Keep good inventory records.

HANDLING: Do not drag, roll, or slide cylinder. Use a suitable handtruck designed for cylinder movement. Never attempt to lift a cylinder by its cap. Secure cylinders at all times while in use. Use a pressure reducing regulator or separate control valve to safely discharge gas from cylinder. Use a check valve to prevent reverse flow into cylinder. Do not overheat cylinder to increase pressure or discharge rate. If user experiences any difficulty operating cylinder valve, discontinue use and contact supplier. Never insert an object (e.g., wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve causing a leak to occur. Use a special cap wrench or adjustable strap-wrench to remove over-tight or rusted caps.

Nitrogen is compatible with all common materials of construction. Pressure requirements should be considered when selecting materials and designing systems.

SPECIAL REQUIREMENTS: Always store and handle compressed gases in accordance with Compressed Gas Association, Inc. (ph. 703-412-0900) pamphlet CGA P-1, ***Safe Handling of Compressed Gases in Containers.*** Local regulations may require specific equipment for storage or use.

CAUTION: Users of nitrogen must be aware of the hazards caused by the accumulation of high concentrations, especially in confined spaces. Compliance with OSHA regulations, especially 29 CFR 1910.146 (confined space entry), is essential

SECTION 8. PERSONAL PROTECTION / EXPOSURE CONTROL

ENGINEERING CONTROLS: Provide good ventilation and/or local exhaust to prevent accumulation of high concentrations of gas. Oxygen levels in work area should be monitored to ensure they do not fall below 19.5%.

RESPIRATORY PROTECTION:

GENERAL USE: None required.

EMERGENCY: Use SCBA or positive pressure air line with mask and escape pack in areas where oxygen concentration is less than 19.5%. Air purifying respirators will not provide protection.

OTHER PROTECTIVE EQUIPMENT: Safety glasses. Safety shoes and leather work gloves are recommended when handling cylinders.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Colorless gas

ODOR: Odorless

MOLECULAR WEIGHT: 28.01

BOILING POINT (1 Atm): -320.4 °F (-195.8 °C)

SPECIFIC GRAVITY (Air =1): 0.967

SPECIFIC VOLUME (at 70 °F (21.1 °C) and 1 atm): 13.81 ft^3/lb (0.867m^3/kg)

FREEZING POINT/MELTING POINT: -345.8 °F (-209.9 °C)

VAPOR PRESSURE: Not applicable at 70 °F

GAS DENSITY (at 70 °F (21.1 °C) and 1 atm): 0.072 lb/ft^3 (1.153 kg/m^3)

SOLUBILITY IN WATER (Vol./Vol. at 32°F (0°C)): 0.023

SECTION 10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable

CONDITIONS TO AVOID: None

INCOMPATIBILITY: None

HAZARDOUS DECOMPOSITION PRODUCTS: None

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION 11. TOXICOLOGICAL INFORMATION

Nitrogen is a simple asphyxiant.

SECTION 12. ECOLOGICAL INFORMATION

The atmosphere contains approximately 78% nitrogen. No adverse ecological effects are expected. Nitrogen does not contain any Class I or Class II ozone depleting chemicals. Nitrogen is not listed as a marine pollutant by DOT (49 CFR 171).

SECTION 13. DISPOSAL

UNUSED PRODUCT / EMPTY CONTAINER: Return cylinder and unused product to supplier. Do not attempt to dispose of residual or unused quantities.

DISPOSAL: For emergency disposal, secure the cylinder and slowly discharge gas to the atmosphere in a well ventilated area or outdoors.

SECTION 14. TRANSPORT INFORMATION

DOT HAZARD CLASS: 2.2 **DOT SHIPPING LABEL:** Nonflammable Gas

DOT SHIPPING NAME: Nitrogen, Compressed **IDENTIFICATION NUMBER:** UN1066

REPORTABLE QUANTITY (RQ): None

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure upright position in a well ventilated truck. Never transport in passenger compartment of a vehicle.

Compressed gas cylinders shall not be refilled except by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with the owner's written consent is a violation of federal law.

SECTION 15. REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS:

ENVIRONMENTAL PROTECTION AGENCY (EPA):

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act of 1980 requires notification to the National Response Center of a release of quantities of hazardous substances equal to or greater than their reportable quantities (RQ's) in 40 CFR 302.4.

CERCLA Reportable Quantity: None.

SARA TITLE III: Superfund Amendment and Reauthorization Act of 1986

SECTION 302/304: Requires emergency planning on threshold planning quantities (TPQ) and release reporting based on reportable quantities (RQ) of EPA's extremely hazardous substances (40 CFR 355).

Nitrogen is not listed as an extremely hazardous substance.

Threshold Planning Quantity (TPQ): None

SECTIONS 311/312: Require submission of material safety data sheets (MSDSs) and chemical inventory reporting with identification of EPA defined hazard classes. The hazard classes for this product are:

IMMEDIATE HEALTH: No	PRESSURE: Yes
DELAYED HEALTH: No	REACTIVITY: No
	FIRE: No

SECTION 313: Requires submission of annual reports of release of toxic chemicals that appear in 40 CFR 372.

Nitrogen does not require reporting under Section 313.

40 CFR Part 68 - Risk Management for Chemical Accident Release Prevention: Requires the development and implementation of risk management programs at facilities that manufacture, use, store, or otherwise handle regulated substances in quantities that exceed specified thresholds.

Nitrogen is not listed as a regulated substance.

TSCA - TOXIC SUBSTANCES CONTROL ACT: Nitrogen is listed on the TSCA inventory.

OSHA - OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR 1910.119 - Process Safety Management of Highly Hazardous Chemicals: Requires facilities to develop a process safety management program based on Threshold Quantities (TQ) of highly hazardous chemicals.

Nitrogen is not listed in Appendix A as a highly hazardous chemical.

STATE REGULATIONS

CALIFORNIA:

Proposition 65:	This product does NOT contain any listed substances which the State of California requires warning under this statute.
SCAQMD Rule:	VOC = Not applicable

SECTION 16. OTHER INFORMATION

NFPA RATINGS:		**HMIS RATINGS:**	
HEALTH:	0	HEALTH:	0
FLAMMABILITY:	0	FLAMMABILITY:	0
REACTIVITY:	0	REACTIVITY:	0
SPECIAL:	SA*		

*Compressed Gas Association recommendation to designate simple asphyxiant.

***** Documents with Review Dates August 1997 and Revision Date March 1994 are identical in content and either may be used.***

MATERIAL SAFETY DATA SHEET

W A Butler Company
5600 Blazer Parkway
Dublin, Ohio 43017

EMERGENCY PHONE #': 1-800-424-9300
NON-EMERGENCY PHONE #: 1-800-650-4899 **Date Prepared:** January 7, 2004

SECTION I:

CHEMICAL NAME AND SYNONYMS: Hydrogen Peroxide

TRADE NAME: **HYDROGEN PEROXIDE 3%**

CHEMICAL FAMILY: Mixture

FORMULA: NA

CAS REGISTRY#: 7722-84-1

SECTION II: HAZARDOUS INGREDIENTS

The hazard communication standard requires that such mixtures be assumed to present the same health hazard as do components that constitute at least 1% of the mixture (0.1 % for carcinogens) although OSHA has noted that the hazards of individual components may be altered by including them in a mixture. Some of the ingredients of this mixture are a trade secret.

NAME	CAS NO.'S	OSHA PEL/ACGIH TLV - TWA	PERCENT
Hydrogen Peroxide	7722-84-1		3.0

SECTION III: PHYSICAL DATA

BOILING POINT (ºF): 226 º F 108ºcC **SPECIFIC GRAVITY:** 1.03 @ 20º F 4ºC

VAPOR PRESSURE (MM Hg): 23mmHg at 30º C **PERCENT, VIOLATILE by VOLUME (%):** 100%

VAPOR DENSITY (Air=1): Not available **EVAPORATION RATE:** (Butyl Acetate = 1) Above 1

SOLUBILITY IN WATER: Soluble **APPEARANCE & ODOR:** Clear colorless liquid, odorless

SECTION IV: FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (method used): Non-combustible **ESTIMATED FLAMMABLE LIMITS IN AIR:** Non-combustible
EXTINGUISHING MEDIA: Preferably water or water fog. Carbon dioxide and dry chemical may also be used.
SPECIAL FIRE FIGHTING PROCEDURES: Any tank or container surrounded by fire should be flooded with water for cooling. Wear full protective clothing and self-contained breathing apparatus.
UNUSUAL FIRE AND EXPLOSION HAZARDS: Product is non-combustible. On decomposition H_2O_2 releases oxygen, which may intensify fire.

SECTION V: HEALTH HAZARD DATA:

EFFECTS OF OVEREXPOSURE:

EYES: Corrosive to eyes. May cause irreversible tissue damage to the eyes including blindness.
SKIN: May cause mild irritation to skin.
INHALATION: Inhalation of mist or vapor could cause irritation lungs, nose and throat, usually subsides after exposure ceases.
INGESTION: Do not ingest. Corrosive to gastrointestinal tract.

EMERGENCY AND FIRST AID MEASURES:

EYE CONTACT: Immediately flush with large amounts of water for at least 15 minutes. Lifting upper and lower lids intermittently. See a physician or ophthalmologist.
SKIN CONTACT: Wash with large amounts of water. If irritation persists, obtain medical attention.
INHALATION: Remove to fresh air. If breathing difficulty or discomfort occurs, call a physician.

INGESTION: If swallowed, drink plenty of water immediately to dilute. Do not induce vomiting or give anything by mouth to an unconscious person. See a physician. Note to Physician: Hydrogen Peroxide at these concentrations is a strong oxidant.

NA = NOT APPLICABLE
NE = NOT ESTABLISHED
NL = NOT LISTED
NIF = NO INFORMATION FOUND

Direct contact with the eye is likely to cause corneal damage especially if not washed immediately. Careful ophthalmologic evaluation is recommended and the possibility of local corticosteroid therapy should be considered. Because of likelihood of system effect, attempts at evacuating the stomach via emesis induction or gastric lavage should be avoided.

SECTION VI: REACTIVITY DATA

STABILITY: Stable
CONDITIONS TO AVOID: None known
INCOMPATIBILITIES: Strong oxidizing agents, strong alkalizes and strong mineral acids
HAZARDOUS DECOMPOSITION BY PRODUCTS: Oxidizer. Contact with combustibles may cause fire.
HAZARDOUS POLYMERIZATION: Will not occur.

SECTION VII: PRECAUTIONS FOR SAFE HANDLING AND USE

SPILL/RELEASE MEASURES: Dilute with large volume of water and hold in a pond or dike area until H2O2 decomposes.

WASTE DISPOSAL: An acceptable method of disposal is to dilute with a large amount of water and allow the hydrogen peroxide to decompose followed by discharge into a suitable treatment system in accordance with all regulatory agencies. Because acceptable methods of disposal may vary by location and because regulatory requirements may change, the appropriate regulatory agency should be contacted prior to disposal.

SECTION VIII: SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION: If concentrations in excess of 10ppm are expected use approved self-contained breathing apparatus. Do not use oxidizable absorbants such as activated carbon.
VENTILATION: Ventilation should be provided to minimize the release of H2O2 vapors and mist into the work environment.

SKIN PROTECTION: Rubber or neoprene gloves.

EYE PROTECTION: Wear cup type chemical goggles and/or full-face mask.

OTHER PROTECTIVE EQUIPMENT: Use only suitable protective clothing, e.g., rubber, neoprene or synthetic fibers. Avoid cotton, wool or leather. Wear rubber or neoprene footwear.

SECTION IX: SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Store drums in cool areas out of direct sunlight and away from combustibles. For bulk storage refer to FMC technical bulletins. Decomposition and generation of oxygen gas, which could result in high pressures and possible container rupture, Hydrogen peroxide should be stored only in vented containers and should only be transferred in a prescribed manner. Empty drums should be triple rinsed with water before discarding. Utensils used for handling hydrogen peroxide should me made only of glass, stainless steel, aluminum or plastic.

The above information had been provided by the W.A. Butler Company in good faith; but no warranty, expressed or implied is made with regard to the accuracy of such data or it's suitability for a given application or purpose.

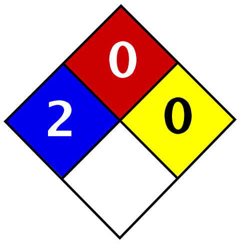
First Priority, Inc. of Elgin, Illinois, manufactures this product for The W.A. Butler Company. The emergency telephone number at the beginning of this MSDS is for First Priority.

Prepared By: George W. Miller III, Regulatory Affairs Manager, W.A. Butler Company using information provided by First Priority in a MSDS dated May 27, 1997.

Date: January 7, 2004

Butler Item Number for the product covered under this MSDS is:
002521 – Hydrogen Peroxide USP 3% WAB 16 oz
002522 – Hydrogen Peroxide USP 3% WAB Gallon

NA = NOT APPLICABLE
NE = NOT ESTABLISHED
NL = NOT LISTED
NIF = NO INFORMATION FOUND



Health	2
Fire	0
Reactivity	0
Personal Protection	J

Material Safety Data Sheet
Potassium Permanganate Solution MSDS

Section 1: Chemical Product and Company Identification

Product Name: Potassium Permanganate Solution

Catalog Codes: SLP3259

CAS#: Mixture.

RTECS: Not applicable.

TSCA: TSCA 8(b) inventory: Potassium permanganateReagent; Water

CI#: Not available.

Synonym:

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Potassium permanganate	7722-64-7	0.09
Water	7732-18-5	99.9

Toxicological Data on Ingredients:

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant). Slightly hazardous in case of skin contact (permeator), of ingestion.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation: Not available.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Spontaneously flammable on contact with ethylene glycol.
Potassium Permanganate being conveyed through propylene tube ignited the tube.
When solid hydroxylamine is brought into contact with solid potassium permanganate, there is produced immediately a with flame.
Potassium permanganate decomposes hydrogen trisulfide so rapidly that sufficient heat is liberated to ignite the trisulfide.
When Antimony or arsenic and solid potassium permanganate are ground together, the metals ignite.
(Potassium Permanganate crystal)

Special Remarks on Explosion Hazards:
Take care in handling as explosions may occur if it is brought in contact with organic or other readily oxidizable substances, either in solution or in dry state.
Explosive in contact with sulfuric acid or hydrogen peroxide.
Potassium permanganate + acetic acid or acetic anhydride can explode if permanganate is not kept cold.
Explosions can occur when permanganates come on contact with benzene, carbon disulfide, diethyl ether, ethyl

alcohol, petroleum, or oganic matter.
Contact with glycerol may produce explosion.
Crystals of potassium permanganate explode vigorously when ground with phosphorous.
A mixture of .5% potassium permanganate + ammonium nitrate explosive caused an explosion 7 hrs. later.
Addition of Potassium permanganate + dimethylformamide to give a 20% solution led to an explosion after 5 min.
During a preparation of chlorine by addition of the concentrated acid (Hydrochloric acid) to solid potassium permanganate, a sharp explosion occurred on one occasion.
(Potassium permanganate crystal)

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. Finish cleaning by spreading water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

Section 7: Handling and Storage

Precautions:
Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. If you feel unwell, seek medical attention and show the label when possible. Avoid contact with skin and eyes.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection: Splash goggles. Lab coat. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Boots. Gloves. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Not available.

Taste: Not available.

Molecular Weight: Not applicable.

Color: Purple. (Dark.)

pH (1% soln/water): Neutral.

Boiling Point: The lowest known value is 100°C (212°F) (Water).

Melting Point: Not available.

Critical Temperature: Not available.

Specific Gravity: The only known value is 1 (Water = 1) (Water).

Vapor Pressure: The highest known value is 2.3 kPa (@ 20°C) (Water).

Vapor Density: The highest known value is 0.62 (Air = 1) (Water).

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, methanol, acetone.

Solubility: Easily soluble in cold water, hot water, methanol, acetone.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Not available.

Corrosivity: Not available.

Special Remarks on Reactivity:
It is a powerful oxidizing agent.
Incompatible with reducing agents, acids, formaldehyde, ammonium nitrate, dimethylformamide, glycerol, combustible materials, alcohols, arsenites, bromides, iodides, charcoal, organic substances, ferrous or mercurous salts, hypophosphites, hyposulfites, sulfites, peroxides, oxalates, ethylene glycol,
Manganese salts in air oxidize the toxic sulfur dioxide to more toxic sulfur trioxide.
Can react violently with most metal powders, ammonia, ammonium salts, phosphorous, many finely divided organic compounds (materials), flammable liquids, acids, sulfur.
(Potassium permanganate crystal)

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact.

Toxicity to Animals:
LD50: Not available.
LC50: Not available.

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans:

Hazardous in case of skin contact (irritant).
Slightly hazardous in case of skin contact (permeator), of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (Male and Female fertility) based on animal data.
May affect genetic material (mutagenetic) based on animal data. (Potassium permanganate)

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Causes skin irritation.
Eyes: Causes eye irritation.
Inhalation: Inhalation of mist or vapor may cause respiratory tract irritation.
Ingestion: May cause digestive/gastrointestinal tract irritation with nausea, vomiting. This solution contains Potassium Permanganate which may affect respiration (hypoxia, dyspnea), cardiovascular system (hypertension, hypotension, tachycardia), liver (hepatits, jaundice, hepatocellular necrosis), blood (methemoglobinemia), urinary system (renal failure, albuminuria, hematuria, proteinuria), behavior/central nervous system(somnolence, headache, dizziness, tremor, paresthesia, fatigue)
Chronic Acute Potential Health Effects:
Ingestion: It may affect the central nervous system. It may also affect the liver and kidneys.
Skin: Repeated prolonged contact may cause dermatitis

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: Not available.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Not a DOT controlled material (United States).

Identification: Not applicable.

Special Provisions for Transport: Not applicable.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut carcinogen reporting list.: Potassium permanganate
Illinois toxic substances disclosure to employee act: Potassium permanganate
Illinois chemical safety act: Potassium permanganate

New York release reporting list: Potassium permanganate
Rhode Island RTK hazardous substances: Potassium permanganate
Pennsylvania RTK: Potassium permanganate
Massachusetts RTK: Potassium permanganate
Massachusetts spill list: Potassium permanganate
New Jersey: Potassium permanganate
New Jersey spill list: Potassium permanganate
Louisiana spill reporting: Potassium permanganate
California Director's List of Hazardous Substances: Potassium Permanganate
TSCA 8(b) inventory: Potassium permanganate; Water
CERCLA: Hazardous substances.: Potassium permanganate: 100 lbs. (45.36 kg);

Other Regulations: Not available.

Other Classifications:

WHMIS (Canada): CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Wear appropriate respirator when
ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 11:48 AM

Last Updated: 10/10/2005 11:48 AM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the

RODUCT: SODIUM THIOSULFATE

ORDER NO: 179380
PROD NO : 503245

ERM
171 FORBES BLVD
SUITE # 5000

MANSFIELD ,MA 02048 ,

NIVAR USA INC. (425)889-3400
100 CARILLON POINT , KIRKLAND , WA 98033

-- EMERGENCY ASSISTANCE --

FOR EMERGENCY ASSISTANCE INVOLVING CHEMICALS CALL - CHEMTREC
(800)424-9300

RODUCT NAME: SODIUM THIOSULFATE

SDS NUMBER: MZS5230

FFECTIVE DATE: 5/22/02

UPERSEDES: 11/21/2001

SSUED BY: 008614

. PRODUCT IDENTIFICATION

YNONYMS: SODIUM THIOSULFATE, PENTAHYDRATE; THIOSULFURIC ACID,
ISODIUM SALT, PENTAHYDRATE
AS NO: 7772-98-7 (ANHYDROUS) 10102-17-7 (PENTAHYDRATE)
OLECULAR WEIGHT: 248.17
HEMICAL FORMULA: NA2S2O3.5H2O

2. COMPOSITION/INFORMATION ON INGREDIENTS

NGREDIENT	CAS NO	PERCENT	HAZARDOUS
SODIUM THIOSULFATE	7772-98-7	100%	YES

RODUCT: SODIUM THIOSULFATE

ORDER NO: 179380
PROD NO : 503245

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

CAUTION! MAY BE HARMFUL IF SWALLOWED OR INHALED. MAY CAUSE IRRITATION TO SKIN, EYES, AND RESPIRATORY TRACT.

POTENTIAL HEALTH EFFECTS

INHALATION:
MAY CAUSE IRRITATION TO THE RESPIRATORY TRACT. SYMPTOMS MAY INCLUDE COUGHING AND SHORTNESS OF BREATH.

INGESTION:
LOW LEVEL OF TOXICITY BY INGESTION. DIARRHEA MAY OCCUR BY INGESTION OF LARGE QUANTITIES.

SKIN CONTACT:
IRRITATION MAY OCCUR FROM PROLONGED SKIN CONTACT.

EYE CONTACT:
CONTACT MAY CAUSE MECHANICAL IRRITATION.

CHRONIC EXPOSURE:
CHRONIC EXPUSURE MAY CAUSE SKIN EFFECTS.

AGGRAVATION OF PRE-EXISTING CONDITIONS:
NO INFORMATION FOUND.

4. FIRST AID MEASURES

INHALATION:
REMOVE TO FRESH AIR. GET MEDICAL ATTENTION FOR ANY BREATHING DIFFICULTY.

INGESTION:
INDUCE VOMITING IMMEDIATELY AS DIRECTED BY MEDICAL PERSONNEL. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. GET MEDICAL ATTENTION.

SKIN CONTACT:
WASH EXPOSED AREA WITH SOAP AND WATER. GET MEDICAL ADVICE IF IRRITATION DEVELOPS.

EYE CONTACT:
WASH THOROUGHLY WITH RUNNING WATER. GET MEDICAL ADVICE IF IRRITATION

EVELOPS.

. FIRE FIGHTING MEASURES

IRE:
OT CONSIDERED TO BE A FIRE HAZARD.

XPLOSION:
OT CONSIDERED TO BE AN EXPLOSION HAZARD.

IRE EXTINGUISHING MEDIA:
SE ANY MEANS SUITABLE FOR EXTINGUISHING SURROUNDING FIRE.

PECIAL INFORMATION:
SE PROTECTIVE CLOTHING AND BREATHING EQUIPMENT APPROPRIATE FOR THE URROUNDING FIRE.

. ACCIDENTAL RELEASE MEASURES

ENTILATE AREA OF LEAK OR SPILL. WEAR APPROPRIATE PERSONAL PROTECTIVE QUIPMENT AS SPECIFIED IN SECTION 8. SPILLS: SWEEP UP AND CONTAINERIZE FOR ECLAMATION OR DISPOSAL. VACUUMING OR WET SWEEPING MAY BE USED TO AVOID UST DISPERSAL.

'. HANDLING AND STORAGE

EEP IN A TIGHTLY CLOSED CONTAINER, STORED IN A COOL, DRY, VENTILATED AREA. ROTECT AGAINST PHYSICAL DAMAGE. ISOLATE FROM INCOMPATIBLE SUBSTANCES. ONTAINERS OF THIS MATERIAL MAY BE HAZARDOUS WHEN EMPTY SINCE THEY RETAIN RODUCT RESIDUES (DUST, SOLIDS); OBSERVE ALL WARNINGS AND PRECAUTIONS ISTED FOR THE PRODUCT.

. EXPOSURE CONTROLS/PERSONAL PROTECTION

IRBORNE EXPOSURE LIMITS:
ONE ESTABLISHED.

ENTILATION SYSTEM:
N GENERAL, DILUTION VENTILATION IS A SATISFACTORY HEALTH HAZARD CONTROL OR THIS SUBSTANCE. HOWEVER, IF CONDITIONS OF USE CREATE DISCOMFORT TO THE ORKER, A LOCAL EXHAUST SYSTEM SHOULD BE CONSIDERED.

ERSONAL RESPIRATORS (NIOSH APPROVED):
OR CONDITIONS OF USE WHERE EXPOSURE TO DUST OR MIST IS APPARENT AND

RODUCT: SODIUM THIOSULFATE

ORDER NO: 179380
PROD NO : 503245

NGINEERING CONTROLS ARE NOT FEASIBLE, A PARTICULATE RESPIRATOR (NIOSH TYPE
95 OR BETTER FILTERS) MAY BE WORN. IF OIL PARTICLES (E.G. LUBRICANTS,
UTTING FLUIDS, GLYCERINE, ETC.) ARE PRESENT, USE A NIOSH TYPE R OR P
ILTER. FOR EMERGENCIES OR INSTANCES WHERE THE EXPOSURE LEVELS ARE NOT
NOWN, USE A FULL-FACE POSITIVE-PRESSURE, AIR-SUPPLIED RESPIRATOR.
ARNING: AIR-PURIFYING RESPIRATORS DO NOT PROTECT WORKERS IN
XYGEN-DEFICIENT ATMOSPHERES.

KIN PROTECTION:
EAR PROTECTIVE GLOVES AND CLEAN BODY-COVERING CLOTHING.

YE PROTECTION:
AFETY GLASSES. MAINTAIN EYE WASH FOUNTAIN AND QUICK-DRENCH FACILITIES IN
ORK AREA.

. PHYSICAL AND CHEMICAL PROPERTIES

```
PPEARANCE:                           BOILING POINT:
ONOCLINIC, COLORLESS CRYSTALS.       > 100C (> 212F)

DOR:MELTING POINT:
DORLESS.                             48C (118F) LOSES WATER @ 100C (212F)

OLUBILITY:                           VAPOR DENSITY (AIR=1):
79G/100 ML WATER @ 4C (39F)          NO INFORMATION FOUND.

ENSITY:                              VAPOR PRESSURE (MM HG):
.75 NO INFORMATION FOUND.

H:  EVAPORATION RATE (BUAC=1):
O INFORMATION FOUND.                 NO INFORMATION FOUND.

% VOLATILES BY VOLUME @ 21C (70F):
0
```

0. STABILITY AND REACTIVITY

TABILITY:
TABLE UNDER ORDINARY CONDITIONS OF USE AND STORAGE. STABILITY LIMITED IN
OLUTION.

AZARDOUS DECOMPOSITION PRODUCTS:
XIDES OF SULFUR AND HYDROGEN SULFIDE.

AZARDOUS POLYMERIZATION:
ILL NOT OCCUR.

NCOMPATIBILITIES:
ODIUM NITRATE, HALOGENS, AND OXIDIZING AGENTS. REACTS WITH ACIDS TO ELEASE SULFUR DIOXIDE.

ONDITIONS TO AVOID:
NCOMPATIBLES.

1. TOXICOLOGICAL INFORMATION

O LD50/LC50 INFORMATION FOUND RELATING TO NORMAL ROUTES OF OCCUPATIONAL XPOSURE.

--------/CANCER LISTS/--

---NTP CARCINOGEN---

NGREDIENT	KNOWN	ANTICIPATED	IARC CATEGOR
ODIUM THIOSULFATE (7772-98-7)	NO	NO	NONE

2. ECOLOGICAL INFORMATION

NVIRONMENTAL FATE:
O INFORMATION FOUND.

NVIRONMENTAL TOXICITY:
O INFORMATION FOUND.

3. DISPOSAL CONSIDERATIONS

HATEVER CANNOT BE SAVED FOR RECOVERY OR RECYCLING SHOULD BE MANAGED IN AN PPROPRIATE AND APPROVED WASTE DISPOSAL FACILITY. PROCESSING, USE OR ONTAMINATION OF THIS PRODUCT MAY CHANGE THE WASTE MANAGEMENT OPTIONS. TATE AND LOCAL DISPOSAL REGULATIONS MAY DIFFER FROM FEDERAL DISPOSAL EGULATIONS.

ISPOSE OF CONTAINER AND UNUSED CONTENTS IN ACCORDANCE WITH FEDERAL, STATE ND LOCAL REQUIREMENTS.

14. TRANSPORT INFORMATION

NOT REGULATED.

15. REGULATORY INFORMATION

RODUCT: SODIUM THIOSULFATE

ORDER NO: 179380
PROD NO : 503245

--------/CHEMICAL INVENTORY STATUS - PART 1/--------------------------------------

NGREDIENT	TSCA	EC	JAPAN	AUSTRALIA
ODIUM THIOSULFATE (7772-98-7)	YES	YES	YES	YES

--------/CHEMICAL INVENTORY STATUS - PART 2/--------------------------------------

		-CANADA--		
NGREDIENT	KOREA	DSL	NDSL	PHIL.
ODIUM THIOSULFATE (7772-98-7)	YES	YES	NO	YES

-------/FEDERAL, STATE & INTERNATIONAL REGULATIONS - PART 1/----------------

	SARA 302-	--------SARA 313------	
NGREDIENT	RQ	TPQ	LIST	CHEMICAL CATG
ODIUM THIOSULFATE (7772-98-7)	NO	NO	NO	NO

--------/FEDERAL, STATE & INTERNATIONAL REGULATIONS - PART 2/----------------

		-RCRA-	-TSCA-
NG...IENT	CERCLA	261.33	8(D)
ODIUM THIOSULFATE (7772-98-7)	NO	NO	NO

HEMICAL WEAPONS CONVENTION: NO TSCA 12(B): NO CDTA: NO
ARA 311/312: ACUTE: YES CHRONIC: NO FIRE: NO PRESSURE: NO
EACTIVITY: NO (PURE / SOLID)

USTRALIAN HAZCHEM CODE: NONE ALLOCATED.
OISON SCHEDULE: NONE ALLOCATED.

HMIS: THIS MSDS HAS BEEN PREPARED ACCORDING TO THE HAZARD CRITERIA OF
HE CONTROLLED PRODUCTS REGULATIONS (CPR) AND THE MSDS CONTAINS
LL OF THE INFORMATION REQUIRED BY THE CPR.

6. OTHER INFORMATION

FPA RATINGS:
EALTH: 1 FLAMMABILITY: 0 REACTIVITY: 0

EVISION INFORMATION:
SDS SECTION(S) CHANGED SINCE LAST REVISION OF DOCUMENT INCLUDE: 3.

ODUCT: SODIUM THIOSULFATE

ORDER NO: 179380
PROD NO : 503245

FOR ADDITIONAL INFORMATION

CONTACT: MSDS COORDINATOR UNIVAR USA INC.
DURING BUSINESS HOURS, PACIFIC TIME (425)889-3400

05/11/04 15:05 PRODUCT: 503245 CUST NO: 537358 ORDER NO: 179380

NOTICE

******* UNIVAR USA INC("UNIVAR"), EXPRESSLY DISCLAIMS

LL EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A

ARTICULAR PURPOSE, WITH RESPECT TO THE PRODUCT OR INFORMATION PROVIDED

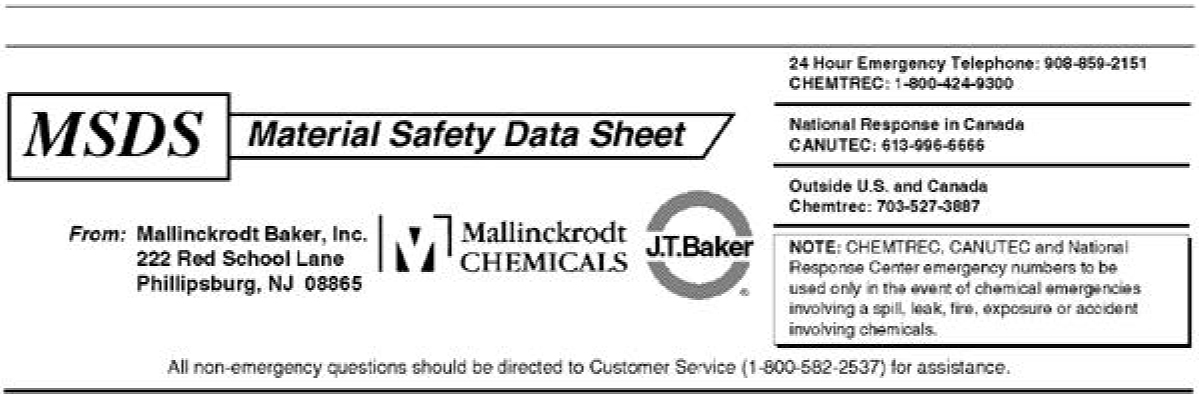
ER" ', AND SHALL UNDER NO CIRCUMSTANCES BE LIABLE FOR INCIDENTAL OR

ONSEQUENTIAL DAMAGES. **

DO NOT USE INGREDIENT INFORMATION AND/OR PERCENTAGES IN THIS MSDS AS A RODUCT SPECIFICATION. FOR PRODUCT SPECIFICATION INFORMATION REFER TO A PRODUCT PECIFICATION SHEET AND/OR A CERTIFICATE OF ANALYSIS. THESE CAN BE OBTAINED FROM OUR LOCAL UNIVAR SALES OFFICE.

ALL INFORMATION APPEARING HEREIN IS BASED UPON DATA OBTAINED FROM THE ANUFACTURER AND/OR RECOGNIZED TECHNICAL SOURCES. WHILE THE INFORMATION IS ELIEVED TO BE ACCURATE, UNIVAR MAKES NO REPRESENTATIONS AS TO ITS ACCURACY OR UFFICIENCY. CONDITIONS OF USE ARE BEYOND UNIVARS CONTROL AND THEREFORE USERS RE RESPONSIBLE TO VERIFY THIS DATA UNDER THEIR OWN OPERATING CONDITIONS TO ETERMINE WHETHER THE PRODUCT IS SUITABLE FOR THEIR PARTICULAR PURPOSES AND THEY SSUME ALL RISKS OF THEIR USE, HANDLING, AND DISPOSAL OF THE PRODUCT, OR FROM HE PUBLICATION OR USE OF, OR RELIANCE UPON , INFORMATION CONTAINED HEREIN. HIS INFORMATION RELATES ONLY TO THE PRODUCT DESIGNATED HEREIN, AND DOES NOT ELATE TO ITS USE IN COMBINATION WITH ANY OTHER MATERIAL OR IN ANY OTHER ROCESS.

*** END OF MSDS ***



MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS

J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

TRICHLOROETHYLENE

MSDS Number: T4940 --- *Effective Date: 09/14/00*

1. Product Identification

Synonyms: Trichloroethene; TCE; acetylene trichloride; Ethinyl trichloride
CAS No.: 79-01-6
Molecular Weight: 131.39
Chemical Formula: C2HCl3
Product Codes:
J.T. Baker: 5376, 9454, 9458, 9464, 9473, 9474
Mallinckrodt: 8598, 8600, 8633

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Trichloroethylene	79-01-6	100%	Yes

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED OR INHALED. AFFECTS HEART, CENTRAL NERVOUS SYSTEM, LIVER AND KIDNEYS. CAUSES SEVERE SKIN

IRRITATION. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.

J.T. Baker SAF-T-DATA[(tm)] Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Cancer Causing)
Flammability Rating: 1 - Slight
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: Blue (Health)

Potential Health Effects

Inhalation:
Vapors can irritate the respiratory tract. Causes depression of the central nervous system with symptoms of visual disturbances and mental confusion, incoordination, headache, nausea, euphoria, and dizziness. Inhalation of high concentrations could cause unconsciousness, heart effects, liver effects, kidney effects, and death.
Ingestion:
Cases irritation to gastrointestinal tract. May also cause effects similar to inhalation. May cause coughing, abdominal pain, diarrhea, dizziness, pulmonary edema, unconsciousness. Kidney failure can result in severe cases. Estimated fatal dose is 3-5 ml/kg.
Skin Contact:
Cause irritation, redness and pain. Can cause blistering. Continued skin contact has a defatting action and can produce rough, dry, red skin resulting in secondary infection.
Eye Contact:
Vapors may cause severe irritation with redness and pain. Splashes may cause eye damage.
Chronic Exposure:
Chronic exposures may cause liver, kidney, central nervous system, and peripheral nervous system effects. Workers chronically exposed may exhibit central nervous system depression, intolerance to alcohol, and increased cardiac output. This material is linked to mutagenic effects in humans. This material is also a suspect carcinogen.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders, cardiovascular disorders, impaired liver or kidney or respiratory function, or central or peripheral nervous system disorders may be more susceptible to the effects of the substance.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Call a physician.
Skin Contact:
Immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
Do not administer adrenaline or epinephrine to a victim of chlorinated solvent poisoning.

5. Fire Fighting Measures

Fire:
Autoignition temperature: 420C (788F)
Flammable limits in air % by volume:
lel: 8; uel: 12.5
Explosion:
A strong ignition source, e. g., a welding torch, can produce ignition. Sealed containers may rupture when heated.
Fire Extinguishing Media:
Use water spray to keep fire exposed containers cool. If substance does ignite, use CO2, dry chemical or foam.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Combustion by-products include phosgene and hydrogen chloride gases. Structural firefighters' clothing provides only limited protection to the combustion products of this material.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

---

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from any source of heat or ignition. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
Trichloroethylene:
-OSHA Permissible Exposure Limit (PEL):
100 ppm (TWA), 200 ppm (Ceiling),
300 ppm/5min/2hr (Max)

-ACGIH Threshold Limit Value (TLV):
50 ppm (TWA) 100 ppm (STEL);
listed as A5, not suspected as a human carcinogen.

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134). This substance has poor warning properties. Where respirators are required, you must have a written program covering the basic requirements in the OSHA respirator standard. These include training, fit testing, medical approval, cleaning, maintenance, cartridge change schedules, etc. See 29CFR1910.134 for details.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Neoprene is a recommended material for personal protective equipment.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Chloroform-like odor.
Solubility:
Practically insoluble in water. Readily miscible in organic solvents.
Specific Gravity:
1.47 @ 20C/4C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
87C (189F)
Melting Point:
-73C (-99F)
Vapor Density (Air=1):
4.5
Vapor Pressure (mm Hg):
57.8 @ 20C (68F)
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Will slowly decompose to hydrochloric acid when exposed to light and moisture.
Hazardous Decomposition Products:
May produce carbon monoxide, carbon dioxide, hydrogen chloride and phosgene when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong caustics and alkalis, strong oxidizers, chemically active metals, such as barium, lithium, sodium, magnesium, titanium and beryllium, liquid oxygen.
Conditions to Avoid:
Heat, flame, ignition sources, light, moisture, incompatibles

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11. Toxicological Information

Toxicological Data:
Trichloroethylene: Oral rat LD50: 5650 mg/kg; investigated as a tumorigen, mutagen, reproductive effector.
Reproductive Toxicity:
This material has been linked to mutagenic effects in humans.

```
--------\Cancer Lists\------------------------------------------------------
                                       ---NTP Carcinogen---
Ingredient                             Known    Anticipated    IARC Category
------------------------------------   -----    -----------    -------------
Trichloroethylene (79-01-6)             No          Yes             2A
```

12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released to water, this material is expected to quickly evaporate. This material has an experimentally-determined bioconcentration factor (BCF) of less than 100. This material is not expected to significantly bioaccumulate. When released into the air, this material may be moderately degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
The LC50/96-hour values for fish are between 10 and 100 mg/l. This material is expected to be slightly toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: TRICHLOROETHYLENE
Hazard Class: 6.1
UN/NA: UN1710

Packing Group: III
Information reported for product/size: 5GL

International (Water, I.M.O.)

Proper Shipping Name: TRICHLOROETHYLENE
Hazard Class: 6.1
UN/NA: UN1710
Packing Group: III
Information reported for product/size: 5GL

International (Air, I.C.A.O.)

Proper Shipping Name: TRICHLOROETHYLENE
Hazard Class: 6.1
UN/NA: UN1710
Packing Group: III
Information reported for product/size: 5GL

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15. Regulatory Information

```
  --------\Chemical Inventory Status - Part 1\---------------------------------
  Ingredient                                       TSCA  EC   Japan  Australia
  -----------------------------------------------  ----  ---  -----  ---------
  Trichloroethylene (79-01-6)                       Yes  Yes   Yes      Yes

  --------\Chemical Inventory Status - Part 2\---------------------------------
                                                              --Canada--
  Ingredient                                       Korea  DSL   NDSL  Phil.
  -----------------------------------------------  -----  ---   ----  -----
  Trichloroethylene (79-01-6)                       Yes   Yes   No     Yes

  --------\Federal, State & International Regulations - Part 1\----------------
                                             -SARA 302-    ------SARA 313------
  Ingredient                                 RQ    TPQ     List  Chemical Catg.
  -----------------------------------------  ---   -----   ----  --------------
  Trichloroethylene (79-01-6)                No    No      Yes        No

  --------\Federal, State & International Regulations - Part 2\----------------
                                                        -RCRA-    -TSCA-
  Ingredient                                 CERCLA     261.33     8(d)
  -----------------------------------------  ------     ------    ------
  Trichloroethylene (79-01-6)                100        U228       No


Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: No  Pressure: No
Reactivity: No          (Pure / Liquid)
```

WARNING:

THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: No information found.
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **2** Flammability: **1** Reactivity: **0**
Label Hazard Warning:
WARNING! HARMFUL IF SWALLOWED OR INHALED. AFFECTS HEART, CENTRAL NERVOUS SYSTEM, LIVER AND KIDNEYS. CAUSES SEVERE SKIN IRRITATION. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. SUSPECT CANCER HAZARD. MAY CAUSE CANCER. Risk of cancer depends on level and duration of exposure.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep away from heat and flame.
Label First Aid:
If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases call a physician. Note to physician: Do not administer adrenaline or epinephrine to a victim of chlorinated solvent poisoning.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8, 11.
Disclaimer:
****

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****

Prepared by: Strategic Services Division
Phone Number: (314) 539-1600 (U.S.A.)

H J HEINZ -- DISTILLED WHITE VINEGAR

MATERIAL SAFETY DATA SHEET

NSN: 895000N048492

Manufacturer's CAGE: 73137

Part No. Indicator: A

Part Number/Trade Name: **DISTILLED WHITE VINEGAR**

General Information

Company's Name: H.J. HEINZ CO.

Company's Street: 1062 PROGRESS ST.

Company's City: PITTSBURGH

Company's State: PA

Company's Country: US

Company's Zip Code: 15212-5990

Company's Emerg Ph #: 412-237-5118

Company's Info Ph #: 412-237-5119

Record No. For Safety Entry: 001

Tot Safety Entries This Stk#: 001

Status: SMJ

Date MSDS Prepared: 13NOV92

Safety Data Review Date: 11FEB94

MSDS Serial Number: BVCGS

Hazard Characteristic Code: NK

Ingredients/Identity Information

Proprietary: NO

Ingredient: DILUTE ACETIC ACID (CH*3 COOH)

Ingredient Sequence Number: 01

NIOSH (RTECS) Number: 1010888AA

CAS Number: 8028-52-2

OSHA PEL: N/K (FP N)

ACGIH TLV: N/K (FP N)

Physical/Chemical Characteristics

Appearance And Odor: CLEAR LIQUID, ODOR OF VINEGAR

Boiling Point: 244F,118C

Vapor Pressure (MM Hg/70 F): 11 MM

Vapor Density (Air=1): 2.1

Specific Gravity: 1.01

Evaporation Rate And Ref: NOT KNOWN

Solubility In Water: COMPLETE

pH: SUPDAT

Fire and Explosion Hazard Data

Extinguishing Media: MEDIA SUITABLE FOR SURROUNDING FIRE (FP N).

Special Fire Fighting Proc: USE NIOSH/MSHA APPROVED SCBA & FULL PROTECTIVE EQUIPMENT (FP N).

Unusual Fire And Expl Hazrds: NONE SPECIFIED BY MANUFACTURER.

Reactivity Data

Stability: YES

Cond To Avoid (Stability): NONE SPECIFIED BY MANUFACTURER.

Materials To Avoid: NONE SPECIFIED BY MANUFACTURER.

Hazardous Decomp Products: NONE SPECIFIED BY MANUFACTURER.

Hazardous Poly Occur: NO

Conditions To Avoid (Poly): NOT RELEVANT.

Health Hazard Data

LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.

Route Of Entry - Inhalation: YES

Route Of Entry - Skin: YES

Route Of Entry - Ingestion: YES

Health Haz Acute And Chronic: PROLONGED INHALATION OF VAPORS CAN CAUSE IRRITATION TO RESPIRATORY TRACT. EYES:WILL CAUSE EYE IRRITATION - SMARTING AND REDDENING OF THE EYE.

Carcinogenicity - NTP: NO

Carcinogenicity - IARC: NO

Carcinogenicity - OSHA: NO

Explanation Carcinogenicity: NOT RELEVANT.

Signs/Symptoms Of Overexp: SEE HEALTH HAZARDS.

Med Cond Aggravated By Exp: NONE SPECIFIED BY MANUFACTURER.

Emergency/First Aid Proc: INHAL:REMOVE TO FRESH AIR. SUPPORT BREATHING (GIVE O*2/ARTF RESP) (FP N). SKIN:FLUSH W/COPIOUS AMOUNTS OF WATER. CALL MD (FP N). EYE:FLUSH IMMEDIATELY AND THOROUGHLY WITH WATER FOR AT LEAST 15-20 MINUTES (TIMED BY A CLOCK). CALL A PHYSICIAN. INGEST:LARGE AMOUNTS, WATER

SHOULD BE CONSUMED TO DILUTE. DO NOT INDUCE VOMITING. DO NOT GIVE EMETICS OR BAKING SODA. CALL A PHYSICIAN.

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: IF VINEGAR IS SPILLED, WATER MAY BE USED TO DILUTE.

Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.

Waste Disposal Method: DISPOSAL MUST BE I/A/W FEDERAL, STATE & LOCAL REGULATIONS (FP N).

Precautions-Handling/Storing: NONE SPECIFIED BY MANUFACTURER.

Other Precautions: NONE SPECIFIED BY MANUFACTURER.

Control Measures

Respiratory Protection: NIOSH/MSHA APPROVED RESPIRATOR APPROPRIATE FOR EXPOSURE OF CONCERN (FP N).

Ventilation: NONE SPECIFIED BY MANUFACTURER.

Protective Gloves: NONE SPECIFIED BY MANUFACTURER.

Eye Protection: NONE SPECIFIED BY MANUFACTURER.

Other Protective Equipment: NONE SPECIFIED BY MANUFACTURER.

Work Hygienic Practices: NONE SPECIFIED BY MANUFACTURER.

Suppl. Safety & Health Data: PH:2.2 @ 100 GRAIN.

Transportation Data

Disposal Data

Label Data

Label Required: YES

Technical Review Date: 11FEB94

Label Date: 11FEB94

Label Status: G

Common Name: DISTILLED WHITE VINEGAR

Chronic Hazard: NO

Signal Word: CAUTION!

Acute Health Hazard-Slight: X

Contact Hazard-Slight: X

Fire Hazard-None: X

Reactivity Hazard-None: X

Special Hazard Precautions: ACUTE:INHAL/EYES:IRRITATION. CHRONIC:NONE

SPECIFIED BY MANUFACTURER.

Protect Eye: Y

Protect Skin: Y

Protect Respiratory: Y

Label Name: H.J. HEINZ CO.

Label Street: 1062 PROGRESS ST.

Label City: PITTSBURGH

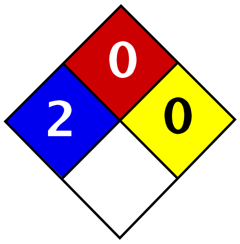
Label State: PA

Label Zip Code: 15212-5990

Label Country: US

Label Emergency Number: 412-237-5118

ScienceLab.com
Chemicals & Laboratory Equipment



Health	2
Fire	0
Reactivity	0
Personal Protection	G

Material Safety Data Sheet
Tetrachloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Tetrachloroethylene

Catalog Codes: SLT3220

CAS#: 127-18-4

RTECS: KX3850000

TSCA: TSCA 8(b) inventory: Tetrachloroethylene

CI#: Not available.

Synonym: Perchloroethylene; 1,1,2,2-Tetrachloroethylene; Carbon bichloride; Carbon dichloride; Ankilostin; Didakene; Dilatin PT; Ethene, tetrachloro-; Ethylene tetrachloride; Perawin; Perchlor; Perclene; Perclene D; Percosolvel; Tetrachloroethene; Tetraleno; Tetralex; Tetravec; Tetroguer; Tetropil

Chemical Name: Ethylene, tetrachloro-

Chemical Formula: C2-Cl4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Tetrachloroethylene	127-18-4	100

Toxicological Data on Ingredients: Tetrachloroethylene: ORAL (LD50): Acute: 2629 mg/kg [Rat]. DERMAL (LD): Acute: >3228 mg/kg [Rabbit]. MIST(LC50): Acute: 34200 mg/m 8 hours [Rat]. VAPOR (LC50): Acute: 5200 ppm 4 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (anticipated carcinogen) by NTP.
MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast.
TERATOGENIC EFFECTS: Not available.

DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to kidneys, liver, peripheral nervous system, respiratory tract, skin, central nervous system (CNS).
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available.
Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with skin. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, metals, acids, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent.
Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 25 (ppm) from OSHA (PEL) [United States]
TWA: 25 STEL: 100 (ppm) from ACGIH (TLV) [United States]
TWA: 170 (mg/m3) from OSHA (PEL) [United States]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Ethereal.

Taste: Not available.

Molecular Weight: 165.83 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 121.3°C (250.3°F)

Melting Point: -22.3°C (-8.1°F)

Critical Temperature: 347.1°C (656.8°F)

Specific Gravity: 1.6227 (Water = 1)

Vapor Pressure: 1.7 kPa (@ 20°C)

Vapor Density: 5.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 5 - 50 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.4

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Miscible with alcohol, ether, chloroform, benzene, hexane.
It dissolves in most of the fixed and volatile oils.
Solubility in water: 0.015 g/100 ml @ 25 deg. C
It slowly decomposes in water to yield Trichloroacetic and Hydrochloric acids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Oxidized by strong oxidizing agents.
Incompatible with sodium hydroxide, finely divided or powdered metals such as zinc, aluminum, magnesium, potassium, chemically active metals such as lithium, beryllium , barium.
Protect from light.

Special Remarks on Corrosivity: Slowly corrodes aluminum, iron, and zinc.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute oral toxicity (LD50): 2629 mg/kg [Rat].
Acute dermal toxicity (LD50): >3228 mg/kg [Rabbit].
Acute toxicity of the vapor (LC50): 5200 4 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (Some evidence.) by NTP.
MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast.
May cause damage to the following organs: kidneys, liver, peripheral nervous system, upper respiratory tract,

skin, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of inhalation.
Slightly hazardous in case of skin contact (permeator), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Publishe Lethal Dose/Conc:
LDL [Rabbit] - Route: Oral; Dose: 5000 mg/kg
LDL [Dog] - Route: Oral; Dose: 4000 mg/kg
LDL [Cat] - Route: Oral; Dose: 4000 mg/kg

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects(teratogenic).
May affect genetic material (mutagenic).
May cause cancer.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: Causes skin irritation with possible dermal blistering or burns. Symtoms may include redness, itching, pain, and possible dermal blistering or burns. It may be absorbed through the skin with possible systemic effects. A single prolonged skin exposure is not likely to result in the material being absorbed in harmful amounts.
Eyes: Contact causes transient eye irritation, lacrimation. Vapors cause eye/conjunctival irritation. Symptoms may include redness and pain.
Inhalation: The main route to occupational exposure is by inhalation since it is readily absorbed through the lungs. It causes respiratory tract irritation, . It can affect behavior/central nervous system (CNS depressant and anesthesia ranging from slight inebriation to death, vertigo, somnolence, anxiety, headache, excitement, hallucinations, muscle incoordination, dizziness, lightheadness, disorentiation, seizures, enotional instability, stupor, coma). It may cause pulmonary edema
Ingestion: It can cause nausea, vomiting, anorexia, diarrhea, bloody stool. It may affect the liver, urinary system (proteinuria, hematuria, renal failure, renal tubular disorder), heart (arrhythmias). It may affect behavior/central nervous system with symptoms similar to that of inhalation.
Chronic Potential Health Effects:
Skin: Prolonged or repeated skin contact may result in excessive drying of the skin, and irritation.
Ingestion/Inhalation: Chronic exposure can affect the liver(hepatitis,fatty liver degeneration), kidneys, spleen, and heart (irregular heartbeat/arrhythmias, cardiomyopathy, abnormal EEG), brain, behavior/central nervous system/peripheral nervous system (impaired memory, numbness of extremeties, peripheral neuropathy and other

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 18.4 mg/l 96 hours [Fish (Fatthead Minnow)]. 18 mg/l 48 hours [Daphnia (daphnia)]. 5 mg/l 96 hours [Fish (Rainbow Trout)]. 13 mg/l 96 hours [Fish (Bluegill sunfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Tetrachloroethylene UNNA: 1897 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Tetrachloroethylene
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Tetrachloroethylene
Connecticut hazardous material survey.: Tetrachloroethylene
Illinois toxic substances disclosure to employee act: Tetrachloroethylene
Illinois chemical safety act: Tetrachloroethylene
New York release reporting list: Tetrachloroethylene
Rhode Island RTK hazardous substances: Tetrachloroethylene
Pennsylvania RTK: Tetrachloroethylene
Minnesota: Tetrachloroethylene
Michigan critical material: Tetrachloroethylene
Massachusetts RTK: Tetrachloroethylene
Massachusetts spill list: Tetrachloroethylene
New Jersey: Tetrachloroethylene
New Jersey spill list: Tetrachloroethylene
Louisiana spill reporting: Tetrachloroethylene
California Director's List of Hazardous Substances: Tetrachloroethylene
TSCA 8(b) inventory: Tetrachloroethylene
TSCA 8(d) H and S data reporting: Tetrachloroethylene: Effective date: 6/1/87; Sunset date: 6/1/97
SARA 313 toxic chemical notification and release reporting: Tetrachloroethylene
CERCLA: Hazardous substances.: Tetrachloroethylene: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC).
CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects.
R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
S23- Do not breathe gas/fumes/vapour/spray
S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S37- Wear suitable gloves.
S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: g

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:29 PM

Last Updated: 11/06/2008 12:00 PM

Appendix H
Air Monitoring Documentation Form

ERM

Ambient Air Monitoring Form

Project Name:
Project Number:
Date:

Document Routing	
FSO	Retain copy in site health & safety file.

1. Work Information

ERM Representative:	
Work Crew Members & Employers:	

2. Monitoring Details

Time	Ambient Air Monitoring Location	Results

3. Completion

Name: ______________________________

Signature: ______________________________

Appendix I
Emergency Drill Evaluation Form

Emergency Drill Evaluation Form

Project Name:
Project Number:

Document Routing	
FSO	Retain copy in site health & safety file.

1. Basic Information

Date of the Drill: ______________________

Drill Facilitator: ______________________
Name *Signature*

2. Describe the Drill Scenario below

3. Post-drill Review

Evaluation Date: ______________________

a. List the Positive Attributes of the Drill below

b. List the Opportunities for Improvement below

c. List the corrective actions taken and their completion date below

Corrective Action	Assigned to…	Completion Date

Appendix J
Incident Reporting & Investigation Form

Incident Report & Investigation Form

FOR ERM & ERM RCM MANAGEMENT INTERNAL USE ONLY
CONFIDENTIAL - WITHOUT PREJUDICE REPORT

Project Name: Project Number: Report Number:

Document Routing	
FSO	After completion to site health & safety file
Project Manager	After completion to office health & safety file

PART I: INCIDENT DATA AND SUMMARY

Instructions: FSO to complete this form within 24 hours after the occurrence of the Incident and deliver to Division H&S Leader.

FSO to verbally notify Project Manager and Division H&S Leader as soon as practicable following occurrence of the Incident. Continue verbal communication per ERM Health & Safety Management System guidance or per applicable client requirements.

If a piece of information does not apply, put N/A in the block.

1. Where did the Incident occur?

Site Name:
Site Address:
Location Within the Site:

2. When did the Incident occur?

Date: ______________________ Time of Day: ______________________

3. What were the weather conditions at the time?

Light Conditions at Incident Location	<u>If Outdoor:</u> ☐ Sunny ☐ Cloudy ☐ Night / Artificial Light ☐ Dawn / Dusk		<u>If Indoor:</u> ☐ Low Light ☐ Normal Light
Precipitation	☐ None ☐ Sleet	☐ Drizzle ☐ Snow	☐ Rain

Temperature (F) ____________ Relative Humidity (%) ____________ Wind Speed (mph) ____________

Incident Report & Investigation Form

FOR ERM & ERM RCM MANAGEMENT INTERNAL USE ONLY
CONFIDENTIAL - WITHOUT PREJUDICE REPORT

Project Name:
Project Number:
Report Number:

4. Which event categories apply?

☐ Traffic-related
☐ Bodily Reaction and Exertion
☐ Impact or contact with objects or equipment
☐ Travel-related
☐ Equipment-operation related
☐ Exposure to the release of chemicals, substances or environments
☐ Falls from height
☐ Aggressive and Violent Acts
☐ Vandalism, theft or site control breach
☐ Slips or trips
☐ Fires or Explosions
☐ Electrocution
☐ Other (specify): ______________________________

5. What type of Incident occurred?

☐ Injury ☐ Illness ☐ Property Damage

6. Who reported and witnessed the Incident?

	Name	Employer
Reported By:		
Witnessed By:		

7. Who was involved in the Incident? What happened to those individuals?

Injured	Suffered Illness	Damaged Property	Name	Employer	Date of Hire	Time Workday Began

Incident Report & Investigation Form

FOR ERM & ERM RCM MANAGEMENT INTERNAL USE ONLY
CONFIDENTIAL - WITHOUT PREJUDICE REPORT

Project Name:
Project Number:
Report Number:

8. What activity/task was taking place just prior to the Incident? (Describe the activity/task as well as tools, equipment and material involved that set the stage for the incident. What was the worker doing?)

9. What changed about the situation or task to cause the Incident? How did the incident happen?

10. What was the outcome of the Incident? (e.g., "Injury: 2 cm long cut to left ring finger", "Property Damage: Snapped overhead telephone cable")

11. What object or substance directly harmed the employee? (e.g., Concrete floor, chlorine, H2S, manhole cover. If this question does not apply to the incident, write N/A.)

12. What immediate actions were taken by whom in response to the Incident?

Action Taken	By…	Employer

Incident Report & Investigation Form

FOR ERM & ERM RCM MANAGEMENT INTERNAL USE ONLY
CONFIDENTIAL - WITHOUT PREJUDICE REPORT

Project Name:
Project Number:
Report Number:

13. If medical treatment was given away from worksite, state name and mailing address of both the facility and treating health care professional.

	Facility	Professional
Name:		
Address:		

14. If outside medical treatment was received, provide the following details:

Name	Employer	Received prescription for medication?	Treated in an emergency room?	Was employee hospitalized overnight as an in-patient?

15. If there were fatalities resulting from this Incident, provide names and the date of death.

Project Name:
Project Number:
Report Number:

16. Attach the report of any external investigations conducted into this Incident. Also attach any photographs or sketches that help to describe the Incident. Describe attachments below.

Completed by…

Name: ______________________________

Signature: ______________________________

Project Role: ______________________________

Date: ______________________________

Incident Report & Investigation Form

FOR ERM & ERM RCM MANAGEMENT INTERNAL USE ONLY
CONFIDENTIAL - WITHOUT PREJUDICE REPORT

Project Name:
Project Number:
Report Number:

PART II: CAUSES AND PLANS TO PREVENT RECURRENCE

Instructions: Division H&S Leader to lead effort to complete Part II of this form with cooperation of Field Safety Officer, Project Manager, and appropriate site personnel

17. Actions leading to Incident. Check all that apply and explain.

☐ Failure to observe warning
☐ Delayed discovery
☐ Lack of site awareness
☐ Other: ______________________________

☐ Failure to use PPE
☐ Procedure not followed

☐ Failure to warn
☐ Abuse / misuse of equip.

Explanation:

18. Conditions leading to Incident. Check all that apply and explain.

☐ Temperature / weather
☐ Time pressure / constraints
☐ Other: ______________________________

☐ Inadequate maintenance
☐ Improper design / engin.

☐ Nature (animals, plants)
☐ Construction deficiencies

Explanation:

19. Job factors leading to Incident. Check all that apply and explain.

☐ Leadership / supervision
☐ Inadequate communication
☐ Inadequate work procedures / practices
☐ Other: ______________________________

☐ Lack of / inadequate PPE
☐ Inadequate training

☐ Inadequate inspections
☐ Improper / defective tools / equip.

Explanation:

Incident Report & Investigation Form

FOR ERM & ERM RCM MANAGEMENT INTERNAL USE ONLY
CONFIDENTIAL - WITHOUT PREJUDICE REPORT

Project Name:
Project Number:
Report Number:

20. Personnel factors leading to Incident. Check all that apply and explain.

☐ Physical capability
☐ Knowledge of task
☐ Other: ____________________
☐ Physical stress / fatigue
☐ Employee skills
☐ Mental stress
☐ Attention to details

Explanation:

21. Event Principal(s)

☐ ERM or RCM ☐ Subcontractor ☐ Third Party

22. What were the corrective actions taken, by whom, and when were they completed?

Corrective Action	Assigned to…	Completion Date

23. Was this Incident recordable/reportable under any governmental requirement?

☐ Yes Determined By: ____________________

☐ No Project Role: ____________________

Part II Completed by…

Name: ____________________

Signature: ____________________

Project Role: ____________________

Date: ____________________

Appendix K
Daily Safety Meeting Documentation Form

Daily Safety Meeting Documentation Form

Project Name:
Project Number:
Meeting Date & Time:
Meeting Leader:

Document Routing	
FSO	Retain copy in site health & safety file.

What work will be conducted on site today and by whom?

Work Task	Conducted By

What overlapping operations/simultaneous operations will occur today?

Any follow-up from previous Major Incidents, Near Misses, Unsafe Acts or Unsafe Conditions discussed today?

List any new / short-service personnel on site today?

Safety Meeting Core Topics – All Site Workers *and* Visitors

- ☐ What PPE is required in order to enter the work zone?
- ☐ What are the potential hazards associated with today's work. How will they be managed?
- ☐ What are the potential impacts of planned activities to: Visitors? Nearby workers? Public?
- ☐ Is everyone aware that they are empowered to stop work if something is questionable or unsafe?
- ☐ What happens and who do you contact if there is an injury or emergency? If working at an active facility, how will you be alerted of an emergency and what will you do?
- ☐ Who do you contact if you have questions, or before deviating from written procedures?
- ☐ Where is fire extinguisher, first aid kit, eyewash, safety shower located?
- ☐ Are any work permits required? Are permits completed and posted in plain view of workers?
- ☐ Have all excavation / borehole locations been cleared of underground utilities/structures, in accordance with ERM and client-specific subsurface clearance procedures?
- ☐ Have all tools / equipment / vehicles been inspected today to ensure safe operating condition?
- ☐ Will a follow-up safety meeting be conducted after lunch?
- ☐ Has anything unexpected or out-of-the-ordinary occurred on this job recently to share?
- ☐ What is the worst that could happen if something goes wrong today?

Daily Safety Meeting Documentation Form

Project Name: Project Number: Meeting Date & Time: Meeting Leader:

Who attended the safety meeting today (employees, subcontractors, visitors)?

Name	Company	Signature	Sign-In Initials*	Sign-Out Initials**

* Employee initials in this space verify that the employee is fit for performing work.
**Employee initials in this space verify that the employee was uninjured during the workday.

Who visited the site today but was not involved in work activities?

Name	Company	Arrival Time

Meeting documented by…

Name: ________________________________

Signature: ________________________________