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**ALTERNATIVE REMEDIAL
CONTRACTING STRATEGY PROGRAM**

ADDENDUM NO. 1 TO REMEDIAL INVESTIGATION SITE OPERATION PLAN FOR THE FISCHER AND PORTER RI/FS

EPA CONTRACT NO: 68-W8-0090
EPA WORK ASSIGNMENT NO.: 90-67-SLO8
CH2M HILL PROJECT NO.: NAE63191.PP.QS
APRIL 1995

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION III
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APPROVAL SHEET
RISOP ADDENDUM NO. 1
FISCHER AND PORTER RI/FS

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EPA Regional III's RPM — Date

2. Reviewed by: _____ _____
EPA Region III's CRL — Date

3. Reviewed by: _____ _____
CH2M HILL's SM — Date

4. Reviewed by: _____ _____
CH2M HILL's Designated QC Officer — Date

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LIST OF ACRONYMS AND ABBREVIATIONS

ARCS	Alternative Remedial Contracting Strategy
ASM	ARCS sample manager
BNA	base neutral/acid compounds
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
COC	chain of custody
CPMS	Contract Program Management Section
CRL	Central Regional Laboratory
DAS	delivery of analytical services
DQO	data quality objective
DV	data validator
EPA	United States Environmental Protection Agency
FS	feasibility study
FSP	field sampling plan
GC	gas chromatograph
HSP	health and safety plan
NPL	National Priorities List
PADER	Pennsylvania Department of Environmental Resources
PCBs	polychlorinated biphenyls
PCE	perchloroethene or tetrachloroethene
PM	program manager
PPE	personal protective equipment
PRP	potentially responsible party
PVC	polyvinyl chloride
QA	quality assurance
QA/QC	quality assurance and quality control

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LIST OF ACRONYMS AND ABBREVIATIONS

QAPP	quality assurance project plan
QC	quality control
RAS	routine analytical services
RI	remedial investigation
RI/FS	remedial investigation and feasibility study
RISOP	Remedial Investigation Site Operations Plan
ROD	record of decision
RPM	remedial project manager
RSCC	Regional Sample Control Center
SAMLCWOA	Superfund Analytical Methods for Low Concentration Water for Organic Analysis
SAP	Sampling and Analysis Plan
SM	site manager
SMO	Sample Management Office
SOP	standard operating procedure
SVOC	semivolatile organic compound
TAL	Target Analyte List
TAL/CN	TAL including cyanide
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TCL	Target Compound List
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TIC	tentatively identified compound
TOC	total orgnaic carbon
TSS	total suspended solids

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LIST OF ACRONYMS AND ABBREVIATIONS

USGS	United States Geological Survey
VOC	volatile organic compound

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Preface

This Remedial Investigation Site Operations Plan (RISOP) Addendum was prepared by CH2M HILL , for the U.S. Environmental Protection Agency (EPA) under Work Assignment No. 90-67-SL08, for the Phase II Remedial Investigation (RI) at the Fischer and Porter site in Warminster, Bucks County, Pennsylvania. The objectives of this Phase II RI are to investigate the presence of free product and ground water contamination at the site. This RISOP Addendum was prepared to supplement the RISOP and Draft Ground Water Sampling Plan previously prepared by Dynamac Corporation for the Phase I RI at the site. An Addendum to the RISOP was necessary, because the RISOP and Draft Ground Water Sampling Plan prepared by Dynamac did not include sufficient procedures to cover the ground water investigation activities to be conducted by CH2M HILL during the Phase II RI.

Revisions to these previous plans included, but were not limited to, the following:

- Modifying procedures in the Draft Ground Water Sampling Plan to reflect the sampling and analyses planned during this Phase II RI
- Preparing additional standard operating procedures (SOPs) for ground water sampling and hydrogeologic testing
- Preparing a health and safety plan (HSP) that is specific to CH2M HILL's personnel and their on-site activities

Sections and attachments either revised from the previous RISOP and Draft Ground Water Sampling Plan or newly prepared and included in this Addendum are as follows:

- Section 1 - Project Description
- Section 2 - Project Organization
- Section 3 - Field Investigation
- Section 4 - Sample Custody
- Section 5 - Equipment Calibration
- Attachment 1 - Standard Operating Procedures
- Attachment 2 - Health and Safety Plan

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Section 1
Project Description

Introduction

CH2M HILL received Work Assignment No. 90-67-SL08 from the U.S. Environmental Protection Agency (EPA) Region III Office, under Contract No. 68-W8-0090 (Alternative Remedial Contracting Strategy [ARCS]), to complete a limited remedial investigation/feasibility study (RI/FS) to address the source of contamination at the Fischer and Porter site in Warminster, Bucks County, Pennsylvania. CH2M HILL will complete work initiated by Dynamac Corporation (Dynamac) under Work Assignment No. C03135 of Contract No. 68-W9-005 (TES VIII). Dynamac discontinued work on the site when their TES VIII contract concluded in May 1994.

The activities for which Dynamac was responsible included the following:

- Review of background information and preparation of a work plan (referred to hereafter as the Phase I RI work plan)
- Preparation of Remedial Investigation Site Operations Plan (RISOP) for soil borings, surface water and sediment sampling, and limited ground water sampling
- A Phase I field investigation including a soil gas survey, soil boring installation and soil sampling in the source areas at the site, sampling of surface water and sediments, limited sampling of ground water from existing on-site and off-site wells, and sampling of existing air stripper effluent discharge
- Preparation of a soil gas results report
- Preparation of sections for the site RI report describing the Phase I investigation including the soil boring and surface water and sediment programs

EPA has charged CH2M HILL with the responsibility of evaluating data generated by the above activities, identifying data gaps, preparing a work plan to fill these gaps, conducting a Phase II field investigation, preparing an RI report describing the results of the Phase I and II field investigations, and conducting a human health and environmental risk assessment and feasibility study (FS).

The overall objectives of the Phase II RI are to investigate the presence of free-product in the source area at the site and determine the feasibility for its recovery, if found. As current data suggest that ground water contamination has already migrated to the site boundary, the Phase

AR300768

II RI will not collect further data on the nature and extent of ground water contamination within the source area. For the remedial design, however, additional analytical and hydrogeologic data will probably need to be obtained in this area.

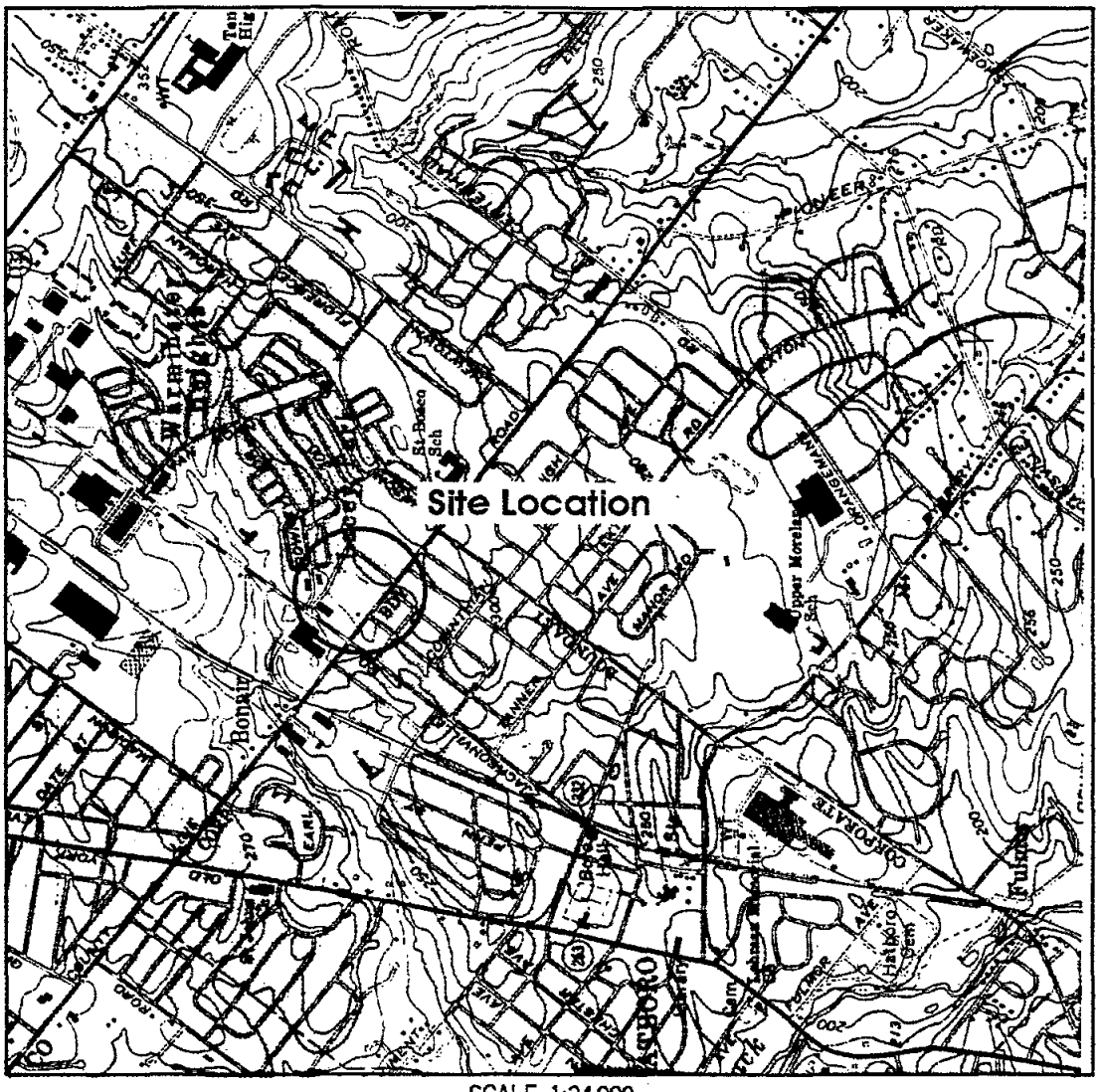
Site Background

The Fischer and Porter facility is a National Priorities List (NPL) site located in Warminster, Pennsylvania. A site location map is provided in Figure 1-1. Figure 1-2 shows the current site layout. In the late 1970s, trichloroethene (TCE) and other volatile organic compounds (VOCs) were found in production wells for Warminster Township and Hatboro Borough, adjacent to the Fischer and Porter site. In 1980, Fischer and Porter initiated a ground water investigation at the site to evaluate the potential impact of VOCs from the plant on ground water. The results of the 1980 investigation indicated that Fischer and Porter was contributing to what was reported to be an isolated plume of ground water contamination, located southwest of the site.

In 1984, Fischer and Porter entered into a Consent Decree with EPA to pump three on-site wells, and to operate an air stripper to treat the contaminated water from the three wells. The Consent Decree further stipulated that influent to and effluent from the treatment system would be monitored for TCE and tetrachloroethylene (PCE). Finally, Fischer and Porter agreed to pay $300,000 and $45,000 to Hatboro and Warminster Heights Water Authorities, respectively, to support the treatment of those water supplies, and further, to pay $40,000 to the Hatboro Water Authority annually for 5 years to support operation and maintenance of its treatment system. Both Hatboro and Warminster Heights Water Authorities have installed air stripping towers on several of the wells affected by the VOC plume. Fischer and Porter now sends quarterly monitoring reports to EPA, pursuant to the decree. According to the decree, the 5-year remedial action review was due in Fiscal Year 1989.

Most of the studies performed at the Fischer and Porter site have involved hydrogeological investigations to evaluate the rate and extent of migration of VOCs in ground water. These studies include the previously mentioned 1980 study, a 1986 study, and the quarterly monitoring of three on-site wells by Fischer and Porter. Other studies include sampling of water supply systems and observation wells in the vicinity of the Fischer and Porter site by NUS Corporation in 1985, under contract to EPA Region III. Sampling of the on-site wells and quarterly monitoring of the three extraction wells indicates varying levels of TCE and other VOCs in ground water beneath the site.

As part of the site hydrogeologic investigations, 12 monitoring wells were installed. Fischer and Porter also operated two production wells on the site in the past, although both wells are currently utilized as part of the ground water extraction and treatment system (Wells FP1 and 2). Also included in the extraction system is Well FP7. The three ground water production wells are being pumped at a combined rate of 75 gallons per minute. The water is being



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HATBORO, PA.
7.5 minute series USGS Quadrangle maps, 1966
Photorevised 1983.

Figure 1-1
SITE LOCATION

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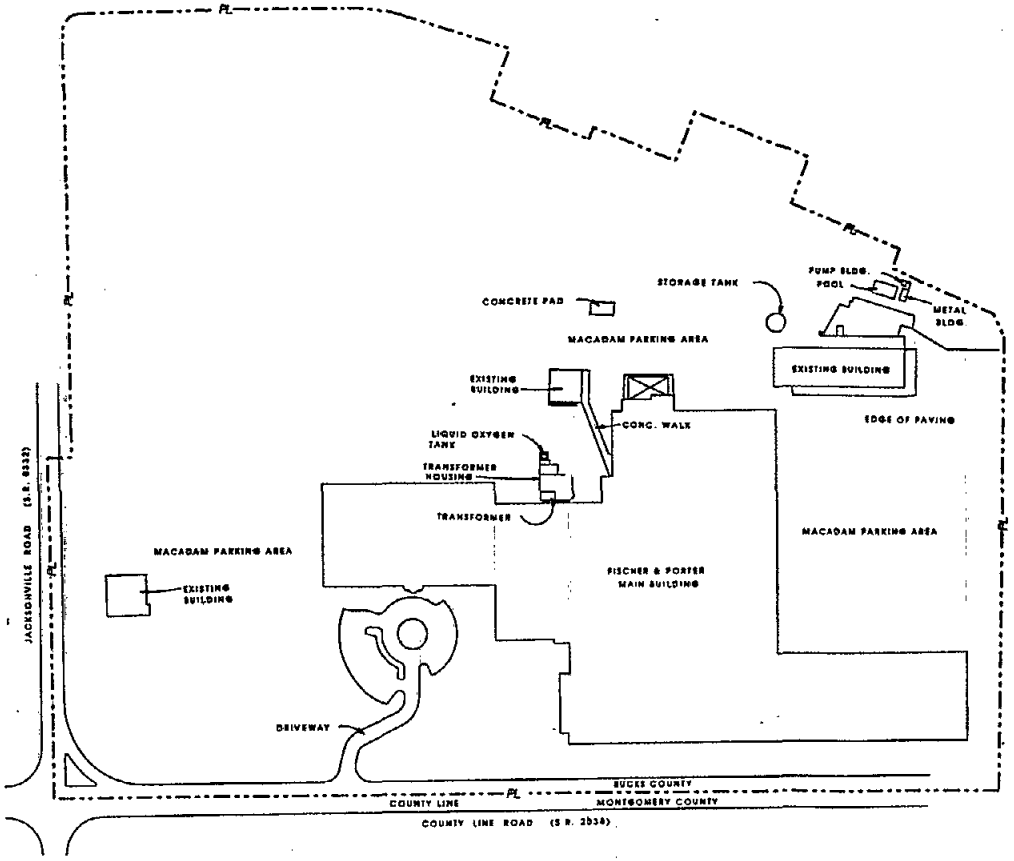

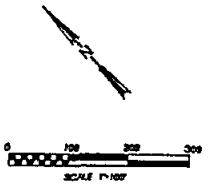

NOTES:

1. OUTBOUND INFORMATION TAKEN FROM A PLAN PREPARED FOR FISCHER & PORTER DATED FEBURARY 12,1991
2. HORIZONTAL DATUM ASSUMED & ROTATED TO PLAN BOUNDARY MERIDIAN.
3. APPROXIMATE FEATURE LOCATION DIGITIZED FROM A PLAN PREPARED FOR FISCHER & PORTER DATED 2/12/91.

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treated in an air stripper. The effluent is discharged to a stream via an open drainage ditch. Fischer and Porter has also installed an oil-recovery system to remove an oil layer which allegedly exists on the water table and is highly contaminated with TCE

Studies into the source(s) of VOC contamination on the site are limited to the Ecology and Environment (E&E) report of 1985 on collection of multi-media samples to assist in identifying sources. It should be noted that this report was prepared by a third party (not EPA) and not in accordance with the EPA Contract Laboratory Program (CLP) protocols. Therefore, the reliability of this information is uncertain. A total of twenty-seven oil, water, and sludge samples were collected, and nine boreholes were augured from which 40 soil samples were collected. The results showed varying concentrations of VOCs at the site. Of concern are not only point sources, but also areas of the vadose zone which have been subjected to prolonged VOC contamination from past waste management practices.

In the 1985 E&E report, several areas were identified as significant contamination sources. These areas include a drum storage area, a waste compacting area, the area in and around a waste oil tank, and the area northwest of the Colburn Lab. In general, the contamination sources were located behind the main building in the vicinity of well FP7.

Most recently, Dynamac has completed the following field activities to investigate the source of ground water contamination:

- In February 1992, a soil gas survey was implemented to investigate subsurface contamination by VOCs and focus the soil boring program. Soil gas samples were analyzed for total and individual VOCs.

- In November 1993, up to fifteen soil borings were completed to the depth of bedrock at the site. Continuous split-spoon soil samples were collected at every 2-foot interval. Selected soil samples were analyzed for target compound list (TCL) organics, target analyte list (TAL) metals, toxicity characteristic leaching procedure (TCLP), total organic carbon (TOC), total recoverable petroleum hydrocarbons, grain size, porosity, and vertical permeability.

In addition to activities completed by Dynamac, USGS has investigated hydrogeologic conditions and ground water contamination at the site. Activities completed by USGS include the following:

- Installation of up to fourteen wells at five locations along the periphery of the facility, as well as three core holes

- Downhole geophysical logging of selected wells installed by USGS and previously existing at the facility

- Packer testing of the deep wells and sampling of ground water from the packers at each of the five locations along the periphery of the site
- Water-level monitoring

RI/FS Objectives

The objectives of this Phase II RI are as follows:

- To investigate ground water contamination by VOCs in the source area at the site
- To investigate ground water contamination by VOCs that has migrated to the perimeter of the site
- To investigate the presence of other contaminants, such as metals and heavier organics in the source area
- To determine if light non-aqueous phase liquids (LNAPLs) are present within the source area and if present to investigate their extent, thickness, and make-up
- To investigate the hydrogeologic conditions within the source area that control transport of free-product and dissolved-phase contamination in the shallow ground water zone from this area
- To evaluate the effectiveness of the present ground water extraction system (wells FP1, 2, and 7)

Section 2

Project Organization

Project Organization

The project team organization for the Phase II RI is shown in Figure 2-1. The responsibilities of key members of the project team are discussed below.

Primary responsibility for project quality rests with the EPA remedial project manager (RPM) and the CH2M HILL site manager (SM). Tables 2-1 and 2-2 outline the QA organization and personnel for the project. All routine analytical services (RAS) will take place through a CLP laboratory or the EPA Region III Central Regional Laboratory (CRL). Delivery of analytical services (DAS) will be procured through CRL personnel or CH2M HILL.

Site Manager

The SM will be responsible for project execution and for all technical, financial, administrative, and agency-related aspects of the project. The SM will also select properly trained and qualified personnel. The SM will be the primary contact between CH2M HILL and the RPM.

Program Manager

The program manager (PM) will ensure that work is performed in accordance with the ARCS III Management Plan.

RI Manager

The RI Manager will coordinate and implement all CH2M HILL field activities associated with the sampling and ensure adherence to all QA/QC procedures outlined in the RISOP, RISOP Addendum, and Draft Ground Water Sampling Plan. The RI Manager's responsibilities include.

- Verifying that field personnel are trained and qualified in saqmpling procedures and field analytical procedures, before taking samples
- Verifying that field analytical QC procedures are followed as specified in the RISOP, RISOP Addendum, and Draft Ground Water Sampling Plan
- Issuing corrective action orders when necessary

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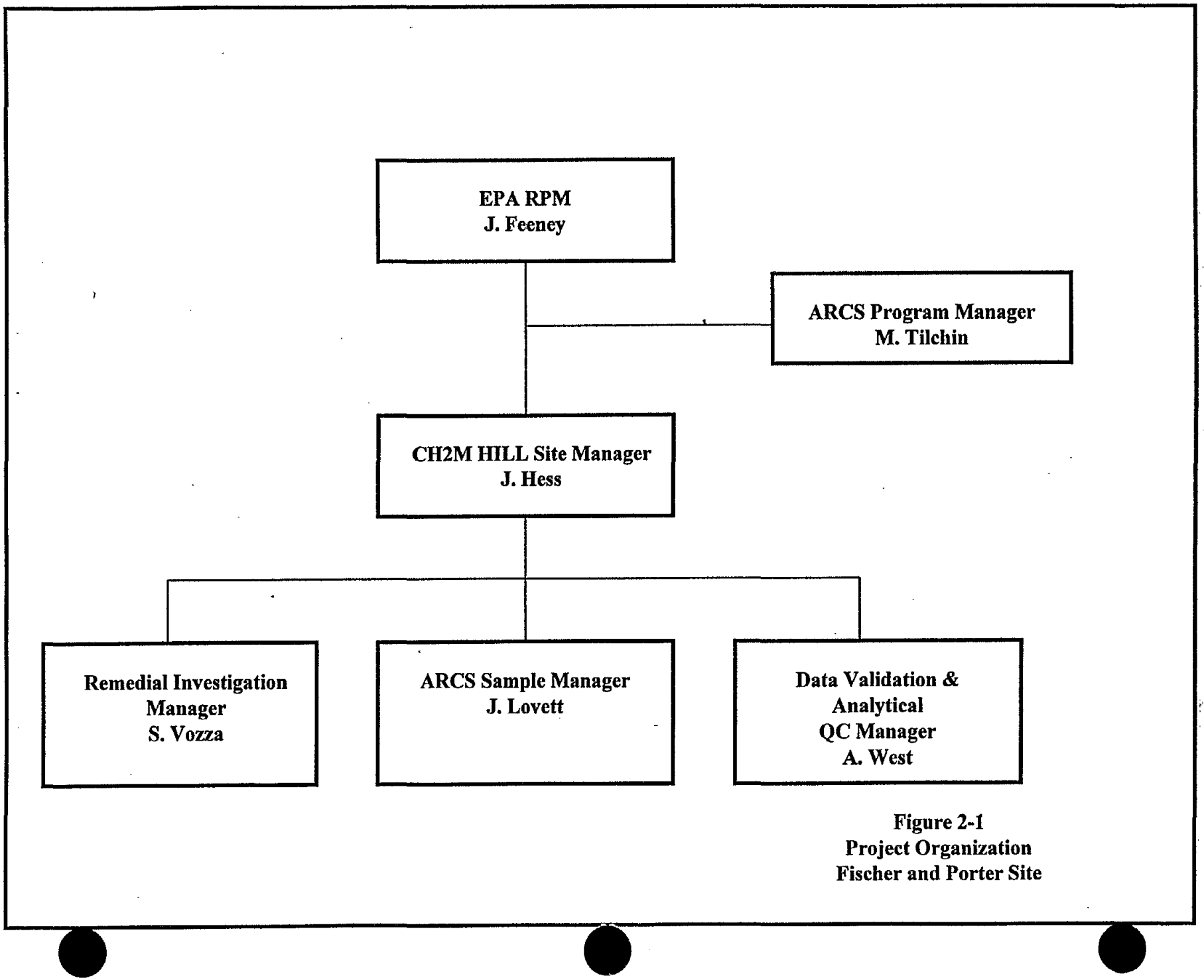

Figure 2-1
Project Organization
Fischer and Porter Site

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Table 2-1
QA Organization
Fischer and Porter Phase II RI

QA Task	Responsible Organization/Personnel
Overall management	EPA Region III/Project Officer EPA Region III/RPM CH2M HILL/PM CH2M HILL/SM
Preparation of RISOP Addendum and supporting documents	CH2M HILL
Review and approval of RISOP Addnedum and supporting documents	EPA Region III/RPM EPA Region III/CRL CH2M HILL/QC Manager CH2M HILL/SM
QA review and approval of reports, SOPs, field activities, auditing of reports, procedures, and internal corrective actions	CH2M HIL/SM CH2M HILL/RI Manager
Approval of QA procedures for other than CLP-RAS	EPA Region III/CRL
Approval of QA plan for field sample collection and measurements	CH2M HILL/SM EPA Region III/RPM
Approval of field sample collection activities	CH2M HILL/RI Manager
CLP-RAS initiation of requests	CH2M HILL/ASM
DAS initiation and preparation of DAS requests	CH2M HILL/QC Manager
Review and approval of DAS	EPA Region III/CRL

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Table 2-2
QA Project Personnel
Fischer and Porter Phase II RI

Site Manager	Juliana Hess CH2M HILL 99 Cherry Hill Road Parisppany, NJ 07054 201/316-9300
RI Manager	Scott Vozza CH2M HILL 99 Cherry Hill Road Parsippany, NJ 07054 201/316-9300
Analytical QC Officer, and Data Validation Manager	Ann West CH2M HILL P.O. Box 4400 Reston, VA 22090 703/471-1441
ARCS Sample Manager	Julie Lovett CH2M HILL P.O. Box 4400 Reston, VA 22090 703/471-1441

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ARCS Sample Manager (ASM)

The primary responsibility of the ASM will be processing of the samples and the analytical data. The ASM will perform the following duties:

- Coordination with Region III for the delivery of sample containers and appropriate paperwork for sample collection, custody, and shipping
- Scheduling through Region III for analytical laboratory services by the CLP or the CRL
- Processing of analytical results in parallel with validation and presentation of the results for the final report

Field Personnel (Sample Collectors)

The field personnel will be under the direction of the RI Manager. The field personnel will be responsible for the following:

- Collecting and labeling the samples following the procedures outlined in the RISOP Addendum
- Taking photographs of the sampling locations
- Completing all necessary documentation
- Packaging and shipping the samples
- Verifying that samples are collected, labeled, preserved, stored, transported, and when necessary, filtered as specified in the RISOP Addendum
- Checking that all sample documentation (labels, field notebooks, chain-of-custody (COC) records, packing lists) is correct and transmitting that information with the samples to the analytical laboratory

Analytical QC Officer and Data Validation Manager

The Analytical QC Officer and Data Validation Manager will prepare all DAS requests and submit them to the CRL. In addition, this person will coordinate the validation of analytical data from samples analyzed through both RAS and SAS, with CRL. Data validation on samples collected by CH2M HILL and analyzed by CRL or a CLP laboratory will be done by CRL.

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Section 3
Field Investigation

Field Investigation

The Phase II field investigation will involve well installation, hydrogeologic testing, ground water sampling, sampling of effluent from the treatment system installed to treat RI-generated water, and characterization sampling of RI-derived wastes from all field activities.

Well Installation and Hydrogeologic Testing

Several suspected source areas are located behind the main facility building. These include former drum storage area, the Colburn Lab Area, and the area outside the scrap room. In addition, the former degreaser area and the area near the former Glass Annex Building may represent sources of ground water contamination. Combined, these are referred to as the "source area" throughout the rest of this document. To date, several investigations have been implemented to investigate these sources and the associated soil contamination. The last of these was the work completed by Dynamac.

In addition to soil contamination, ground water contamination is known to exist within this source area as well as at the site boundary. This contamination is known to include TCE and other TCL VOCs found in wells of varying depths at the facility. Fuel oil floating on top of the ground water table is also suspected.

Several hydrogeologic investigations have been implemented at the site. These investigations have provided limited information about the nature and extent of ground water contamination and the hydrogeologic framework at the site. Therefore, there is a need to characterize the extent of ground water contamination and the hydrogeologic regime at the site. The purpose of this Phase II RI is to investigate the presence of free-product within the source area and the feasibility of its extraction, if present, as well as the effectiveness of the existing ground water extraction system to capture any free-product found and control the off-site migration of dissolved contamination in the shallow ground water zone. The results of the previous investigations, although limited, together with the results of this RI will then be used to evaluate remedial alternatives for free-product recovery and ground water remediation for the entire site.

The ground water well installation and hydrogeologic testing program designed to investigate any light non-aqueous phase liquid (LNAPL) within the source area will be comprised of the following elements:

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- Installation of up to four observation wells (PH1 through PH4) in the area behind the main building where the LNAPL is expected (Figure 3-1. The wells will be installed and screened across the first water encountered and up to a depth of 80 feet below this surface to ensure that the wells measure the water table at all times irrespective of any water table fluctuations caused by local pumping.

- Installation of a fifth well (PH5) within the source area (Figure 3-1). This well will be left as an open borehole initially so that up to three packer-pumping tests may be performed to identify the hydrogeologic zone which can create the greatest cone of depression for LNAPL recovery.

- Construction of a test well in the fifth borehole by screening the zone which was determined during the packer-pumping tests, to create the greatest cone of depression for LNAPL recovery.

- 72-hour pumping test on the test well following completion of the well to provide hydrogeologic information and data to evaluate the capability of this well for free-product/ground water recovery, if needed.

- Water level measurements to evaluate the effectiveness of the existing extraction system for LNAPL recovery.

Operation of the existing ground water extraction system may need to be discontinued following installation of the observation wells. It is important to obtain LNAPL thickness measurements during stable hydrogeologic conditions when free-product can accumulate in the newly installed free-product observation wells. It may be suitable to obtain free-product readings under one of the two scenarios:

- Several weeks after the existing extraction system has discontinued pumping
- While the extraction system is operational

If it is found that the water levels exhibit considerable fluctuations due to operation of the extraction system, the former scenario will be selected. To determine which of these two scenarios will provide the best opportunity for free-product to accumulate in the observation wells, data loggers will be installed on select wells following the installation of the four observation wells to monitor the response of the ground water system to the existing pumping scheme. Data loggers will be installed at select free-product observation wells as well as other wells at the site. Monitoring will continue for seven days. Based on the results of this monitoring, CH2M HILL will determine which scenario is more suitable for free-product thickness measurements and will inform the EPA RPM if there is a need to discontinue pumping to collect these measurements. Irrespective of which scenario is selected for the product thickness measurements, the existing pumping system must be switched off during the packer-pumping tests and the long-term pumping test on the test well.

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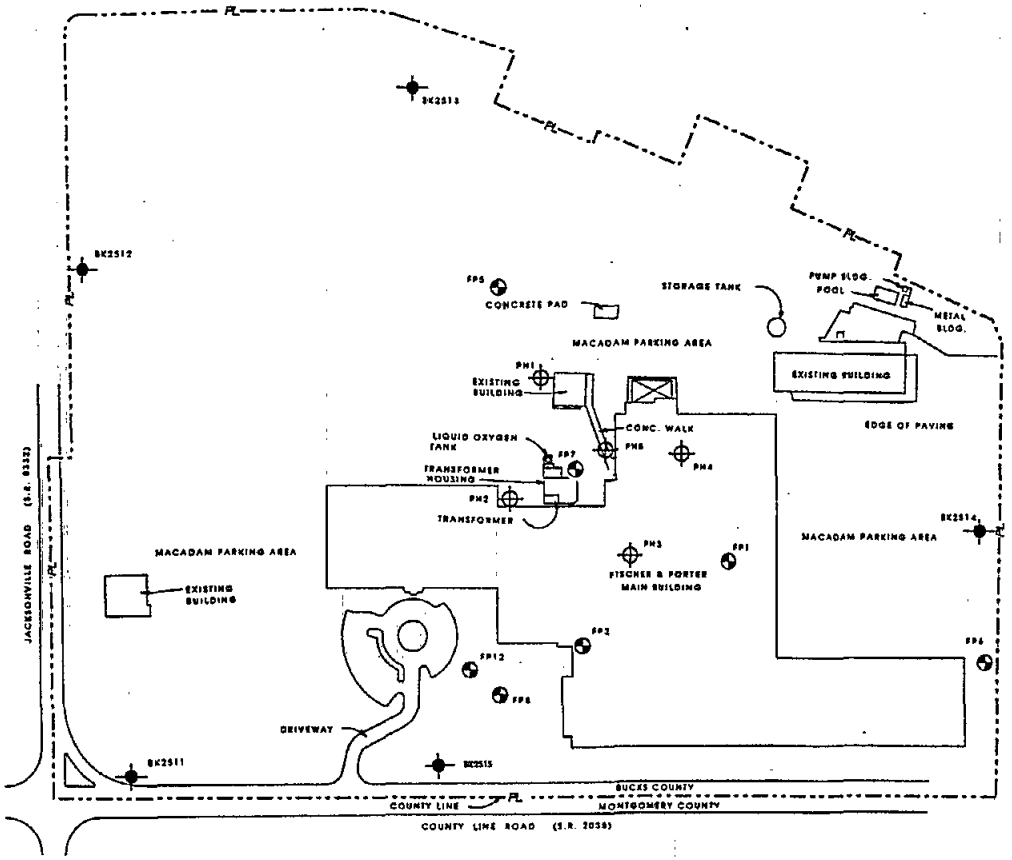

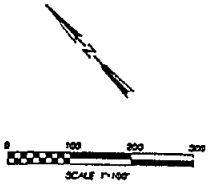

LEGEND

- EXISTING FISCHER AND PORTER WELL LOCATION
- NEW SHALLOW WELL
- EXISTING FISCHER AND PORTER WELL
- PL — PROPERTY LINE

NOTES:

1. OUTBOUND INFORMATION TAKEN FROM A PLAN PREPARED FOR FISCHER & PORTER DATED FEBURARY 12,1991
2. HORIZONTAL DATUM ASSUMED & ROTATED TO PLAN BOUNDARY MERIDIAN.
3. APPROXIMATE FEATURE LOCATION DIGITIZED FROM A PLAN PREPARED FOR FISCHER & PORTER DATED 2/12/91.
4. ALL WELL LOCATIONS ARE APPROXIMATE

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CH2M HILL	DSGN				REUSE OF DOCUMENTS	BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.	FISCHER AND PORTER RI/FS	Figure 3-1 PROPOSED MONITORING WELL LOCATIONS	SHEET	1
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The times and estimated duration when pumping will need to be discontinued will be provided to the EPA RPM several days in advance.

Two complete rounds of manual water level measurements will be collected during the field investigation. Procedures for taking water level measurements are found in SOP No. 1. One of the rounds will be collected when data loggers are installed on select wells and before discontinuing operation of the extraction system. The objective of this round is to evaluate the capture zone created by the existing system. The second round of water level measurements will be collected at the time of sampling of ground water from all on-site wells.

As per conversations between the USGS and CH2M HILL, the USGS will survey the wells installed as part of this investigation before any water-level measurements are collected.

Well Installation

A source area behind the main building near operating well FP7 is suspected to have resulted in free-product floating on top of the ground water table. The areal extent of this free-product has not been delineated. Five wells (PH1 through PH5) are proposed to delineate the extent of the free-product and identify the optimum zones of hydrologic influence for remedial purposes. Four of the wells will be intended as observation wells to delineate the horizontal extent of free-product. The wells, PH1, 2, 3, and 4, will be positioned as shown in Figure 3-1. The results of the soil gas and soil sampling performed by Dynamac will be considered in selecting final well locations. Two of the wells (PH-3 and PH-4) are proposed within the building to provide information about contamination present under the building. In addition to considering previous sampling results, the locations of these indoor wells will be selected after the driller is consulted about accessibility to the desired areas and Fischer and Porter is consulted about convenience and minimizing impacts on plant operations. Angle boreholes may be considered if the boreholes cannot be installed within the building due to access problems or interference with Fischer and Porter manufacturing operations.

For each of the four wells, an 8-inch surface casing will first be installed 10 feet into competent rock and above the water table. According to observations during drilling of the USGS wells and the boreholes installed by Dynamac, the water table is below the top of the bedrock. However, field determination will be made on whether to install permanent or temporary casing so as to ensure that the casing is not installed across the water table. A 7 7/8-inch borehole will then be installed approximately 80 feet below the first water encountered, or the average water surface if this can be determined. Four-inch diameter well screen will be installed from the hole bottom to well above the water surface so that the wells can collect free-product on the water surface. The actual depth of the wells will be determined in the field with the objective being to measure the water table and any floating product at all times irrespective of ground water table fluctuations caused by local pumping (i.e., care will be taken to prevent the casing from being installed across the water table). According to conversations with Fischer and Porter, fluctuations up to 80 feet in ground water elevations have been observed.

Graded silica sand will be installed to at least 2 feet above the top of the screen in the wells, and will be separated from a bentonite grout column by 2 feet of bentonite pellets. Schedule 80 PVC screens are planned for these wells; PVC is considered adequate because the purpose of the wells is to investigate free-product contamination. Wells will be flush mounted. USGS will perform downhole geophysical logging of the four observation wells.

Following installation, the wells will be developed, using a bailer, pump, or surge block, for approximately 1 hour or until temperature, pH, and conductivity have stabilized. Temperature, pH, and conductivity measurements will be taken in accordance with SOP Nos. 4 and 5 As previously described, data loggers will then be installed on select wells to determine whether pumping should be continued or discontinued in order to provide the best opportunity for free-product to accumulate in the wells. At the same time one round of water level measurements in accordance with SOP No. 14 will be collected from all wells. Monitoring with data loggers will continue for seven days before the decision is made about continuing or discontinuing the existing extraction system. If the system must be switched off, the EPA RPM will be immediately notified. In that case, free-product thickness measurements will be collected at least four weeks after pumping is discontinued. If the system does not need to be switched off, free-product measurements will be collected four weeks after this determination is made. A complete round of water level measurements and ground water samples will also be collected at the time of the free-product measurements. Refer to **Ground Water and Treatment System Sampling** section and SOP No. 2 for details on the sampling procedures and analytical parameters.

The results of the free-product thickness measurements and ground water sampling will dictate where a fifth free-product test well (PH5) will be installed within the source area. This well will be of the same dimensions and depth as the other four wells. After drilling and before construction of this fifth well, two to three packer-pumping tests will be performed on key intervals, as described below.

Well PH5 will be installed and hydrogeologic testing performed even if no free-product is measured in the observation wells in order to obtain some hydrogeologic information within the source area at the site.

Upon completion of packer-pumping tests on the fifth well, the zone that created the most extensive and greatest drawdown of the ground water table during pumping will be selected for screening. Pumping of this zone will be expected to create the water-table depression needed for collection and recovery of free-product. A stainless steel screen is anticipated in this well. Upon completion of the screening of the test well, a 72-hour pumping test and ground water sampling will be conducted to provide hydrogeologic information and data on the performance of the well as a free-product recovery well, as described below.

SOP NO. 15 provides guidelines for soil boring log preparation.

Hydrogeologic Testing

After installation of the observation wells, select wells will be monitored with pressure transducers for measurement of water level fluctuations. The transducers will be connected to Campbell Scientific Dataloggers for instantaneous readout and permanent electronic recording. The objective of this monitoring is to determine the best conditions for taking free-product thickness measurements.

Two rounds of manual water level measurements will be collected. Water level measurements will be taken in accordance with SOP No. 1 One of the rounds will be collected before operation of the extraction system is discontinued in order to evaluate the capture zone created by this system. The second round will be collected at the time of sampling of ground water from all on-site wells.

Three packer-pumping tests will be conducted on the shallow test well, PH5, installed at the site. The packer-pumping test will be conducted for approximately 4 hours, enough time to demonstrate relative influence on the observation wells to be monitored. Two samples will be collected from each zone, one after 1 hour, and another just before completion of the test. These samples will be analyzed for Target Compound List (TCL) VOCs to provide information about contaminant distribution in various zones. To obtain this information in a timely manner, these samples will be sent for 2-week turnaround analyses. Upon completion of the tests, the optimum zone of hydrogeologic influence or the zone of highest contamination will be selected for screening. Select wells will be monitored during all packer-pumping tests using the datalogger equipment.

After the packer-pumping test, a 72-hour pumping test will be performed on well PH5. Background water levels will be collected for a minimum of 3 days prior to the start of testing to identify fluctuations in water levels due to extraneous pumping of Hatboro and Westminster Heights wells or meteorological conditions. Water levels will be measured at 15-minute intervals during this period. Barometric pressure will also be measured because differential responses on variable depth wells are anticipated. These data will help to identify the degree of confinement of the wells and formulate a descriptive model of site conditions. Recovery data will be collected following the test for a length of time not to exceed the respective drawdown test period.

Water level measurements will be recorded at decreasing frequency as the pumping test proceeds (every minute for the first hour, then every 15 minutes for the remainder of the test). Drawdown data from each observation well will be reduced and plotted on log-log graphs throughout the test to monitor the progress and effectiveness of the test, and to identify a time to terminate pumping, based on stabilization of drawdown. Flowrates will be measured at the same frequency as drawdown using an impeller style flow-meter that can be integrated with the Campbell datalogger for recording. Ground water samples will also be collected for select parameters during the 72-hour pump test of well PH5.

Sampling procedures and analytical parameters for both the packer-pumping test and the 72-hour pump test are described in the **Ground Water and Treatment System Sampling** section and SOP No. 2.

Because the existing Fischer and Porter treatment system cannot be used for treatment of RI-generated water, a separate treatment system will be set on-site to treat the RI-generated water. The treatment system will consist of a Lowry diffused air stripper unit, an oil-water separation unit, and an equalization tank. The location of this system is planned near the proposed test well PH5. The system will be set up before all well drilling activities begin. Discharge of treated water is planned to the open drainage ditch where the effluent from the existing treatment system discharges. Effluent samples from this treatment system will also be collected for the analytical parameters and at the frequencies specified in the **Ground Water and Treatment System Sampling** section.

Ground Water and Treatment System Sampling

Ground Water Sampling from Monitoring Wells

The objectives of the ground water sampling program are to provide ground water contamination information within the source area as well as across the entire site and up to its boundary. One round of ground water samples will be collected from the following wells:

- The four shallow observation wells (PH1, 2, 3, 4)
- The 14 USGS wells
- The existing Fischer and Porter wells (FP1,2,5,6,7,8, and 12)

Ground water sampling will take place after the installation of the four free product observation wells (PH1 through PH4) and prior to the installation of the test well (PH5). Test well PH5 will be sampled as part of the hydrogeologic testing program. The well locations are shown in Figure 3-1. The five USGS well locations shown in Figure 3-1 are actually the locations of well clusters. The USGS well clusters consist of a shallow well, intermediate well, and a deep well, except for location BK2513 which consists of a shallow well and a deep well.

The Phase II RI ground water sampling and analytical program is summarized in Tables 3-1 and 3-2. It is assumed that all analyses of ground water samples will be performed through the EPA Contract Laboratory Program (CLP), through either routine analytical services (RAS) or delivery of analytical services (DAS) programs. Table 3-1 indicates which analyses will be RAS and which will be DAS, and Table 3-2 indicates analytical methodologies which will be followed.

Ground water samples for TCL VOCs analyses will be obtained from all wells. Wells within the suspected source area (PH1-5, FP1, 2, 5, 6, 7, 8, and 12) will be analyzed by the RAS TCL VOCs analysis. The USGS wells samples will be analyzed for low levels VOCs using DAS. Because pesticides, PCBs, metals (total) and cyanide analyses were not performed on

ground water samples previously collected by Dynamac, these parameters will be analyzed for only in the wells in the source area for confirmatory purposes. Total petroleum hydrocarbons (TPH) and oil and grease (O&G) analyses are planned for only the new wells in the source area (PH1-4). It should be noted that well FP8 may not be sampled if found dry as during the USGS downhole geophysical logging of the well.

Because the sampling results from the four new shallow wells (PH1-4) will be used to decide on the location of test well PH5, a 2-week turnaround time will be requested using DAS for the samples for VOC, oil and grease, and TPH analyses from these wells.

One round of water level measurements will be collected from all on-site wells at the beginning of the sampling program. Water level measurements will also be collected at the time ground water samples are collected from each well. Free-product thickness measurements, if free product is found, will be collected from the new shallow observation wells (PH1 through PH4) and well FP5 at the time of the sampling. If free-product is observed in the wells, no ground water samples will be collected from the wells. If free product is found, one sample of the free product will be collected from one of the wells for specific gravity and viscosity determinations and TCE analysis.

Ground water samples will be collected with the existing extraction system on or off depending on the determination made as a result of the monitoring performed before ground water sampling at the site.

Ground water from wells FP1, FP2, and FP7 is pumped and treated through an air stripper and oil water separator. Ground water samples from these wells will be collected from the sampling ports for these wells before the treatment system. One port is provided for the combined flow from FP1 and 2, and a second port is provided for FP7. Refer to the following SOP No. for sampling procedures: No. 1 Electronic Water Level Measurements; No. 2 Ground Water and Treatment System Sampling; No. 3 VOC Sampling; No. 4 Field Measurement of Specific Conductance and Temperature; No. 5 Field Measurement of pH; No. 6 Field Rinse Blank Preparation; No. 7 Preserving Non-VOC Aqueous Samples; NO. 8 Decontamination; and No. 10 Oil/Water Interface Measurements. SOP Nos. 11, 12, and 13 describe sample documentation, packaging, and shipping instructions; maintenance of the on-site logbook; and photographic documentation of sampling activities.

Ground Water Sampling During Hydrogeologic Testing

In addition to ground water samples from monitoring wells, samples will be collected during the hydrogeologic testing of the shallow test well PH5:

- During packer-pumping testing of the well, to determine the zone to be screened
- During the 72-hour pumping testing of the well, for information about contaminant levels expected after prolonged pumping

The sampling and analytical program during hydrogeologic testing is summarized in Tables 3-2 and 3-3.

Two samples for TCL VOC analysis will be obtained from each of the three zones isolated by packers during the packer-pumping test on the test well. The samples will be collected as follows: one sample 1 hour after the start of the test and another just before completion of the test. Six samples in total are planned. The purpose of these samples will be to delineate zones of gross ground water contamination. A two-week turnaround time for these samples will be requested, because the results will be used to determine the screening zone for the test well. Care will be taken to collect packer samples from zones without free-product contamination.

Just before the pumping test begins, a ground water sample will be obtained from the test well. The purpose of this sample will be to characterize contamination in the test well. A second sample will be obtained just before the pumping test is completed; this sample will be collected from the pump to represent the quality of the ground water that can be expected into the treatment system during pumping. Conventional parameters will be collected at the end of the test for existing or modified treatment system evaluation. Conventional parameters include: total suspended solids (TSS), total dissolved solids (TDS), alkalinity, hardness, total organic carbon (TOC), and iron.

Refer to the following SOP No. for sampling procedures: No. 1 Electronic Water Level Measurements; No. 2 Ground Water and Treatment System Sampling; No. 3 VOC Sampling; No. 4 Field Measurement of Specific Conductance and Temperature; No. 5 Field Measurement of pH; No. 6 Field Rinse Blank Preparation; No. 7 Preserving Non-VOC Aqueous Samples; NO. 8 Decontamination; and No. 10 Oil/Water Interface Measurements. SOP Nos. 11, 12, and 13 describe sample documentation, packaging, and shipping instructions; maintenance of the on-site logbook; and photographic documentation of sampling activities.

Treatment System Sampling

Finally, the sampling program will include collecting samples from the Lowry unit and oil/water separator systems which will be brought on-site to treat ground water generated during the RI. These samples will include:

- Five samples to monitor the effluent from the treatment system collected when the treatment system is first switched on (one sample) and at regular intervals (four samples) during system operation.
- Two samples collected at the end of the pumping test on well PH5 to evaluate performance of the treatment system and provide information to help evaluate a

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full-scale system, if needed during the FS. These samples will be collected from taps as follows: effluent from oil/water separator (one sample) and effluent from Lowry unit (one sample).

A summary of the RI effluent treatment system samples is provided in Tables 3-2 and 3-3. Procedures for collecting samples from the RI effluent treatment system are detailed in SOP No. 2.

RI-Derived Waste Sampling

CH2M HILL will assist EPA in disposing solid wastes such as drill cuttings and used personal protective equipment (PPE), generated during Dynamac and CH2M HILL activities at the site. The wastes will be characterized and arrangements made for their disposal. A total of 10 samples will be collected for characterization of solid wastes (5 for wastes generated by Dynamac and 5 for wastes generated by CH2M HILL). Samples will be analyzed through the CLP DAS program, for toxicity characteristic leaching procedure (TCLP) parameters. Based on the results, CH2M HILL will procure a disposal subcontractor and will oversee the removal from the site of the RI-derived wastes by the selected subcontractor.

Sample Designation

Samples collected during the field activities will be designated by an alphanumeric sample number that will identify the location, depth (if necessary), and sampling round. The site-specific abbreviations and procedures are discussed below.

Ground Water Sampling from Monitoring Wells

Groundwater samples will be identified by the location type (BK), the location number (i.e., 2511), and the depth code (S),if necessary. For example, a sample from one of the USGS wells would be BK2511M.

Location Type:

FB = Field Blank
EQ = Equipment Blank
TB = Trip Blank
PH = Shallow Observation Well
BK = US Geological Survey Well
FP = Existing Fischer Porter Well
PP = Petroleum Product or LNAPL sample

All blank samples will be numbered sequentially as they are collected. For example, FB1 is the first field blank collected, FB2 the second, and so on. Duplicates (ground water and free product) will be numbered sequentially (DUP 1, 2) and a record will be made in the field notebook as to the sample of which the duplicate is taken and its designation.

Depth Codes (for USGS wells only):

S = Shallow
M = Intermediate
D = Deep

Ground Water Sampling During Hydrogeologic Testing (Well PH5 Only)

PH5PT = Well PH5 samples collected during packer testing; PH5PT1 and PH5PT2 will be collected from first zone; PH5PT3 and PH5PT4 will be collected from second zone tested; PH5PT5 and PH5PT6 will be collected from third zone tested.

PH5LPT = Well PH5 samples collected during 72-hour pumping test. PH5LPT1 will be collected prior to start of test; PH5LPT2 will be collected at end of pumping test.

EFLPT = Effluent sample from treatment system at end of pump test. EFLPT1 will be collected from effluent from oil/water separator; EFLPT2 will be collected from effluent from air stripper.

PH5LPTFB = Field blank during long-term pump test.

PH5LPTEQ = Equipment blank during long-term pump test.

PH5PTTB and PH5LPTTB — Trip blanks during packer test and long-term pump test.

PH5PTDUP PH5LPTDUP — Duplicate during packer and long-term pump test.

All blank samples will be numbered sequentially as they are collected. For example, PH5LPTFB1 is the first blank during the long-term pump test.

A record will be made in the field notebook as to the sample of which the duplicates taken and its designation.

Treatment System Sampling

EF1-5 = Samples 1 through 5 from effluent from treatment system.

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RI-Derived Waste Sampling

W1-10 = Samples 1 through 10 from the RI-derived wastes.

Decontamination

Sampling Equipment

To prevent cross-contamination between ground water samples, pre-cleaned decontaminated stainless steel bailers and pumps, and dedicated tubing will be used. By using pre-cleaned sampling equipment, minimal field equipment decontamination will be necessary.

Stainless steel submersible pumps will be used to purge and sample wells with greater than 1 foot of water present. A peristaltic or jet pump will be used for purging wells with less than 1 foot of water present and water levels of no greater than 25 feet. The peristaltic or jet pump will also be used for collecting the ground water samples for metals analysis. The peristaltic or jet pump does not require decontamination, since only the tubing comes in contact with the ground water. The submersible pump will be decontaminated prior to each use in accordance with SOP No. 8. Tubing for all pumps will be dedicated and disposed of after it is used.

If stainless steel bailers are used to collected ground water samples, they will be laboratory decontaminated or field decontaminated prior to the start of sampling activities. The cleaning procedure to be used for bailers and submersible pumps is outlined in SOP No. 8.

On-Site Equipment

To prevent contamination between installation of monitoring wells, all drilling tools will be cleaned before commencement of drilling of each monitoring well. All soil adhering to the augers and drill rods will be removed using a high-pressure steam rinse. A decontamination area, where the rinse water and sediment can be collected and contained for proper disposal, will be established at the site for this purpose. SOP No. 8 provides a detailed description of on-site equipment decontamination.

Personnel

All on-site personnel, before leaving the work site, will follow the decontamination procedures described in the HSP and SOP No. 8.

Data Validation Levels

It is assumed that a CLP laboratory or CRL will analyze the ground water samples and that CRL will perform data validation. Data validation levels M3 and IM2 will be used for all ground water samples collected during the ground water and hydrogeologic sampling programs. No data validation is planned for waste samples, free product samples, packer testing samples, and treatment system effluent samples, since these data are collected for design purposes only.

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Table 3-1
Ground Water Sampling
Fischer and Porter Site

Well[1]	Analysis	Analytical Program[5]
Extraction Wells		
nd 2	TCL organics;[2] TAL metals (total) and cyanide; field parameters[3]	All RAS
	TCL organics; TAL metals (total) and cyanide; field parameters	All RAS
Monitoring Wells		
	Product thickness; TCL organics; TAL metals (total) and cyanide; field parameters	All RAS
	TCL VOC; field parameters	All RAS
	TCL VOC; field parameters	All RAS
	TCL organics; TAL metals (total) and cyanide; field parameters	All RAS
iS Monitoring Wells		
511 Well Location -S -M -D	 Low level TCL VOC; field parameters Low level TCL VOC; field parameters Low level TCL VOC; field parameters	All DAS
512 Well Location -S -M -D	 Low level TCL VOC; field parameters Low level TCL VOC; field parameters Low level TCL VOC; field parameters	All DAS
513 Well Location -S -M -D	 Low level TCL VOC; field parameters Low level TCL VOC; field parameters Low level TCL VOC; field parameters	All DAS
514 Well Location -S -D	 Low level TCL VOC; field parameters Low level TCL VOC; field parameters	All DAS
515 Well Location -S -M -D	 Low level TCL VOC; field parameters Low level TCL VOC; field parameters Low level TCL VOC; field parameters	All DAS
se II RI Free Product Observation Wells		
	Product thickness; TCL organics; TAL metals (total) and cyanide; O&G; TPH; field parameters	RAS-TCL (semi VOCs),[4] TAL and cyanide DAS-O&G and TPH and TCL VOCs (fast turnaround)
	Product thickness; TCL organics; TAL metals (total) and cyanide; O&G; TPH; field parameters	RAS-TCL (semi VOCs), TAL and cyanide DAS-O&G and TPH and TCL VOCs (fast turnaround)
	Product thickness; TCL organics; TAL metals (total) and cyanide; O&G; TPH; field parameters	RAS-TCL (semi VOCs), TAL and cyanide DAS-O&G and TPH and TCL VOCs (fast turnaround)
	Product thickness; TCL organics; TAL metals (total) and cyanide; O&G; TPH; (field parameters)	RAS-TCL (semi VOCs), TAL and cyanide DAS-O&G and TPH and TCL VOCs (fast turnaround)

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Table 3-1
Ground Water Sampling
Fischer and Porter Site

Well[1]	Analysis	Analytical Program[5]
Free Product		
One of PH series wells, to be determined in the field	Specific gravity, viscosity, and TCE analysis of LNAPL	All DAS

Note:
S-Shallow; M-Intermediate; D-Deep

[1] The wells to be sampled during each round are as marked. QA/QC samples are not included.
[2] TCL organics include TCL VOCs, base-neutral/acid compounds, pesticides, and PCBs.
[3] Field parameters include temperature, pH, and conductivity.
[4] Semi VOCs include base neutral/acid compounds (BNAEs), pesticides, and PCB analyses.
[5] Analytical program does not include field measurements.

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Table 3-2
Summary of Sampling, Bottle, and Preservative Requirements
Fischer and Porter Site

Sample Matrix	Laboratory Analysis	Analytical Method	Field Samples, Duplicates, MS/MSD: Samples	Field Duplicate[2]	MS/MSD[3,4]	Bottles for Samples, Duplicate, MS/MSD: Bottles/ Sample	Type of Bottle[5]	Preservatives[6]	Holding Times[7]	Total Bottles	Blanks: Field Blank[8]	Trip Blank[9]	Equipment Blank[10]	Bottles for Blanks: Bottles/ Sample	Type of Bottle[5]	Preservatives[6]	Total Bottles
Ground Water Monitoring Well Sampling																	
Fischer & Porter Extraction Wells (FP1 and FP2, FP7)	TCL VOCs	OLM01	2	1	2	3	40-ml vial	HCl to pH<2, 4°C	14 days	15	1	1	0	3	40-ml vial	HCl to pH<2, 4°C	6
	TCL Semi-VOCs[11]	OLM01	2	1	2	1	2-L amber glass bottle	4°C	7 days; 40 days extraction	5	1	0	0	1	2-L amber glass bottle	4°C	1
	TAL Metals total	ILM01	2	1	1	1	1-L poly bottle	HNO_3 to pH<2, 4°C	6 months; Hg-28 days	4	1	0	0	1	1-L poly bottle	HNO_3 to pH<2, 4°C	1
	Cyanide	ILM01	2	1	1	1	1-L poly bottle	NaOH to pH>12, 4°C	14 days	4	1	0	0	1	1-L poly bottle	NaOH to pH>12, 4°C	1
Fischer & Porter Monitoring Wells (FP5, FP12)	TCL VOCs	OLM01	2	0	0	3	40-ml vial	HCl to pH<2, 4°C	14 days	6	0	1	1	3	40-ml vial	HCl to pH<2, 4°C	6
	TCL Semi-VOCs[11]	OLM01	2	0	0	1	2-L amber glass bottle	4°C	7 days; 40 days extraction	2	0	0	1	1	2-L amber glass bottle	4°C	1
	TAL Metals total	ILM01	2	0	0	1	1-L poly bottle	HNO_3 to pH<2, 4°C	6 months; Hg-28 days	2	0	0	1	1	1-L poly bottle	HNO_3 to pH<2, 4°C	1
	Cyanide	ILM01	2	0	0	1	1-L poly bottle	NaOH to pH>12, 4°C	14 days	2	0	0	1	1	1-L poly bottle	NaOH to pH>12, 4°C	1
Fischer & Porter Monitoring Wells (FP5, FP8)	TCL VOCs	OLM01	2	0	0	3	40-ml vial	HCl to pH<2, 4°C	14 days	6	0	1	1	3	40-ml vial	HCl to pH<2, 4°C	6
	TCL Semi-VOCs[11]	OLM01	0	0	0	1	2-L amber glass bottle	4°C	7 days; 40 days extraction	0	0	0	1	1	2-L amber glass bottle	4°C	1
	TAL Metals total	ILM01	0	0	0	1	1-L poly bottle	HNO_3 to pH<2, 4°C	6 months; Hg-28 days	0	0	0	1	1	1-L poly bottle	HNO_3 to pH<2, 4°C	1
	Cyanide	ILM01	0	0	0	1	1-L poly bottle	NaOH to pH>12, 4°C	14 days	0	0	0	1	1	1-L poly bottle	NaOH to pH>12, 4°C	1
USGS Monit. Wells	TCL VOCs (low concentration)	OLC02.0	14	1	2	3	40-ml vial	HCl to pH<2, 4°C	14 days	51	1	10	10	3	40-ml vial	HCl to pH<2, 4°C	63
New Observation Wells (PH1, PH2, PH3, and PH4)	TCL VOCs[12]	OLM01	4	0	0	3	40-ml vial	HCl to pH<2, 4°C	14 days	12	0	3	3	3	40-ml vial	HCl to pH<2, 4°C	18
	TCL Semi-VOCs[11]	OLM01	4	0	0	1	2-L amber glass bottle	4°C	7 days; 40 days extraction	4	0	0	3	1	2-L amber glass bottle	4°C	3
	TAL Metals total	ILM01	4	0	0	1	1-L poly bottle	HNO_3 to pH<2, 4°C	6 months; Hg-28 days	4	0	0	3	1	1-L poly bottle	HNO_3 to pH<2, 4°C	3
	Cyanide	ILM01	4	0	0	1	1-L poly bottle	NaOH to pH>12, 4°C	14 days	4	0	0	3	1	1-L poly bottle	NaOH to pH>12, 4°C	3
	Oil & Grease[12]	EPA 413.1	4	1	0	1	1-L glass bottle	H_2SO_4 to pH<2, 4°C	28 days	5	1	0	3	1	1-L glass bottle	H_2SO_4 to pH<2, 4°C	4
	TPH-GC[12]	SW846 8015B	4	1	0	1	1-L glass bottle	HCl to pH<2, 4°C	14 days	5	1	0	3	1	1-L glass bottle	HCl to pH<2, 4°C	4
Free Product	Specific Gravity/Viscosity	ASTM D1298	1	0	0	1	8 oz. jar	4°C	14 days	1	0	0	0	1			0
	TCE	OHC01.2	1	1	0	1	40 ml vial	4°C	14 days	2	0	0	0	1	40-ml vial	HCl to pH<2, 4°C	0
Packer-Pumping Test Sampling																	
PH5	TCL VOCs[13]	OLM01	6	1	0	3	40-ml vial	HCl to pH<2, 4°C	14 days	21	0	1	0	3	40-ml vial	HCl to pH<2, 4°C	3
Long-Term Pumping Test Sampling																	
PH5	TCL VOCs	OLM01	3	1	2	3	40-ml vial	HCl to pH<2, 4°C	14 days	18	1	3	3	3	40-ml vial	HCl to pH<2, 4°C	21
	TCL Semi-VOCs[11]	OLM01	2	1	2	1	2-L amber glass bottle	4°C	7 days; 40 days extraction	5	1	0	2	1	2-L amber glass bottle	4°C	3
	Oil & Grease	EPA413.1	4	1	0	1	1-L glass bottle	H_2SO_4 to pH<2, 4°C	28 days	5	1	0	3	1	1-L glass bottle	H_2SO_4 to pH<2, 4°C	4
	TPH-GC	SW846 8015B	4	1	0	1	1-L glass bottle	HCl to pH<2, 4°C	14 days	5	1	0	3	1	1-L glass bottle	HCl to pH<2, 4°C	4
	TSS, TDS, Alkalinity, Hardness	EPA 160.1, 160.2, 310.1, 130.1	1	1	0	1	1-liter poly bottle	4°C	7 days	2	0	0	0	0	1-liter poly bottle	4°C	0
	TOC	EPA 415.1	1	1	0	1	500 ml amber glass	HCl/H_2SO_4 to pH<2, 4°C	28 days	2	0	0	0	0	500 ml amber glass	HCl to pH<2, 4°C	0
	Iron	EPA 200 Series	1	1	0	1	500 ml poly bottle	HNO_3 to pH<2, 4°C	6 months	2	0	0	0	0	500 ml poly bottle	HNO_3 to pH<2, 4°C	0
Treatment System Effluent Sampling																	
Effluent Sample Port	TCL VOCs	OLM01	5	0	0	3	40-ml vial	HCl to pH<2, 4°C	14 days	15	0	5	0	3	40-ml vial	HCl to pH<2, 4°C	15
	Oil & Grease	EPA 413.1	5	0	0	1	1-L glass bottle	H_2SO_4 to pH<2, 4°C	28 days	5	0	0	0	1	1-L glass bottle	H_2SO_4 to pH<2, 4°C	0
	TPH-GC	SW846 8015B	5	0	0	1	1-L glass bottle	HCl to pH<2, 4°C	14 days	5	0	0	0	1	1-L glass bottle	HCl to pH<2, 4°C	0
Waste Sampling																	
Drums of RI-derived waste	TCLP VOCs	SW846 1311	10	0	0	2	40-ml vial	4°C	14 days	20	0	0	0	2	40-ml vial	4°C	0
	TCLP Semi-VOCs[11]	SW846 1311	10	0	0	1	8-oz wide mouth glass jar	4°C	7 days; 40 days extraction	10	0	0	0	1	8-oz wide mouth glass jar	4°C	0
	TCLP Metals	SW846 1311	10	0	0	1	8-oz wide mouth glass jar	4°C	14 days	10	0	0	0	1	8-oz wide mouth glass jar	4°C	0

Notes

[1] OLM01 - U.S. EPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration (OLM01).
ILM01 - U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis, Multi-Media Multi-Concentration, (ILM01)
OHC01.2 - U.S. EPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, High Concentration (OHC01-2).
EPA - EPA Methods for Chemical Analysis of Water and Wastes, March 1983
ASTM - American Society of Testing Materials
SW846 - EPA Test Methods for Evaluating Solid Waste Physical and Chemical Methods, December 1987.
OLC02.2 - U.S. Contract Laboratory Statement of Work for Organics Analysis - Low Concentration Water (OLC02.0) Draft.

[2] One field duplicate will be collected for every 20 or less samples per sampling event.

[3] One MS/MSD will be collected for every 20 or less samples per sampling event for TCL VOCs and TCL semi-VOCs only. One matrix duplicate (MD) will be collected for every 20 or less samples per event for TAL metals and cyanide.

[4] Two additional volumes will be collected for a MS/MSD for the TCL VOCs and TCL semi-VOCs. Only one additional volume will be collected for the MD for TAL metals and cyanide.

[5] All bottles will have Teflon lined caps or septa.

[6] All preservatives will be ultra pure grade.

[7] Holding times are from date of sample collection.

[8] One field blank will be collected per each sampling event.

[9] One trip blank will be collected per day when analysis involves VOCs. One equipment blank will be collected per day per equipment type.

[10] One equipment blank sample will be collected per day per equipment type for analytical parameters indicated in this column.

[11] TCL Semi-VOCs also include base neutral/acid compounds (BNAEs), pesticides, and PCB analyses.

[12] Two week turnaround time.

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Table 3-3
Ground Water Sampling During Hydrogeologic Testing of Well PH5
Fischer and Porter Site

Activity	No. of Samples	Analysis	Analytical Program[4]
Packer-Pumping Tests			
3 zones x 2 samples/zone	6	TCL VOCs; field parameters[1]	DAS-TCL VOCs (2-week turnaround)
Long-Term Pumping Tests			
Prior to start	1	TCL VOCs and TCL BNAEs; O&G; TPH; field parameters[2]	RAS-TCL VOCs and semi-VOCs DAS - O&G and TPH
Prior to end	1	TCL VOCs and TCL BNAEs; O&G; TPH; field parameters[2]; conventional parameters[3]	RAS-TCL VOCs and semi-VOCs DAS-O&G, TPH, and conventional parameters
At end: effluent from oil/water separator	1	O&G; TPH	DAS-O&G and TPH
At end: effluent from air stripper (Lowry unit)	1	TCL VOCs; O&G; TPH	RAS-TCL VOCs DAS-O&G and TPH
Treatment System Effluent			
Effluent[5]	5	TCL VOCs; O&G; TPH	RAS-TCL VOCs DAS-O&G and TPH

Notes:
QA/QC samples are not included.

[1] Field parameters include temperature, pH, and conductivity.
[2] Field parameters during the long-term test will be measured at the beginning of the test, once per hour for the first 3 hours, and then once every 6 hours until the end of the test.
[3] Conventional parameters include Total Suspended Solids (TSS); Total Dissolved Solids (TDS), Alkalinity, Hardness, Total Organic Carbon (TOC), and Iron.
[4] Analytical program does not include field parameters.
[5] First sample to be collected when system is first switched on.

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Section 4
Sample Custody

Appropriate sample custody procedures must be followed to preserve sample integrity and to ensure the validity of field and laboratory data. As a result, all sample data must be traceable from the time and location of sample collection through chemical analyses and ultimately to the time when the data are used to determine compliance with regulatory standards.

The SM is responsible for maintaining original field records that document sampling activities. These records will include daily logs, field instrument logs, sampling logs, signed and dated chain-of-custody documentation, bound field logbooks, field data validation notes, and any other information specific to field activities not mentioned.

The CLP or CRL laboratory assigned to this project will analyze the samples collected as part of this project and will be responsible for maintaining custody records within the laboratory. These records will include the following: procedures for sample analysis, handling, storage; dispersement for analysis and sample disposal; instrument logs, laboratory correspondence files, laboratory data, laboratory data validation notes, and any other information specific to laboratory activities not mentioned.

Chain-of-Custody Procedures

Sample possession must be traceable throughout the collection, preparation, shipping, and analysis. Chain-of-custody procedures maintain and document sample possession during collection and analysis. The principle documents used to identify and to document sample possession are:

- Chain-of custody records
- Sample identification tags
- Sample labels
- Air Bills (e.g., Federal Express)
- Field notebooks (site logbooks)
- Shipping logs

The field sampling personnel who perform the sample collection and preparation assumes responsibility for the care and custody of the samples until they are transferred or dispatched properly. A chain-of-custody record will accompany each sample shipment from the field to the laboratory at all times. The chain of custody procedures and sample management and documentation requirements of EPA Region III are outlined in SOP No. 11.

After collecting the samples, the field sampling personnel will complete a chain-of-custody records. The following information will be specified for each sample on the chain-of custody records:

- Laboratory name and address and contact person

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- Sample location (i.e., well number)
- Date and time of sample collection
- Sample type (grab or composite)
- Sample matrix
- Number of sample containers
- Analysis requested
- Air bill number (if applicable)
- Preservative
- Name of person receiving the data

When transferring samples, the individuals relinquishing and receiving the samples will sign, date and note the time on the form. This form documents sample custody transfer from the sampler, often through another person, to the analyst in the off-site laboratory.

Sample Packaging and Shipping Procedures

Samples will be placed in appropriate bottles and sample containers as listed in Table 3-2. CH2M HILL will be responsible for obtaining bottles for samples going to CLP laboratories or CRL. Sample packaging and shipment will be accordance with procedures outlined in SOP No. 11. Sample numbers for tracking through the CLP will be provided by the sample management office (SMO) and will be assigned in the field.

All samples will be shipped via Federal Express Priority 1 Overnight Service each day they are collected. Sample shipping will be reported to the SMO or CRL daily depending upon whether CLP or CRL are doing the analysis. Sample shipping information may be provided to SMO or CRL by fax and confirmed through daily telephone conversations. Sample shipping protocols are also described in detail in SOP No. 11.

The free product sample for TCE analysis will be shipped separately from other samples and blanks to prevent cross contamination. SOP No. 11 describes the procedures for shipping high concentration samples.

Sample Labels

A sample label will be affixed to each sample container, and it will include the following information:

- Sample identification number (a unique number assigned to every sample);
- Project code (F&P);
- Station number (well designation);
- Date sample was collected (month, day and year);
- Time sample was collected (in military time);
- Sample collector's initials;

- Analysis to be performed;
- Preservative added; and
- Any important remarks to the laboratory.

For further information on sample labels see SOP No. 11.

Site Logbooks

Site logbooks will be used by field personnel to record all aspects of sample collection and handling, visual observations, and field measurements. Entries will be written in sufficient detail so that a history of the field activities can be reconstructed with minimal reliance on memory.

Site logbooks will be bound field-survey books. Logbooks will be assigned to field personnel and will be stored in a secure location when not in use. After completion of the field activities, the site logbooks will be in the custody of the project manager. Each logbook will be identified by the project-specific document number, and each page will be numbered. SOP No. 12 describes the procedures for making entries into site logbooks and the type of information that should be recorded.

Photographs

Photographs of sampling locations, sampling procedures, drilling operations, and any significant findings will be taken during the remedial investigation. Each photograph will be logged in a site logbook according to procedures described in SOP No. 13.

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Section 5

Equipment Calibration

Various instruments will be used in the field and in the laboratory to collect data and monitor site conditions. Proper calibration, maintenance, and use of these instruments is important for collecting quality data. A record of calibration and maintenance activities is as important as the data record itself.

Field Equipment Calibration

The following field equipment to be used during the field activities requires calibration:

- pH meter
- Conductivity meter
- Dissolved oxygen meter
- Turbidity meter
- HNu
- OVA
- Combustible gas indicator (CGI) meter

The field equipment will be calibrated before and during each day's use according to procedures and schedules outlined the HSP and the SOPs provided in Attachment A of this document. The standards which will be used to calibrate these instruments are shown in Table 5-1. Standards will be purchased as necessary from appropriate vendors. Information about each standard including the dates, manufacturer, lot number, and description will be entered into the field notebook. This information will be used to trace standards. The calibration results will be recorded in the field log books.

If an individual suspects an equipment malfunction, the device shall be removed from service, tagged so that it is not inadvertently used, and the ARCS equipment manager notified so that a substitute piece of equipment can be used.

Equipment that fails calibration or becomes inoperable during use, shall be removed from service and tagged so that it is not inadvertently used. Such equipment shall be repaired and satisfactorily recalibrated. Equipment that cannot be repaired will be replaced.

Results of activities performed using equipment that has failed recalibration shall be evaluated. If the results are adversely affected, the outcome of the evaluation will be documented and the SM notified.

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Table 5-1
Calibration Standards
Fischer and Porter Site

Instrument	Calibration Standard	Span	Reading	Method
HNu, 10.2 ev probe	100 ppm isobutylene	9.8 ± 2.0	55 ppm	1.5 l/m reg: T-tubing
HNu, 11.7 ev probe	100 ppm isobutylene	5.0 ± 2.0	68 ppm	1.5 l/m reg: T-tubing
OVA	100ppm methane	3.0 ± 1.5	100 ppm	1.5 l/m reg: T-tubing
pH meter	pH 4 and 7 Buffers	N/A	N/A	N/A
Conductivity meter	EC 225 and 1,000 ms/cm	N/A	N/A	N/A
CGI	0.75% pentane	N/A	50% LEL ±5% of LEL	1.5 l/m reg: direct tubing

Laboratory Calibration

The CLP laboratory is responsible for equipment and instrument calibration and maintenance. Manufacturer's guidance should be followed for general upkeep. The laboratory is also required to comply with calibration criteria specified in the CLP User's Guide and instructions provided with DAS requests.

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Attachment A
Standard Operating Procedures

AR300800

Attachment A

Standard Operating Procedures

SOP

1	Electronic Water Level Measurements
2	Ground Water and Treatment System Sampling
3	VOC Sampling
4	Field Measurement of Specific Conductivity and Temperature
5	Field Measurement of pH
6	Field Rinse Blank Preparation
7	Preserving Non-VOC Aqueous Samples
8	Decontamination
9	Field Measurements of Organic Vapors Using an HNu or OVM
10	Oil/Water Interface Level Measurements
11	Sample Documentation, Packaging and Shipping Instructions
12	Site Logbook
13	Photographic Documentation
14	Combustible Gas Indicator
15	Soil Boring Log Guidelines

AR300801

SOP No. 1 Electronic Water Level Measurements

AR300802

SOP NO. 1: WATER LEVEL MEASUREMENTS

I. PURPOSE

General reference information for measuring depth to water in monitoring wells.

II. SCOPE

Standard water level measuring techniques using the appropriate measuring equipment are summarized. Two rounds of water level measurements will be collected:

- One at the time of installation of data loggers for the one-week water level monitoring, and
- One at the beginning of the ground water sampling event

Water level measurements will also be collected before collecting ground water samples from each of the wells.

III. EQUIPMENT AND MATERIALS

- Electronic water level indicator
- Deionized water for cleaning water level indicator
- Straight edge ruler
- Paper towels
- Keys
- Manhole opener (if applicable)
- Personal protection - latex or surgical gloves, etc. (REFER TO SITE HEALTH AND SAFETY PLAN)

IV. PROCEDURES AND GUIDELINES

1. Open well and scan well with FID/PID as per site specific health and safety plan and/or amendments. If warranted, upgrade personal protective equipment (PPE).
2. Lower a pre-cleaned water level indicator probe into the monitoring well.

3. When "tone" sounds and/or the light comes on, probe has contacted the ground water. Pull probe up slightly until tone/light turns off. This will be your indication that you are at the top of the water table.

4. Read the depth to water from the datum point at the top of the inner casing to 0.01 foot. This will be established during the well survey. Because the hydraulic gradient across the site is low, several additional water level measurements are necessary. Repeat 2-to-3 times to confirm a consistent reading.

5. Place a straight edge ruler across the top of the outer casing, perpendicular to the predetermined datum point, and repeat step 4 using the center of the straight edge ruler as your datum point.

6. Check the difference between measurements against the difference of the surveyed elevation.

7. If difference between the two is greater than 0.03 feet, water levels will be taken again. If difference is still greater than 0.03 feet surveyed elevations will be checked.

8. Rinse the water level probe with deionized water.

V. ATTACHMENTS

None.

VI. KEY CHECKS AND ITEMS

- Electronic water level indicator is in good operating condition. Check batteries.
- Decontaminate electronic water level indicator between wells.
- Straight edge ruler must lay flat on top of casing.

AR300804

SOP No. 2 Ground Water and Treatment System Sampling

AR300805

SOP NO. 2: GROUNDWATER AND TREATMENT SYSTEM SAMPLING

I. PURPOSE

General reference information for all groundwater sampling activities during the remedial investigation is provided.

II. SCOPE

Standard groundwater sampling techniques using the appropriate sampling equipment are summarized. Site-specific details are discussed in related sections of the RISOP addendum.

III. EQUIPMENT AND MATERIALS

- Water level indicator
- Oil/water interface level indicator
- Deionized water
- 2.5% (W/W) trisodium phosphate ("TSP") and water solution
- Calibrated bucket to measure volume of water purged
- Plastic sheeting to lay on ground around the well
- Bottles and preservatives (if required)
- Personal protection equipment - latex or surgical gloves, etc. (REFER TO HSP)
- pH, specific conductance, temperature meters with calibration solutions
- Peristaltic or jet pump
- Submersible pump
- Silicon and polyethylene tubing
- Stainless steel bailers with Teflon-coated leaders

IV. PROCEDURES AND GUIDELINES

A. MONITORING WELL SAMPLING

These procedures are to be followed for all monitoring wells except wells FP1, 2, and 7.

1. Check the condition of the well and look for damage or evidence of tampering and record. Set up a table in the log book for sampling parameters, discharge, and water levels. Check summary sheet showing well construction, previous sampling information, and purging data.

2. Remove the well cap and measure the well headspace using an HNu or OVM organic vapor analyzer (see SOP No. 9). Record the measurement.

3. **For wells PH1, 2, 3, 4, and F5,** using an oil/water interface level indicator (SOP No. 10), determine if there is free product in the well. **For all other wells, proced to step 6.**

4. If free product is present, measure the depth to free product and the depth to ground water surface with the oil/water interface level indicator. Also, measure the depth to the bottom of the well. Decontaminate probes with detergent and deionized water rinse when done.

   A free product sample will be collected from one of the wells containing free product. This sample will be collected using a decontaminated bailer, following the appropriate sections of step 9 of this SOP. Free product samples will be collected in the following order: TCE, viscosity, and specific gravity.

   Do not sample ground water in wells where free product is present.

5. If free product is not present, collect ground water samples by following steps 6 through 11 of this SOP.

6. Measure the depth to water surface and the depth to the bottom of the well with a water level indicator following SOP No. 1. Decontaminate the probe with detergent and deionized water rinse when done.

7. Calculate the volume of water in the well with the following equation:

$$V = 3.14 \times (D^2/4) \times H \times 7.48$$

Where:

V = total volume of water to be purged (gallons)
D = inside diameter of the well (ft)

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H = height of water column in the well (ft)
(depth to bottom of well minus depth to water)

8. Lay out plastic sheeting in areas where equipment must be set on the ground.

9. Purge three to five well volumes to remove stagnant water. Collect ground water in plastic tank and bring to on-site treatment system for treatment.

Depending on the depth to water and the amount of water in the well, the well will be purged by using either a low flow submersible pump or a peristaltic pump. Wells will be purged using a low pumping rate (0.5-1l) that minimizes sediment disturbances.

If there is less than 1 foot of water in the well, and the depth to water is less than 25 feet; the well will be purged using a peristaltic or jet pump.

TAL metals, TPH, and oil & grease samples will be collected through the pump; in that order. The pump tubing will then be removed from the well, and TCL VOCs and TCL semi-VOCs samples will be collected using a decontaminated stainless steel bailer with a 10-foot Teflon coated leader (see step 10). This sampling procedure will result in reducing the amount of sediments in the metals samples. By using a bailer, we will minimize the costs of teflon tubing as the majority of the wells are greater than 200 feet in depth.

If there is greater than 1 foot of water in the well, a submersible pump will be used to purge the well and to collect TAL metals, TPH, and oil & grease samples in the same manner as described above. A decontaminated stainless steel bailer will be used to collect TCL VOCs and TCL semi-VOCs samples (see step 10).

If there is less than 1 foot of water in the well and the well depth is greater than 25 feet, a peristaltic, jet, or submersible pump can not be used. In this case the well will be purged and all samples collected using a decontaminated stainless steel bailer (see step 10).

All tubing will be dedicated. The submersible pumps will be decontaminated in the field, both externally and internally, by rinsing with soapy water and deionized water prior to use. Purge water as near to the water surface as possible to assure that no stagnant water remains in the well above the well screen. Purge water should be placed in a calibrated bucket so total volume removed can be measured. While purging, temperature, specific conductance, and pH should be measured at least once per well volume. Instrument probes will be rinsed with deionized water before and in between uses. Temperature, pH, and specific conductance readings must be stabilized to within 10% variance over two successive well volumes (refer to SOP Nos. 4 and 5). These

measurements will provide evidence of stability. If stability is indicated at three well volumes, sampling can begin. If not, continue to purge until stable conditions are achieved or five well volumes have been removed. If well is purged dry, wait 15 minutes, allowing well to recover. Collect sample as soon as there is sufficient water required for intended analysis. Sampling must be performed within 3 hours of completion of purging. After sample collection, temperature, pH, and specific conductance should be measured again.

10. SAMPLING BY BAILER: Clean latex or surgical gloves must be worn at all times when sampling by bailer. (Note: Gloves used for sampling will be dedicated and phthalate-free.) Place a large, clean plastic sheet on the ground around the well. Attach sufficient decontaminated Teflon-coated line (10 feet or more) to the bailer to reach to the desired depth, and secure the end to something (well cap, sampler's wrist, etc.) that will prevent the line from being lost down the well. Slowly lower the bailer into the well. Do not let the bailer ``free fall" and do not allow the bailer to touch the bottom. Retrieve the bailer smoothly and do not let the line rub against the side of the casing or touch the ground. Slowly pour the sample into the appropriate container. The proper order of sample collection for the bailer is indicator parameters (pH, temperature, specific conductance), TCL VOCs, TCL semi-VOCs, TAL metals, cyanide, TPH, and oil & grease. When done, remove Teflon-coated line, dispose of any rope, and thoroughly decontaminate bailer before reusing. A decontaminated bailer must be used to sample all wells.

11. SAMPLING BY PUMP: When using a peristaltic pump, position the tubing in the well so the water removed is from the same portion of the well, preferably within or just above the screened area. Set the discharge of the pump to 0.5 to 1 l/min. Direct the sample into the container in the same manner as with the bailer. The pump and all associated equipment that contacts the water or inside portion of the well must be thoroughly decontaminated before reusing.

When using a submersible pump lower the pump into the well preferable within or just above the screened area. Set the discharge of the pump 0.5 to 1 l/min. Direct the sample into the container in the same manner as with the bailer.

The proper order of sample collection for the peristaltic and submersible pumps is as follows: indicator parameters (pH, temperature, specific conductance), TAL metals, cyanide, TPH, and oil & grease. TCL VOCs, and TCL semi-VOCs will not be collected through a pump.

For sampling VOCs, see SOP No. 3.

B. EXISTING EXTRACTION WELL SAMPLING (Wells FP1, 2, and 7)

Water from wells FP1, FP2, and FP7 is pumped and treated through an existing air stripper and an oil/water separator. Samples will be collected from the sampling ports for the wells before the treatment system. One port is provided for the combined flow from FP1 and 2; a second port is provided for FP7.

1. The port should be allowed to run open continuously for at least 1 minute (if possible) before the sample is collected. Collect purged water and bring to on-site treatment system for treatment.

2. Samples will be collected from the sample port that is located upstream of the water treatment.

3. Take measurements for pH, conductivity, and temperature (in accordance with SOP Nos. 4 and 5).

5. Sample containers should be filled directly from the sample port. The proper order for sample collection is indicator parameters (pH, temperature, conductivity), TCL VOCs, TCL semi-VOCs, TAL metals, and cyanide.

   For VOC sampling, see SOP No. 3.

C. TREATMENT SYSTEM EFFLUENT

These procedures apply to sampling the effluent from the treatment system (Lowry unit and oil/water separator) installed at the site during the RI to treat groundwater generated from RI activities. Samples to be collected from the effluent of the treatment system at the end of the pump test are described under the pump test section below.

1. Samples will be collected from a sample port that is located downstream of the water treatment system. One sample will be collected when the treatment system is first switched on. Four samples will be collected at different times during the RI when the treatment system is operational.

2. Sample containers should be filled directly from the sample port. The proper order for sample collection is TCL VOCs, TPH, and oil & grease.

   For VOC sampling, see separate SOP No. 3.

D. PACKER TEST SAMPLING (Well PH5)

Two samples will be obtained from each zone (3 zones) isolated by packers during the packer-pumping test on test well PH5.

1. After the packer pumping has continued for approximately one hour in a zone, collect a sample for field parameters (pH, temperature, specific conductance) and a TCL VOCs sample through the pump. Direct the sample into the container in the same manner as discussed above.

2. Just before completion of the test for a zone, collect a second field parameter and TCL VOCs sample through the pump. Direct the sample into the container in the same manner as discussed above.

3. For sampling VOCs, see SOP No. 3.

   Because ground water samples collected during the packer test will be used only to determine the zone where the well will be screened, no QA/QC samples will be collected.

E. PUMP TEST SAMPLING (Well PH5)

Samples will be collected during the pump test from the test well PH5 and from the treatment system.

Pump Test Well Initial Sample

1. Prior to the start of the pump test, collect an initial ground water sample following steps 2-6 below.

2. Using an interface water level indicator (SOP No. 10), determine if there is free product in the well. If there is free product, determine its thickness. If no product is present, measure the depth to water surface and the depth to the bottom of the well with a water level indicator (SOP NO. 1). Decontaminate with detergent and deionized water rinse when done.

3. Calculate the volume of water in the well with the following equation:

$$V = 3.14 \times (D^2/4) \times H \times 7.48$$

   Where:
   V = total volume of water to be purged (gallons)
   D = inside diameter of the well (ft)
   H = height of water column in the well (ft)
   (depth to bottom of well minus depth to water)

4. Lay out plastic sheeting in areas where equipment must be set on the ground.

5. Lower a decontaminated submersible pump below the free product, if present.

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6. Purge three to five well volumes to remove stagnant water. The well will be purged with a submersible pump using a low pumping rate (0.5 to 1 l/min) that minimizes sediment disturbances (and will not draw down free product into the pump, if free product is present).

   All tubing will be Teflon-coated and dedicated, since ground water samples for all parameters including TCL VOCs and semi-VOCs will be collected through the pump. Do not use a bailer or peristaltic pump to collect samples, since they can get contaminated as they are lowered through the free product to the ground water. Purge water should be placed in a calibrated bucket so total volume removed can be measured. While purging, temperature, specific conductance, and pH should be measured (SOP Nos. 4 and 5) at least once per well volume. Instrument probes will be rinsed with deionized water before and in between uses. Temperature, pH, and specific conductance readings must be stabilized to within 10% variance over two successive well volumes. These measurements will provide evidence of stability. If stability is indicated at three well volumes, sampling can begin. If not, continue to purge until stable conditions are achieved or five well volumes have been removed. If well is purged dry, wait 15 minutes, allowing well to recover. Collect sample as soon as there is sufficient water required for intended analysis. Sampling must be performed within 3 hours of completion of purging. The proper order of sample collection is TCL VOCs, TCL semi-VOCs, TPH, and oil & grease. For sampling VOCs, see SOP No. 3.

Pump Test Second Sample

1. Prior to the end of the pump test, collect a sample through the pump test pump.

2. The proper order of sample collection for the submersible pump is TCL VOCs, TCL semi-VOCs, TPH, oil & grease, and conventional parameters. For sampling VOCs, see SOP No. 3.

Sampling of Treatment System

1. At the end of the pump test, samples will be collected from sample ports after the oil/water separator (one sample) and after the Lowry unit (one sample).

2. Open sample ports and allow to run about 1 minute. Fill sample containers directly from the sample port. The proper order for sample collection is TCL VOCs, TPH, and oil & grease.

   For VOC sampling, see SOP No. 3.

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VII. ATTACHMENTS

None.

VI. KEY CHECKS AND ITEMS

- Cover ground.
- Wear latex or surgical gloves.
- Secure bailer line end.
- For VOC sampling: do not sample with pumps unless specified (e.g., pump and packer tests); check for bubbles.
- Remove sample tap aerator
- Collect samples upstream of any water treatment units unless specified otherwise

AR300813

SOP No. 3 VOC Sampling

AR300814

SOP NO. 3: VOC SAMPLING

I. PURPOSE

To provide general guidelines for sampling for volatile organic compounds.

II. SCOPE

Standard techniques for collecting representative samples are summarized. Site specific details are discussed in the RISOP addendum.

III. EQUIPMENT AND MATERIALS

- Sample vials with Teflon septum caps, clean latex or surgical gloves, pH meter
- Hydrochloric acid (HCl) for preservation (ultra-pure grade)
- pH indicating paper
- Nitrile or latex gloves

IV. PROCEDURES AND GUIDELINES

1. Sample VOCs before sampling other analyte groups.
2. When sampling for VOCs, evaluate the area around the sampling point for possible sources of air contamination by VOCs. Products that may give off VOCs and possibly contaminate a sample include perfumes and cosmetics, skin applied pharmaceuticals, automotive products (gasoline, starting fluid, windshield de-icers, carburetor cleaners, etc.) and household paint products (paint strippers, thinners, turpentine, etc.).
3. To check the amount of hydrochloric acid (HCl) that needs to be added at each location, fill a test vial (40 ml) with the water to be sampled, add one drop of hydrochloric acid (HCl), gently mix, and check the pH. Repeat this cycle (if necessary) until you reach a pH of 2, counting the number of drops of HCl required. HCl used must be ultra-pure grade. DISCARD THE TEST VIAL and add an equal number of drops of HCl to each of the sample vials. Proceed to sample.
4. Keep the caps off the sample vials for as short a time as possible.
5. Wear clean latex or surgical gloves.

6. Fill the sample vial immediately, allowing the water stream to strike the inner wall of the vial to minimize formation of air bubbles. DO NOT RINSE THE SAMPLE VIALS BEFORE FILLING.

7. Fill the sample vial with a minimum of turbulence, until the water forms a positive meniscus at the brim.

8. Replace the cap by gently setting it on the water meniscus. Tighten firmly, but DO NOT OVERTIGHTEN.

9. Invert the vial and tap it lightly. If you see air bubbles in the sample, do not add more sample. Use another vial to collect another sample. Repeat if necessary.

10. If bubbles continue to appear, carbonates may be present in the sample. Fill a new vial without preservative, note the lack of preservative on the Chain-of-Custody form and report the changed protocol to the Site Manager. Place the samples in a cooler with sufficient bagged ice to cool the samples to 4°C, immediately upon collection.

V. ATTACHMENTS

None.

VI. KEY CHECKS AND ITEMS

- Check for possible sources of contamination.
- Check pH.
- Fill slowly, with as little turbulence as possible.
- Check for air bubbles.

SOP No. 4 Field Measurement of Specific Conductivity and Temperature

AR300817

SOP NO. 4: FIELD MEASUREMENT OF SPECIFIC CONDUCTIVITY AND TEMPERATURE

I. PURPOSE

To provide a general guideline for field measurement of specific conductivity and temperature.

II. SCOPE

Standard field conductivity and temperature techniques for use on ground water samples.

III. EQUIPMENT AND MATERIALS

- Conductivity meter and electrode
- Deionized water in squirt bottle
- Standard potassium chloride (KCl) solution (0.01 N and of differrent orders of conductance)

IV. PROCEDURES AND GUIDELINES

TECHNICAL: Detection limit = 1 umho/cm @ 25°C; range = 0.1 to 100,000 umho/cm

CALIBRATION

Calibrate prior to initial daily use. Calibrate with standard solution. The standards should have different orders of conductance. Clean probe according to manufacturer's recommendations.

1. With mode switch in OFF position, check meter zero. If not zeroed, set with zero adjust.

2. Plug probe into jack on side of meter.

3. Turn mode switch to red line and turn red line knob until needle aligns with red line on dial. If they cannot be aligned, change the batteries.

4. Immerse probe in 0.01 N standard KCl solution. Do not allow the probe to touch the sample container.

5. Set the mode control to TEMPERATURE. Record the temperature on the bottom scale of the meter in degrees C.

AR300818

6. Turn the mode switch to appropriate conductivity scale (i.e., x100, x10, or x1). Use a scale that will give a midrange output on the meter.

7. Wait for the needle to stabilize. Multiply reading by scale setting and record the conductivity. The conductivity must then be corrected for temperature.

8. Calculate conductivity using the formula:

$$G_{25} = G_T / [1 + 0.02 (T - 25)]$$

Where:

G_{25} = conductivity at 25°C, umho/cm
T = temperature of sample, degrees C
G_T = conductivity of sample at temperature T, umho/cm

The table below lists the values of conductivity the calibration solution would have if the distilled water were totally nonconductive, however, even water of very high purity will still possess a small amount of conductivity.

Temperature °C	Conductivity (umho/cm)
15	1,141.5
16	1,167.5
17	1,193.6
18	1,219.9
19	1,246.4
20	1,273.0
21	1,299.7
22	1,326.6
23	1,353.6
24	1,380.8
25	1,408.1
26	1,436.5
27	1,463.2
28	1,490.9
29	1,518.7
30	1,546.7

9. Rinse the probe with deionized water.

10. Run sample and rinse with deionized water when done.

AR300819

V. KEY CHECKS AND ITEMS

- Check battery.
- Calibrate.
- Clean probe with deionized water when done.
- When reading results, note sensitivity settings.

VI. PREVENTIVE MAINTENANCE

- Refer to operations manual for recommended maintenance.
- Check batteries, and have a replacement set on hand.

AR300820

CONDUCTIVITY METER CALIBRATION SHEET

Date	Time	Analyst Initials	Instrument Readings: Uncalibrated @EC=225	Instrument Readings: Calibrated @EC=225	Comments

SOP No. 5 Field Measurement of pH

AR300822

SOP NO. 5: FIELD MEASUREMENT OF pH

I. PURPOSE

To provide a general guideline for field measurement of pH.

II. SCOPE

Standard field pH determination techniques for use on ground water samples.

III. EQUIPMENT AND MATERIALS

- pH buffer solution for pH 4, 7, and 10
- Deionized water in squirt bottle
- pH meter
- Combination electrodes
- Beakers
- Glassware that has been washed with soap and water and rinsed twice with deionized water

IV. PROCEDURES AND GUIDELINES

A. CALIBRATION

Calibrate unit prior to initial daily use. Calibrate with at least two solutions. Clean probe according to manufacturer's recommendations.

1. Place electrode in pH 7 buffer solution.

2. Allow meter to stabilize and then turn calibration dial until a reading of 7.0 is obtained.

3. Rinse electrode with deionized water and place it in a pH 4 or pH 10 buffer solution.

4. Allow meter to stabilize again and then turn slope adjustment dial until a reading of 4.0 is obtained for the pH 4 buffer solution or 10.0 for the pH 10 buffer solution.

5. Rinse electrode with deionized water and place in pH 7 buffer. If meter reading is not 7.0, repeat sequence.

AR300823

B. PROCEDURE

1. Before going out into the field:

   a) Check batteries.

   b) Do a quick calibration at pH 7 and 4 to check electrode.

   c) Obtain fresh solutions.

2. Calibrate meter using calibration procedure.

3. Pour the sample into a clean beaker.

4. Rinse electrode with deionized water between samples.

5. Immerse electrode in solution. Make sure the white KCl junction on the side of the electrode is in the solution. The level of electrode solution should be one inch above sample to be measured. Rinse electrode with deionized water after every measurement.

6. Recheck calibration with pH 7 buffer solution after every five samples.

C. GENERAL

1. When calibrating the meter, use pH buffers 4 and 7 for samples with pH <8, and buffers 7 and 10 for samples with pH >8. If meter will not read pH 4 or 10, something may be wrong with the electrode.

2. Measurement of pH is temperature dependent. Therefore, buffer temperatures should be within approximately 2 degrees C of sample temperatures. For refrigerated or cool samples, use refrigerated buffers to calibrate the pH meter.

3. Weak organic and inorganic salts and oil and grease interfere with pH measurements. If oil and grease are visible, note it on the data sheet. Clean electrode with soap and water and rinse with distilled water. Then recalibrate meter.

AR300824

4. Following field measurements:

   a) Report any problems.
   b) Compare with previous data.
   c) Clean all dirt off meter and inside case.
   d) Store electrode in pH 4 buffer.

5. Accuracy and precision are dependent on the instrument used; refer to manufacturer's manual. Expected accuracy and precision are +/- 0.1 pH unit.

V. KEY CHECKS AND ITEMS

- Check batteries
- Calibrate

VI. PREVENTIVE MAINTENANCE

- Refer to operation manual for recommended maintenance.
- Check batteries, have a replacement set on hand.

AR300825

pH METER CALIBRATION SHEET

			Instrument Readings				
			Uncalibrated		Calibrated		
		Analyst	(Two Required)		(Two Required)		
Date	Time	Initial	@ pH4	@pH7	@pH4	@pH7	Comments

NJR139/041R139.WP5/4

SOP No. 6 Field Rinse Blank Preparation

AR300827

SOP NO. 6: FIELD RINSE BLANK PREPARATION

I. PURPOSE

To prepare a blank to determine adequacy of decon procedures and whether any cross-contamination is occurring during sampling.

II. SCOPE

The general protocols for preparing the rinse blank is outlined. The actual equipment to be rinsed will depend on the requirements of the specific sampling procedure.

III. EQUIPMENT AND MATERIALS

- HPLC grade water
- Sample bottles as defined in sampling plan
- Phthalate-free gloves

IV. PROCEDURES AND GUIDELINES

A. Decontaminate all sampling equipment that has come in contact with sample prior to and after sample collection. Field blanks will be collected at a rate of one per decontamination event per matrix for each piece of sampling equipment, not to exceed one per day per matrix.

B. Field blanks shall be prepared in the following order: VOCs, semi-VOCs, metals, TPH, and oil & grease. For volatiles, follow SOP No. 3. To collect the sample, pour HPLC grade water over one piece of equipment and into three 40-ml vials until there is a positive meniscus and seal vials. Note the sample number and associated piece of equipment in the field notebook.

Do not let the HPLC grade water come in contact with any equipment that has not been previously decontaminated.

Field rinse blanks shall also be prepared in a manner which will minimize potential contamination through the air.

C. Preserve rinse samples as defined in the SOP Nos. 3 and 7.

D. Document and ship samples in accordance with SOP No. 11. Ship blanks and the regular samples from the same sample location together.

E. Collect next sample.

V. ATTACHMENTS

None.

VI. KEY CHECKS AND ITEMS

- Wear phthalate-free gloves.
- Do not use any non-decontaminated equipment to prepare blank.

AR300829

SOP No. 7 Preserving Non-VOC Aqueous Samples

AR300830

SOP NO. 7: PRESERVING NON-VOC AQUEOUS SAMPLES

I. PURPOSE

To provide general guidelines for preserving aqueous samples.

II. SCOPE

Standard aqueous sample preservation procedures for non-VOC samples are provided. Site specific details are discussed in related sections of the RISOP addendum.

III. EQUIPMENT AND MATERIALS

- Disposable eye droppers
- Clean beakers for transfer of small portions of chemical preservative
- pH paper strips (Range 0 to 14)
- Chemical preservatives (ultra-pure grade)
- Personal protection (REFER TO HSP)

IV. PROCEDURES AND GUIDELINES

1. Remove caps from sample containers to be chemically preserved. Add appropriate amount of chemical preservative to opened container. See Table 3-2 of the RISOP addendum for preservatives to be used.
2. After adding the appropriate preservatives to the sample containers, cap containers tightly. Invert sample container a few times to mix.
3. After preserving all the sample containers and mixing, open the container and check the pH of the sample by pouring out a small quantity of the sample to a clean receptacle and dipping a pH indicating strip into the sample. Dispose of the portion of sample used to check the pH, do not return it to sample container. Add more preservative to the sample to adjust the pH, if necessary repeating steps 1 and 2.
4. Wrap, package, and ice samples according to the CLP User's Guide.

V. ATTACHMENTS

None.

VI. KEY CHECKS AND ITEMS

- Add appropriate preservatives to sample containers and mix well.
- Check pH with pH indicating strip.
- Put samples on ice.

AR300832

SOP No. 8 Decontamination

SOP NO. 8: DECONTAMINATION

I. PURPOSE

To provide general guidelines for the decontamination of personnel, sampling equipment, and monitoring equipment used in potentially contaminated environments.

II. SCOPE

This is a general description of decontamination procedures. For site-specific deviations, see the RISOP addendum and HSP.

III. EQUIPMENT AND MATERIALS

- HPLC grade water
- Deionized water
- Potable water (must be from a treated municipal water supplier, otherwise TCL/TAL analysis must be run)
- 2.5% (W/W) trisodium phosphate ("TSP") and water solution
- Concentrated (V/V) ultra-pure grade methanol and hexane (DO NOT USE ACETONE)
- 10% (V/V) nitric acid (HNO_3) and water solution (only ultra-pure grade HNO_3 is to be used)
- Large plastic pails or tubs for detergent and water, scrub brushes, squirt bottles for detergent, solvents and water, plastic bags and sheets
- DOT approved 55-gallon drum for disposal of waste
- Phthalate-free gloves
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

IV. PROCEDURES AND GUIDELINES

A. PERSONNEL DECONTAMINATION: To be performed after completion of tasks whenever potential for contamination exists, and upon leaving the exclusion zone.

AR300834

1. Wash boots in low phosphate detergent then rinse with water. If disposable latex booties are worn over boots in the work area, rinse with low phosphate solution, remove, and discard into DOT approved 55-gallon drum.

2. Wash outer gloves in low phosphate solution, rinse, remove, and discard into DOT approved 55-gallon drum.

3. Remove disposable coveralls (``Tyveks") and discard into approved 55-gallon drum.

4. Remove respirator (if worn).

5. Remove inner gloves and discard.

6. Sanitize respirator if worn.

7. At the end of the work day, shower entire body, including hair, either at the work site or at home.

B. SAMPLING EQUIPMENT DECONTAMINATION

1. Don phthalate-free gloves.

2. Wash all equipment surface that contacted the potentially contaminated soil/water with TSP solution.

3. Rinse with potable water.

4. Rinse with 10% HNO_3 solution when sampling for inorganics (carbon split spoons will be rinsed with a 1% solution and rinse).

5. Rinse with distilled or potable water

6. Rinse with methanol followed by a hexane rinse, when sampling for organics.

7. Air dry.

8. Rinse with HPLC grade water. Use at least five times the volume of solvent used.

9. Completely air dry and wrap exposed areas with aluminum foil for transport and handling if equipment will not be used immediately.

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10. Collect solvent rinsates separate from acid and detergent rinsates. Dispose of rinsates in a DOT approved 55-gallon drum.

Note: Instrument probes will be rinsed with deionized water prior to and between uses. For submersible pump decontamination follow steps 1 through 3 above and rinse with deionized water.

C. ONSITE EQUIPMENT: A temporary decontamination pad will be used for decontamination of heavy equipment (drilling, augers, back hoe). The following procedures must be followed by the subcontractor providing the heavy equipment.

1. Remove all soil and any other debris from augers, drill rods, and back hoe bucket using high pressured stream rinse. This should be done prior to use and between each hole.

2. Steam clean vehicles (i.e., the undercarriage, wheel wells, lugs or tracks) containing onsite contamination prior to leaving the site.

3. Collect all liquids and solids generated from decontamination process in the decontamination pad.

In addition, well casings must be steam cleaned prior to installation to ensure that any residual oils, greases, and waxes have been removed.

D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

1. Wipe all surfaces (i.e., sampling tubes, PID & CGI meters) that had possible contact with contaminated materials during handling, with a paper towel wet with a TSP solution, then a towel wet with deionized water. Dispose of all used paper towels in a DOT approved 55-gallon drum.

E. SAMPLE CONTAINER DECONTAMINATION: Sample bottles or containers filled in the field must be decontaminated before being packed for shipment or handled by personnel without hand protection.

1. Wipe container with a paper towel dampened with a TSP detergent solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.

2. Dispose of all used paper towels in a DOT approved 55-gallon drum.

AR300836

V. ATTACHMENTS

None.

VI. KEY CHECKS AND ITEMS

- Clean with appropriate type of surfactant, acids, solvents, and rinsewaters.
- Do not use acetone for decontamination.
- Drum all contaminated rinsate and materials.
- Decontaminate filled sample bottles before relinquishing them to anyone.

AR300837

SOP No. 9 Field Measurements of Organic Vapors Using an HNu or OVM

SOP 9: FIELD MEASUREMENTS OF ORGANIC VAPORS USING AN HNU OR OVM

I. PURPOSE

To provide general guidelines for the calibration and use of the HNU or OVM photoionization detector.

II. SCOPE

This is a broad guideline for the field use of an HNU or OVM. For specific instructions, refer to the operations manual.

III. HNU EQUIPMENT AND MATERIALS

- Operations manual
- An HNU readout/control unit and photoionization probe (either 10.2 or 11.7 eV depending on requirements) with fully charged battery pack
- Charging unit
- A cylinder of calibration gas, typically 100 ppm isobutylene in air
- A regulator for the calibration gas cylinder
- A short length of 1/8th-inch tube to transfer calibration gas from the cylinder to the HNU probe (as short as possible)

IV. HNU PROCEDURES AND GUIDELINES

ONLY PROPERLY TRAINED PERSONNEL SHOULD USE THIS INSTRUMENT. FOR SPECIFIC INSTRUCTIONS, SEE OPERATIONS MANUAL.

A. CALIBRATE THE HNU

1. Identify the probe by lamp model.
2. Connect the sensor/probe to the readout/control unit.
3. Perform a battery check by turning the function switch to ``Batt."

AR300839

however, must also be made. The following is an example of the type of information which may be included on a placard:

Fischer and Porter
Roll 1
Frame 1 of 36
May 30, 1995 -- M. Smith
B-1

5. If a time dated video camera is used, audio notes can be made while video taping an activity. Field logbook entries, however, must also be made.

6. Refer to SOP No. 12 for guidelines on site logbook entries.

V. ATTACHMENTS

None.

VI. KEY CHECKS AND ITEMS

- Record information on each photograph taken into site logbook.
- Check camera for batteries and film.

AR300840

- A 1.5 L/min regulator for the calibration gas cylinder
- T-tube of 1/8th-inch transfer tubing to transfer the calibration gas from the cylinder to the OVM

VI. PROCEDURES AND GUIDELINES

ONLY PROPERLY TRAINED PERSONNEL SHOULD USE THIS INSTRUMENT. FOR SPECIFIC INSTRUCTIONS SEE OPERATION MANUAL.

A. OPERATION

1. Power-up instrument by plugging in the power plug or the charger cable.
2. Depress ``ON/OFF" key to ignite lamp and initiate sample pump. ``LAMP OUT" will be displayed until lamp is ignited. Unit is now operational.

B. SETTING ZERO

1. Depress ``MODE/STORE" key.
2. Using ``-/CRSR" key, scroll through: ``LOG THIS VALUE"¾``R/COMM"¾``CONC METER"¾``FREE SPACE"¾``RESET TO CALIBRATE." Display should read ``RF=___."
3. Depress ``RESET" and ``-/CRSR" keys simultaneously to select cursor position.
4. Depress ``RESET" and ``+/INC" keys simultaneously to scroll through preset response factor (RF) values. Set RF = 1.00.
5. Using ``-/CRSR" key, scroll through ``LAMP"¾``ALM"¾``AVERAGE"¾``LOC. CODE MODE"¾``AUTO LOGGING"¾`CONC. METER"¾FREE SPACE." Display should read ``RESET TO CALIBRATE." Depress ``RESET" key.
6. Depress ``-/CRSR" in response to ``RESTORE BACKUP" prompt.

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E. SETTING THE ALARM

1. Depress ``MODE/STORE" key. Use ``-/CRSR" key to scroll to ``ALM". Depress ``RESET" and ``-/CRSR" keys simultaneously to select cursor position.

2. Depress ``RESET" and ``+/INC" keys simultaneously to scroll through preset alarm values. Set alarm to desired level.

3. Depress ``MODE/STORE" key. Unit is now operational.

F. ERASING PREVIOUS DATAPOINTS

1. Depress ``MODE/STORE" key. Use ``-/CRSR' key to scroll to ``R/COMM." Depress ``RESET" key.

   - If ``NO DATA STORED" is displayed, depress ``MODE/STORE" key. Unit will display ``COMPUTER." Depress ``MODE/STORE" key. Unit is operational.

   - If ``COMMUNICATE" is displayed, depress ``-/CRSR" key in response to ``COMMUNICATE" and ``DISP. LOG DATA" prompts.

2. Depress ``+/INC" key in response to ``RESET" prompt. Depress ``MODE/STORE" key. Unit is operational. All datapoints have been erased.

G. STORING A DATAPOINT

1. Depress ``MODE/STORE" key when you want to store a datapoint. Depress ``+/INC" key to store the point. Use the ``+/INC" key to set datapoint number or location code; use ``-/CRSR" key to move cursor.

2. Depress ``MODE/STORE" key. Unit is operational.

AR300842

IX. PREVENTIVE MAINTENANCE

A complete preventive maintenance program is beyond the scope of this document. For specific instructions, refer to the operations manual.

- A complete spare HNU or OVM should be available on site whenever field operations require this instrument.
- A spare lamp should be on hand so a defective unit can be changed without returning the unit.
- Occasional cleaning of the lamp should be performed as needed.
- Charge batteries daily.
- Occasionally allow the batteries to totally discharge before recharging to prevent battery memory from occurring.

AR300843

4. Turn function switch to ``Standby" and set the readout to zero by turning the zero knob.

5. Hold the sensor/probe to your ear to verify that it is powered. A faint humming sound will be heard.

6. Set the range to the appropriate setting.

7. Connect the tube from the calibration gas cylinder to the end of the probe and open the valve on the calibration gas cylinder.

8. Sample the calibration gas and adjust to the proper reading with the span control knob.

9. If calibration cannot be achieved, disassemble the sensor/probe assembly and clean lamp. If the span knob setting is at the end of the span range, unit must be serviced by qualified personnel.

B. SAMPLING WITH THE HNU

1. Once calibration is complete, unit is ready for sampling. When not in use, set function knob to ``Standby."

2. When done for the day, turn unit off and disconnect the sensor/probe.

3. Charge the battery overnight (complete recharge takes 14 hours).

4. For preventive maintenance, refer to instruction manual.

V. OVM EQUIPMENT AND MATERIALS

- Operations manual
- An OVM data logger (either 10.0, 10.6, or 11.8 eV lamp depending on requirements) with fully charged battery pack and air filter (silver in-line filter, or plastic disk in-line filter)
- Charging unit
- A cylinder of calibration gas, typically 100 ppm isobutylene in air

AR300844

Table 1
OVM DATA LOGGER

Lamp	Gas	Reading	Response Factor	Calibration Method
10.0 eV 10.6 eV	100 ppm isobutylene	100 ppm (RF=1.0)	Reset to 0.55	• 1.5 L/min regulator; use ``T'' tubing arrangement to connect to OVM. • Flush and fill tedlar bag with calibration gas; connect directly to OVM.
11.8 eV	100 ppm isobutylene	100 ppm (RF=1.0)	Reset to 0.68	• 1.5 L/min regulator; use ``T'' tubing arrangement to connect to OVM. • Flush and fill tedlar bag with calibration gas; connect directly to OVM.

Note that the OVM is initially calibrated to respond ``one-to-one'' to isobutylene (RF=1.0). The RF should then be set to 0.55 (10.0 and 10.6 eV lamps) or 0.68 (11.8 eV lamp), which causes the OVM to mimic the HNU PID. The EPA total vapor action levels are based on HNU readings (Table 2-2). Once the RF value is reset, the calibration gas will read 55 ppm (10.0 and 10.6 eV lamps) or 68 ppm (11.8 eV lamp).

Limitations: The instrument is sensitive to many organic and inorganic vapors/gases; it cannot be used as a qualitative instrument in unknown situations. It is strictly quantitative except when the nature of the contamination is known and the instrument has been calibrated to or a calibration curve has been generated for the contaminant being monitored. High humidity reduces sensitivity. Atmospheres with concentrations of vapors and gases about OVM detection limits will cause inconsistent instrument response.

Exposure Limits: Refer to HSP.

Action Levels: Refer to HSP.

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7. Depress ``RESET" key. Instrument will zero to ambient air. (Note: Zero gas or a zero filter may be used to set the unit to an absolute zero¾connect prior to depressing a ``RESET" key.)

C. CALIBRATION

1. Instrument should display ``SPAN PPM = --- + TO CONTINUE."

2. Depress ``RESET" and ``-/CRSR" keys simultaneously to select cursor position.

3. Depress ``RESET" and ``+/INC" keys simultaneously to scroll through preset SPAN values. Set SPAN = 100, which corresponds to the 100 ppm isobutylene.

4. When span has been entered, depress ``+/INC" key t continue.

5. Connect span gas cylinder. Turn valve on. Depress ``RESET" key.

6. When finished calibrating, display will read ``RESET TO CALIBRATE." Depress ``MODE/STORE" key. Display should read about 100 ppm. Turn valve off. Disconnect span gas cylinder. Unit is now operational.

D. SETTING RF TO MIMIC HNU

1. Depress ``MODE/STORE" key.

2. Using ``-/CRSR" key, scroll through: ``LOG THIS VALUE"¾``R/COMM"¾``CONC METER"¾ ``FREE SPACE"¾``RESET TO CALIBRATE." Display should read ``RF = 1.00."

3. Depress ``RESET" and ``-/CRSR" keys simultaneously to select cursor position.

4. Depress ``RESET" and ``+/INC" keys simultaneously to scroll through preset RF values. Set RF = 0.55 (10.0 eV or 10.2 eV lamp) or RF = 0.68 (11.8 eV lamp). Depress ``MODE/STORE" key. Unit is now operational.

AR300846

SOP No. 10 Oil/Water Interface Level Measurements

AR300847

H. RETRIEVING A DATAPOINT

1. Depress ``MODE/STORE" key. Use ``-/CRSR" key to scroll to ``R/COMM." Depress ``RESET KEY". Depress ``-/CRSR" key in response to ``COMMUNICATE" prompt. Depress ``+/INC" key in response to ``DISP. LOG DATA" prompt. Datapoint(s) and the date/time of collection will be displayed.

2. Continue to depress ``+/INC" key to display additional datapoints and return to the operational mode.

I. TURNING THE AUTOLOGGER FUNCTION ON

1. Depress ``MODE/STORE" key. Use ``-/CRSR" key to scroll to ``AUTO LOGGING" prompt Depress ``RESET" key. Depress ``+/INC" key.

2. Select autologging interval MM:SS. Use ``-/CRSR" key to move cursor. Use ``+/INC" key to select preset values.

3. Depress ``RESET" key. Depress ``MODE/STORE" key. Unit is now operational.

J. TURNING THE AUTOLOGGER FUNCTION OFF

1. Depress ``MODE/STORE" key. Use ``-/CRSR" key to scroll to ``AUTO LOGGING" prompt. Depress ``RESET" key. Depress ``-/CRSR" key.

2. Depress ``MODE/STORE" key. Unit is now operational.

VII. ATTACHMENTS

Instrument profile OVM data logger

VIII. KEY CHECKS AND ITEMS

- Check battery.
- Zero and calibrate.
- Verify sensor probe is working.
- Recharge unit after use.

AR300848

SOP NO. 10: OIL/WATER INTERFACE LEVEL MEASUREMENTS

I. PURPOSE

General reference information for measuring depth to and thickness of free product in monitoring wells.

II. SCOPE

Standard free product measuring techniques using the appropriate measuring equipment are summarized.

III. EQUIPMENT AND MATERIALS

- Electronic oil/water interface probe
- Deionized water
- Trisodium phosphate (TSP) detergent solution
- Straight edge ruler
- Paper towels
- Keys
- Manhole opener (if applicable)
- Personal protection - latex or surgical gloves, etc. (REFER TO SITE HEALTH AND SAFETY PLAN)

IV. PROCEDURES AND GUIDELINES

1. Open well and scan well with FID/PID as per site specific health and safety plan and/or amendments. If warranted, upgrade PPE.
2. Lower a pre-cleaned oil/water interface probe into the monitoring well.
3. When solid "tone" sounds, probe has contacted free product in the well. Pull probe up slightly until tone turns off. This will be your indication that you are at the top of the free product.
4. Read the depth to product from the datum point at the top of the inner casing to 0.01 foot. This will be established during the well survey.

INSTRUMENT PROFILE: ORGANIC VAPOR METERDATA (OVM) LOGGER

Hazard Monitored: Organic and inorganic vapors and gases.

Application: Determines relative concentrations of air contaminants. Information used to establish level of protection and other control measures. It will not detect methane.

Components: Single, integrated unit; interchangeable ultraviolet lamp sources (10.0, 10.6, and 11.8 eV); LCD digital readout, with bargraph; keypad controls instrument functions; positive displacement sampling pump; datalogger function can store 700 data points by date, time, location, and status.

Detection Method: Photoionization.

Operation: Ultraviolet light photons are generated by the UV lamp and directed at the sample. If the energy of the photons is sufficient it will ionize the molecules of vapor/gas in the sample. The amount of energy necessary to photoionize a molecule is represented by its ionization potential (IP). The lamp energy must be equal to or greater than the IP of a compound. Once ionized, the freed electrons are collected at an electrode to generate a current, which corresponds to concentration, and is displayed on the readout.

Readout: Continuous LCD digital readout with bargraph, overrange indication, and audible alarm; linearized range 0.1 to 2000 ppm; auto ranging 0-200 ppm and 200-2000 ppm; maximum concentration signal hold; communications software available.

Calibration: This instrument is calibrated with isobutylene gas. The calibration should be checked before and after use. Refer to Table 1. Note that the unit is initially calibrated to respond ``one-to-one'' to isobutylene (RF=1.0). The RF should then be set to 0.55 (10.0 and 10.6 eV lamps) or 0.68 (11.8 eV lamp), which causes the OVM to mimic the HNU PID. The EPA total vapor action levels are based on HNU readings (HSP).

Inherent Safety: The OVM is approved for Class I Division 2 Groups ABCD.

AR300850

SOP No. 11 Sample Documentation, Packaging and Shipping Instructions

EPA Sample Paperwork

December 12, 1994

The following pages contain information that was designed to assist you in completing the EPA Sample Paperwork correctly. In order for these checklists to be effective you need training on how to fill out the paperwork by the sample manager. Without the training, these checklists will not be as effective.

The intent of these checklists is to make you think about what you are doing. It is extremely easy to make a simple error, and following the checklists will help eliminate those errors.

You will notice as you read through the beginning pages that we talk about a lot of pre-sampling preparation of the paperwork: we strongly recommend you do this. It makes the sampling event go much smoother and you are not so pressed for time at the end of the day.

During the sampling event there are a few things you should keep in mind:

- Always follow the Sampling and Analysis Plan (SAP). The SAP is the Bible for all sampling events and its procedures should be followed as they are described.
- QC samples: make sure all of the QC requirements listed in the SAP are covered.
- Send copies of the completed paperwork to the Sample Manager (Julie Lovett/WDC) every night you ship samples (by Federal Express or FAX). CRL and US EPA Region III often have questions and we need to be able to look at the paperwork to answer these questions.
- **PLEASE CALL IN THE EVENT YOU ARE UNSURE ABOUT ANYTHING!! WE ARE HERE TO HELP.**
  - Sample Manager - Julie Lovett/WDC (x4361)
  - Site Manager - Site Specific
  - Secondary Sample Manager - Ann West/WDC (x4643)

Frequent Paperwork Problems
Things To Avoid Doing

- Dissolved Metals analysis didn't get a separate CLP sample number from that of the Total Metals.

  Whenever you take a total and dissolved metals sample, they **MUST** get separate CLP Sample Numbers. If they don't you will be writing a memo-to-file soon there after.

- Sampler didn't call SMO (RAS) or Jim McKenzie (DAS) with shipping information or didn't call before 3:00pm on Friday for Saturday deliveries. RAS or DAS contacts need to know about Saturday deliveries before 3:00pm so they can make sure someone is at the lab to receive the samples.

  Every night samples are shipped we need to call and fax SMO and/or Jim McKenzie (DAS) with the shipping information.

- Tags incorrectly noted on the Chain of Custody form.

  You need to be very careful when writing down these numbers. It is easy to transpose numbers or place them in the wrong box. This is a much to common problem that needs to be reversed, and that will be done only by being careful.

- MS/MSD samples not given the same EPA sample number or CLP sample number.

  Whenever you collect a sample and an MS/MSD, all volumes need to get the same CLP sample number. Example: You collect the sample, the MS and the MSD, this is triple the volume of normal. You will assign the same CLP sample number to all 3 sets of samples. The reason, they are not separate samples, they are one in the same for the lab to be able to perform QC on them.

- Sample description for trip blanks, field blanks and equipment blanks not noted as Field QC/Rinsates.

  EPA protocol calls for us to assign the description (Box 7 for the Organic and Inorganic paperwork) for the Trip Blanks, Field Blanks and Equipment Blanks are called Field QC/Rinsates.

5. Continue lowering the probe through the free product. When a beeping "tone" sounds, the probe has contacted the top of ground water.

6. Read the depth to ground water from the datum point at the top of the inner casing to 0.01 foot.

7. The difference between the two measurements is the thickness of free product in the well.

8. Continue lowering the probe to the bottom of the well. Read the depth to the bottom of the well from the datum point at the top of the inner casing to 0.01 foot.

9. Repeat all measurements 2 to 3 times to confirm a consistent reading.

10. Raise the probe out of the well.

811 Rinse the probe with TSP solution and deionized water.

V. ATTACHMENTS

None.

VI. KEY CHECKS AND ITEMS

- Electronic oil/water interface probe is in good operating condition. Check batteries.

- Decontaminate electronic oil/water interface probe between wells.

- Straight edge ruler must lay flat on top of casing.

AR300854

EPA

United States Environmental Protection Agency
Contract Laboratory Program Sample Management Office
PO Box 818 Alexandria, VA 22313
703 557-2490 FTS 557-2490

Inorganic Traffic Report & Chain of Custody Record

(For Inorganic CLP Analysis)

SAS No. (if applicable)

Case No.

1. Project Code / Account Code

Regional Information

Non-Superfund Program

Site Name

City, State | Site Spill ID

2. Region No. | Sampling Co.

Sampler *(Name)*

Sampler Signature

3. Type of Activity

	Lead	Pre-Remedial	Remedial	Removal
SF			RIFS	CLEM
PRP		PA	RD	REMA
ST		SSI	RA	REM
FED		LSI	O&M	OIL
			NPL	UST

4. Date Shipped | Carrier

Airbill Number

5. Ship To

ATTN:

6. Preservative *(Enter in Column D)*
1. HCl
2. HNO_3
3. NaOH
4. H_2SO_4
5. $K_2CR_2O_7$
6. Ice only
7. Other *(Specify)*
N. Not preserved

7. Sample Description *(Enter in Column A)*
1. Surface Water
2. Ground Water
3. Leachate
4. Rinsate
5. Soil/Sediment
6. Oil (High only)
7. Waste (High only)
8. Other *(Specify)*

CLP Sample Numbers (from labels)	A Enter # from Box 7	B Conc. Low Med High	C Sample Type: Comp / Grab	D Preservative from Box 6	E - RAS Analysis: Metals Total	Metals Dissolved	Cyanide	Low Conc only: Mercury	Low Conc only: Fluoride	High only: pH	High only: Conductivity	F Regional Specific Tracking Number or Tag Numbers	G Station Location Number	H Mo/Day/ Year/Time Sample Collection	I Sampler Initials	J Corresp. CLP Org. Samp. No.	K Enter Appropriate Qualifier for Designated Field QC

B = Blank S = Spike D = Duplicate PE = Perform. Eval - = Not a QC Sample

...nt for Case ...te? (Y/N)

Page 1 of ____

Sample used for a spike and/or duplicate

Additional Sampler Signatures

Chain of Custody Seal Number

CHAIN OF CUSTODY RECORD

...ulished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
...ulished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
...quished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks Is custody seal intact? Y/N/none	

AR300855

Regional Information

Non-Superfund Program

Site Name

City, State | Site Spill ID

Sampler *(Name)*

Sampler Signature

3. Type of Activity

	Lead	Pre-Remedial	Remedial		Removal
SF			RIFS		CLEM
PRP		PA	RD		REMA
ST		SSI	RA		REM
FED		LSI	O&M		OIL
			NPLD		UST

Airbill Number

5. Ship To

ATTN:

6. Preservative *(Enter in Column D)*

1. HCl
2. HNO_3
3. $NaHSO_4$
4. H_2SO_4
5. Other *(Specify)*
6. Ice only
N. Not preserved

7. Sample Description *(Enter in Column A)*

1. Surface Water
2. Ground Water
3. Leachate
4. Rinsate
5. Soil/Sediment
6. Oil (High only)
7. Waste (High only)
8. Other *(Specify)*

CLP Sample Numbers (from labels)	A Enter # from Box 7	B Conc Low Med High	C Sample Type: Comp / Grab	D Preservative from Box 6	E RAS Analysis VOA	E BNA	E Pest/ PCB	E High only ARO/ TOX	F Regional Specific Tracking Number or Tag Numbers	G Station Location Number	H Mo/Day/ Year/Time Sample Collection	I Sampler Initials	J Corresp. CLP Inorg. Samp. No.	K Enter Appropriate Qualifier for Designated Field QC

K: Enter Appropriate Qualifier for Designated Field QC
B = Blank S = Spike
D = Duplicate
PE = Perform. Eval
-- = Not a QC Sample

Shipment for Case complete? (Y/N)

Page 1 of ____

Sample used for a spike and/or duplicate

Additional Sampler Signatures

Chain of Custody Seal Number

CHAIN OF CUSTODY RECORD

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks Is custody seal intact? Y/N/none	

Split Samples ☐ Accepted *(Signature)*

☐ Declined

EPA Form 9110-2 (Rev. 5-91) Replaces EPA Form (2075-7), previous edition which may be used

DISTRIBUTION:
Blue - Region Copy Pink - SMO Copy White - Lab Copy for Return to Prod. Yellow - Lab

AR300856

Sample Preparation Checklist

____ If the sampling event has DAS analyses, have you had the DAS request written and submitted a minimum of 6 weeks before the sampling takes place?

Check the following 1 week before sampling:

Things to complete:

___ Has the RAS lab been set up yet? (if applicable, call sample manager the Monday of the week before sampling to have the lab set up. Include total number of samples as well as the QC requirements).
___ Review the Sampling and Analysis Plan (SAP).
___ Where is the closest Federal Express office?

Do you have enough:

___ Coolers (remember that organics and inorganics often go to different labs).
___ Bottles (see enclosed list to get proper bottles for desired analyses)
___ Preservative (see enclosed list to get proper preservative for desired analyses)
___ Paperwork (tags, chain of custody forms, etc. - Call the Sample Manager - Julie Lovett - to get these forms if needed)
___ Water-proof pens
___ Filters? If you have a Metals analysis will you be filtering these samples?
___ HPLC water
___ Federal Express Forms
___ Sample Equipment (pumps, meters, H&S, etc.)
___ Trip blanks for VOA analysis? (if applicable)

Before going out into the field, it is a good idea to fill out the paperwork as much as possible, especially if you will be doing oversite (OS) work at the same time. Putting everything onto one form and then copying it over to new forms as those samples are collected and shipped out to the labs has been found to be extremely helpful, especially for people who are new to EPA paperwork, or have been away from it for a while.

If you begin to fill out the paperwork ahead of time, and you feel at all uncomfortable, please ask for a refresher training session. It doesn't take that long, and it will be a great help to you, so please take advantage of it. Even people who have done this before need to be refreshed from time to time. It is easy to make a simple mistake, so if you are unsure of what is supposed to be done, please ask for help.

The easiest way we have found to fill out the paperwork before the sampling event is by placing the corresponding tags and sticky labels in envelopes by location identifier. This will allow you to just grab the envelope for the specific location being sampled at that time. You can fill in just about everything on the paperwork. On the enclosed checklists for each form of paperwork, it notes what can and can't be filled out in advance. This is a huge time saver if all is filled out and correct before you go into the field. When filling out the paperwork ahead of time, make sure you also write up the information for all QC samples (MS/MSD, Field Blanks, Trip Blanks, etc.). The sample manager can assist you on preparing the paperwork ahead of time to make sure you are comfortable with this procedure for future sample activities.

PROJ. NO.	PROJECT NAME					NO. OF CON-TAINERS							REMARKS
SAMPLERS: *(Signature)*													
STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION								
Relinquished by: *(Signature)*			Date / Time		Received by: *(Signature)*		Relinquished by: *(Signature)*			Date / Time		Received by: *(Signature)*	
Relinquished by: *(Signature)*			Date / Time		Received by: *(Signature)*		Relinquished by: *(Signature)*			Date / Time		Received by: *(Signature)*	
Relinquished by: *(Signature)*			Date / Time		Received for Laboratory by: *(Signature)*		Date / Time		Remarks				

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

AR300858

Sample Paperwork Checklist
Inorganic Traffic Report/Chain of Custody

Fill out forms with available information:

B	___	Case No. (RAS No.)
A	___	Project Code (W.A. No.), Account Code. (You can get these from the sample manager, Julie Lovett/WDC)
A	___	Region No. (III), Sampling Co. (CH2M HILL), Sampler Name and Signature
C	___	Date Shipped, Carrier (Fed Ex), Airbill No.
A	___	Site Name, City, State, Site Spill ID (last 2 digits of account code)
A	___	Type of Activity (We will fill in: Lead: SF=Superfund or PRP - also fill in: Remedial: RIFS, RD, etc. depending on the site)
B	___	Lab Shipped to Address and "Attention-Sample Custodian" - no phone number in this box.
A	___	CLP Sample No. (sticky labels) from bottles. Make sure you use the Inorganic Traffic Report (ITR) labels. Note that filtered and unfiltered samples get separate CLP sample numbers. Also put a "*" next to the filtered sample.
A	___	A. Sample Description (from box 7) - Note that Trip Blanks, Field Blanks and Equipment Blanks are Field QC/Rinsates
A	___	B. Concentration ("low" is the majority of our sampling concentrations, refer to the site SAP for special procedures in the event of medium and high concentration samples)
A	___	C. Sample Type (composite or grab-fill in the one being used)
A	___	D. Preservative (from box 6) - See attached table for analyses and preservative requirements.
A	___	E. RAS Analysis - "X" the proper box for the desired analysis
A	___	F. Tag No. on Forms (can use a range if more than 1 tag is being used, **provided the tags run consecutively.** Example: 3-1263634 - 36)
A	___	G. Station Location (this is CH2M HILL's designated sample location identifier. Example: GW-2, GW-2DUP)
C	___	H. Date and Time of Sample Collection
A	___	I. Sampler Initials
A	___	J. Corresponding CLP organic Sample No. (if we have organic sampling at same location, put in the organic CLP sample no.)
A	___	K. Designated Field QC on Forms: Blanks "B" (field/trip), Blanks "R" (Equip), Duplicate "D" also write the number next to the "D" that the sample is a dup of), Spike "S", Not a QC Sample "-", Perform. Eval. "PE" **(CH2M HILL rarely uses)**
C	___	Shipment for Case Complete? (If more sampling under this case, NO - if sampling totally complete, YES)
C	___	Page 1 of ___?
A	___	Sample Used for Spike and/or Duplicate (when we have an MS/MSD we must put in the CLP Sample No. of that sample in this box. This box should only be used for MS/MSD's, NOT field duplicates.)
C	___	Additional Sampler Signatures (Just another place for more samplers to sign)
C	___	Chain of Custody Seal Number (We don't have seal numbers in Region III, what we will use this box for is the filtered metals. When we do filter metals put the statement "* PLEASE DIGEST FILTERED" in this box. If not filtered just write in "N/A"
C	___	Relinquished Signature, Date and Time

A = Can be filled out before the sampling event.
B = If the lab assignment comes through from CRL early you will be able to fill this in before the sampling event.
C = Will be filled out in the field during the sampling event.

★ GPO 706-155

Designate: Grab / Comp	Preservative: Yes ☐ No ☐
	ANALYSES
	BOD Anions Solids (TSS) (TDS) (SS)
	COD. TOC. Nutrients
	Phenolics
	Mercury
	Metals
	Cyanide
	Oil and Grease
	Organics GC/MS
	Priority Pollutants
	Volatile Organics
	Pesticides
	Mutagenicity
	Bacteriology
Time	Samplers (Signatures)
Month/Day/Year	
Station No	Station Location: Remarks:
Project Code	Lab No. 3-1263650 Lab Sample No

Sample Paperwork Checklist
Organic Traffic Report/Chain of Custody

Fill out forms with available information:

B	___	Case No. (RAS No.)
A	___	Project Code (W.A. No.), Account Code. (You can get these from the sample manager, Julie Lovett/WDC)
A	___	Region No. (III), Sampling Co. (CH2M HILL), Sampler Name and Signature
C	___	Date Shipped, Carrier (Fed Ex), Airbill No.
A	___	Site Name, City, State, Site Spill ID (last 2 digits of account code)
A	___	Type of Activity (We will fill in: Lead: SF=Superfund or PRP - also fill in: Remedial: RIFS, RD, etc. depending on the site)
B	___	Lab Shipped to Address and "Attention-Sample Custodian" - no phone number in this box.
A	___	CLP Sample No. (sticky labels) from bottles. Make sure you use the Organic Traffic Report (OTR) labels.
A	___	A. Sample Description (from box 7) - Note that Trip Blanks, Field Blanks and Equipment Blanks are Field QC/Rinsates
A	___	B. Concentration ("low" is the majority of our sampling concentrations, refer to the site SAP for special procedures in the event of medium and high concentration samples)
A	___	C. Sample Type (composite or grab-fill in the one being used)
A	___	D. Preservative (from box 6) - See attached table for analyses and preservative requirements.
A	___	E. RAS Analysis - "X" the proper box for the desired analysis
A	___	F. Tag No. on Forms (can use a range if more than 1 tag is being used, **provided the tags run consecutively.** Example: 3-1263634 - 36)
A	___	G. Station Location (this is CH2M HILL's designated sample location identifier. Example: GW-2, GW-2DUP)
C	___	H. Date and Time of Sample Collection
A	___	I. Sampler Initials
A	___	J. Corresponding CLP Inorganic Sample No. (if we have inorganic sampling at same location, put in the inorganic CLP sample no.)
A	___	K. Designated Field QC on Forms: Blanks "B" (field/trip), Blanks "R" (Equip), Duplicate "D" also write the number next to the "D" that the sample is a dup of), Spike "S", Not a QC Sample "-", Perform. Eval. "PE" **(CH2M HILL rarely uses)**
C	___	Shipment for Case Complete? (If more sampling under this case, NO - if sampling totally complete, YES)
C	___	Page 1 of ___?
A	___	Sample Used for Spike and/or Duplicate (when we have an MS/MSD we must put in the CLP Sample No. of that sample in this box. This box should only be used for MS/MSD's, NOT field duplicates.)
C	___	Additional Sampler Signatures (Just another place for more samplers to sign)
C	___	Chain of Custody Seal Number (We don't have seal numbers in Region III)
C	___	Relinquished Signature, Date and Time

A = Can be filled out before the sampling event.
B = If the lab assignment comes through from CRL early you will be able to fill this in before the sampling event.
C = Will be filled out in the field during the sampling event.

(1) (REQUIRED FOR ALL SAMPLES SENT THROUGH THE CONTRACT LAB PROGRAM)

PROJECT SITE NAME: ______ ; EPA PROJ. OFFICER: ______
RAS NO. ______ ; SAS NO. ______ ; TASK OR SET NO. ______
PROJECT SITE LEADER: ______ ; PHONE NO. ( ) ______
PROJECT SAMPLE COORDINATOR: ______ ; PHONE NO. ( ) ______

SAS REQUEST (DETAILS REQUIRED)
(10)

Preservation

QC SAMPLE INFORMATION AND/OR COMMENTS	CONC. (LOW/ MED./ HIGH)	SAMPLE PHASE (AQ/ SOL.)	TYPE OF REQUEST (ORG. INORG. OR INOR) SAS	EPA SAMPLE NO.	ORGANICS OR INORGANICS: LAB NAME	DATE SHIPPED	DATA RECEIVED (XX-OUT ITEMS NOT REQUESTED): VOA	BNA	PEST	TCDD	METALS	CN	LAB NAME	SAS REQUEST (ITEMIZE)	DATE SHIPPED	DATA REC'D
(2)	(3)	(4)	(5)	(6)	(7)	(8)	←			(9)		→	(11)	(12)	(13)	

REV. [illegible]

AR300862

Sample Paperwork Checklist
DAS - (CRL) Chain of Custody

USE ONLY EPA Chain of Custody Records

A	___	Project No. (W.A. Number)
A	___	Project Name (Use Site Initials (i.e. for Fike Chemical use F.C.)
C	___	Samplers (signature)
A	___	Analysis type(s) (write in the slanted boxes available)
A	___	Lab Name (write in above where "remarks" is written)
A	___	Case Number - write the DAS number assigned directly under where "remarks" is written - it will be R3###. (R3 for Region III)
A	___	Station No. (the CH2M HILL station number assigned)
C	___	Date of sample collected
C	___	Time sample is collected
A	___	Comp./Grab - if you know ahead of time
A	___	Station Location (the CH2M HILL station location assigned)
C	___	No. of Containers (1, 2, 3, etc.)
C	___	Analysis (simply put an "X" in the analysis requested for that sample)
C	___	Remarks - Above the line on the left put EPA Sample #, then on the right put Tag #, then below list the sample number next to the tag number for that sample.
C	___	Relinquished by (Signature), sampler signs
C	___	Date/Time - The date and time the sample is sent out
C	___	Remarks (bottom right corner) please write the QC sample number and "Do QC" next to it, also include the Federal Express Airbill number below that.

A = Can be filled out before the sampling event.
B = If the lab assignment comes through from CRL early you will be able to fill this in before the sampling event.
C = Will be filled out in the field during the sampling event.

Sample Paperwork Checklist - Miscellaneous Continued

Information Needed:

- Your Name
- Sample Company (CH2M HILL)
- Region (III)
- Contact Phone Number (your office)
- Case/DAS Number
- Date Shipped
- Number of samples by concentration and matrix
- Carrier (Fed Ex) and Airbill Number
- Next planned shipment
- **Friday shipments for Saturday delivery MUST be called in to SMO or Jim McKenzie by 3:00pm.**
- CRL does not accept shipments on Saturday unless authorized in advanced.

Things to do back at the office after the sampling event:

___ Check over your paperwork to look for errors. It is better if CH2M HILL discovers them and corrects them before EPA comments on them. If you do find an error a memo-to-file needs to be written; this is discussed later.

___ Fill out the shipping log. These forms need to be submitted before any analytical packages are received by CRL.

___ Mail "REGION" copy of (RAS) paperwork and photo copy of (DAS) chain of custody to:

Annette Lage
United States Environmental Protection Agency
Region III
Quality Assurance Branch
201 Defense Highway, Suite 200
Annapolis, MD 21401

This will be the green, or blue form as indicated on the bottom of the RAS forms. Include the sample shipping log to CRL. Make sure you keep a copy of both the shipping log and chain of custody, and send a copy to the sample manager, Julie Lovett/WDC for the site sample files.

___ Mail "SMO" copy of the (RAS) paperwork to:

RAS - Roger Nowakowski
EPA Sample Management Office (SMO)
P.O. Box 818
Alexandria, VA 22313

This will be the pink form as indicated on the bottom of the forms. SMO DOES NOT get a coy of the shipping log.

DAS sampling events are considered Non-CLP events. Please remember to include DAS sampling information in the Non-CLP data tracking database (ANSETS), to get the information needed please contact Julie Lovett/WDC so you can have the proper forms to fill out. Then return the forms to Julie Lovett/WDC so they may be submitted by diskette to EPA.

Sample Paperwork Checklist - Sample Tags

These can be filled out before the sampling event takes place. Fill in everything but the date and time, but just remember to fill these two things in before shipping off the samples.

___ Project Code (W.A. Number)
___ Station Number (Well number)
___ Date of Sample Collection
___ Time of Sample Collection
___ Sample Type (Composite/Grab, "X" the proper box for the sample type)
___ Station Location (A description of the location. Example: 20 ft from MW-1)
___ Sampler Signature
___ Preservative ("X" yes or no)
___ Analyses (put an "X" in the proper box of the analyses to be performed or write in the analyses name in the last box if not on the list)
___ Remarks (put the RAS or DAS Case Number and the preservative name here. Example: HNO3, HCl, etc.) Also, if the sample is filtered note it in this box.

Sample Paperwork Checklist
Samplers Nightly Shipping Information

Fill out forms with available information:

C	_____	Date of Shipment
C	_____	Number of samples shipped by analyses and matrix
C	_____	Shipment Complete (Yes or No)
A	_____	Your Name
A	_____	Sample Company
A	_____	Region
A	_____	Phone #
B	_____	Lab Name
B	_____	Lab (City, State)
B	_____	Case/DAS #
C	_____	Airbill #
C	_____	Next Shipment date

This form is written documentation of what samples you are sending. NOTHING else is to be written on this document (that includes requests for methods to be performed or anything that is not listed above).

RAS ONLY - SMO still needs to receive a phone call. If you are unable to fax then notify SMO when you call that there will not be a fax'd copy sent.

DAS ONLY - Jim McKenzie (U.S. EPA) needs to receive a phone call. If you are unable to fax then notify Jim when you call that there will not be a fax'd copy sent.

Make copies of this form when received so multiple shippings can be recorded. If you have any questions please call the sample manager, Julie Lovett/WDC (x4361).

A = Can be filled out before the sampling event.
B = If the lab assignment comes through from CRL early you will be able to fill this in before the sampling event.
C = Will be filled out in the filed during the sampling event.

Sample Paperwork Checklist - Shipping Logs

These are filled out after you have returned to the office after the sampling event is totally complete. Each RAS or DAS Case Number needs to have a separate shipping log created.

___ Page 1 of ___
___ Project Site Name
___ EPA Project Officer (RPM)
___ RAS No. or DAS No.
___ Project Site Leader (Site Manager)
___ Site Sample Coordinator (Julie Lovett) (703)471-1441
___ Phone Numbers for above individuals
___ DAS Request Details - if applicable
- Write analyses type (Example: SULFIDE)
- Preservation - Write in name of the one used (Example: HNO3, HCl, etc.) or a "-" if none.
- If this is a RAS shipping log, put a large "X" in this box.

___ QC Sample Information (In this column denote all QC information. Example: Duplicate (i.e. Dup of #), Field Blank, Trip Blank, MS/MSD)
___ Concentration
___ Sample Phase (GW, SW, Soil, Sludge, Sediment)
___ Type of Request (ORG=Organic, INOR=Inorganic, or DAS)
___ EPA Sample No. (RAS-CLP Sample Numbers from sticky labels)

RAS:
___ Lab Name (All labs have abbreviations, some have similar names but are at different locations. If you don't have it ask the sample manager or check to make sure you have the most current listing (a lab address may change), Julie Lovett/WDC)
___ Date Shipped (not the date sampled, date shipped)
___ Data Received ("X" out items NOT requested)
___ Put a large "X" through the DAS columns (it currently still says SAS cross that out and replace with DAS)

DAS:
___ Lab Name (All labs have abbreviations, some have similar names but are at different locations. If you don't have it ask the sample manager, Julie Lovett/WDC).
___ DAS Request in Section 10; (number and write out the analysis requested then put the number in the section below on the form).
___ Date Shipped (not the date sampled, date shipped)
___ Put a large "X" through the RAS columns

___* Nothing is filled in for Data Received. This is for CRL.
___ Final Sampling (Located at the bottom of the page. Most likely will be "yes" since shipping logs will be filled out after the sampling event)
___ Final Shipping Date

BOTTLE TYPE, PRESERVATIVE AND HOLDING TIMES BY ANALYSIS

Soil/Sediment

Analysis	Bottle Type	Preservative	Holding Time
Acidity	N/A	N/A	N/A
Alkalinity	N/A	N/A	N/A
Ammonia (HN3)	N/A	N/A	N/A
BNA/Semivolatiles	8oz glass	None	10 days
BOD5	N/A	N/A	N/A
Bromide (Br)	N/A	N/A	N/A
CBOD5	N/A	N/A	N/A
Chemical Oxygen Demand (COD)	8oz glass	None	28 days
Chloride (Cl)	N/A	N/A	N/A
Color	N/A	N/A	N/A
Cyanide	8oz glass	None	14 days
Dissolved Organic Carbon (DOC)	N/A	N/A	N/A
EP Tox	8oz glass	None	None
Fluoride (F)	N/A	N/A	N/A
Hardness	N/A	N/A	N/A
Hexavalent Chromium (Cr+6)	N/A	N/A	N/A
Mercury (Hg)	8oz glass	None	28 days
Metals	8oz glass	None	6 months preserved
Nitrate (NO3)	N/A	N/A	N/A
Nitrite (NO2)	N/A	N/A	N/A
Nitrite+Nitrate (NO2+NO3)	N/A	N/A	N/A
Oil and Grease (O&G)	N/A	N/A	N/A
PCB/Pesticide	8oz glass	None	10 days
Phenol	8oz glass	None	28 days
Phosphorus (PO4)	N/A	N/A	N/A
Silica (Si)	N/A	N/A	N/A
Sulfate (SO4)	N/A	N/A	N/A
Sulfide	N/A	N/A	N/A
Sulfite (SO3)	N/A	N/A	N/A
Total Dissolved Solid (TDS)	N/A	N/A	N/A
Total Kjeldahl Nitrogen (TKN)	8oz glass	None	28 days
Total Organic Carbon (TOC)	N/A	N/A	N/A
Total Phosphorus (TP)	8oz glass	None	28 days
Total Solid (TS)	N/A	N/A	N/A
Total Suspended Solid (TSS)	N/A	N/A	N/A
Turbidity	N/A	N/A	N/A
Volatiles	2-40ml vials	None	14 days preserved

This list does not contain all possible analyses or acceptable bottle types. It was compiled from a table in the "CRL Sample Submission Guidelines (9/18/90)." In the event a desired analysis is not on the list, call the sample manager to get the proper bottle type and preservative.

Sample Paperwork Checklist - Miscellaneous

___ If the shipment of samples is delayed, canceled, or the sample count number increases/decreases, call the sample manager, Julie Lovett/WDC at 703/471-6405 (ext. 4361). Please give a reason for the delay/cancellation. CRL always needs a reason for delays/cancellations.

___ Did you double check DAS/RAS Numbers on the tags, labels and forms?

___ Did you write out complete sample numbers on each tag? Did you use preprinted sticky labels for RAS events or EPA Sample No. for DAS events?

___ Did you assign the same CLP Sample No. or EPA Sample No. to all volumes of any MS/MSDs?

___ Did you check tags, bottles, and forms for matching times and dates of sample collection?

___ Did you neatly cross-out any changes with one line, initial and date the change? **WHITE-OUT IS PROHIBITED!**

___ Did you put the airbill number on the chain of custody forms?

___ Are the lab copies of the forms, the last 2 sheets of the paperwork (RAS) or the top copy (DAS), protected in the cooler, taped to the cooler lid? The sample shipping log does not go in the cooler.

___ Is the ice packed in plastic bags to minimize leakage during shipping?

___ Are the tags securely attached to each sample bottle?

___ Is each container sealed in a plastic bag (when appropriate)?

___ Did you sign the "Relinquished by" box and fill in the date and time boxes?

___ Are the chain-of-custody seals taped on cooler and secured with clear tape over them to prevent accidental breakage of the seals?

___ Is the CH2M HILL return address written on the front outside corner of the cooler? If not, write it on there so the cooler will make its way back to CH2M HILL.

___ Did you write "Attention-Sample Custodian" on the Lab Address?

___ Are all samples being shipped PRIORITY OVERNIGHT? - No GSA airbills, use CH2M HILL airbills (bulk volume discount). Reason, GSA not guaranteed to get there in the AM the following day.

___ If Saturday delivery is required, the Federal Express form MUST be checked for Saturday delivery.

* Do not call labs or send them the sample shipping log

___ Call and fax EPA Sample Management Office (SMO) for RAS and Jim McKenzie for DAS with complete sample information nightly. Many times you will reach an answering machine, you may leave the complete shipping information in a message. If you are unable to fax let SMO or Jim know this when calling in. This is the only thing we talk to SMO about. All other questions should go to the sample manager, Julie Lovett/WDC:

DAS Samples:	Jim McKenzie/U.S. EPA	215/597-3229
DAS Fax Number:		215/597-9890
RAS Samples:	Roger Nowakowski/SMO	703/519-1174
RAS Fax Number:		703/519-8626

See the next page for the shipping information we are required to inform SMO about.

SOP No. 12 Site Logbook

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Sample Paperwork Checklist - Memo-to-File

In the event you have made a mistake and you are told you need to do a memo-to-file or you have discovered an error that requires a memo-to-file, there are some requirements as to the content of that memo. This memo needs to be written and submitted IMMEDIATELY. The following is a list of those items that are required to be in that memo so they will be able to easily identify that sample activity:

___ Case(RAS)/DAS Number
___ Overnight Carrier/Airbill Number
___ Date of Shipment
___ Chain-of-Custody Document Number
___ Sample Numbers
___ Tag Numbers
___ Sampling Dates
___ Analysis
___ Correction of the Error
___ Your Signature
* **DON'T PUT THE SITE NAME IN THE MEMO-TO-FILE UNLESS THE LAB WAS CRL.**

Once all this is included in the memo-to-file it needs to be distributed to certain individuals:

___ Custodian of Samples at the Laboratory (they get the original signed copy - Fed Ex'd)
___ EPA RPM for the specific site
___ Annette Lage/RSCC/CRL
___ SMO RAS Coordinator or EPA DAS Coordinator (depending on lab assignment)
DAS: Jim McKenzie RAS: Roger Nowakowski
___ CH2M HILL's Sample Manager, Julie Lovett/WDC (for the site sample files)

DAS - Regional Point of Contact (RPOC):
Mr. Jim McKenzie
United States Environmental Protection Agency
Region III
841 Chestnut Building, MC:3HW43
Philadelphia, PA 19107-4431

SOP NO 12: SITE LOGBOOK

I. PURPOSE

General guidelines are provided for keeping a site logbook.

II. SCOPE

The site logbook is a controlled document that records all major onsite activities during a Remedial Investigation/Feasibility Study. At a minimum, the following activities and events should be recorded in the site logbook:

- Arrival and departure of site visitors
- Arrival and departure of equipment
- Sample pickup (airbill number, carrier, time)
- Start or completion of borehole, trench, and monitoring well installation or sampling activities
- Sample locations and identification numbers and any observations made
- Field measurements taken for each sample
- Any deviations to the Work Plan or QAPP
- Health and safety issues
- Locations of photographs taken
- Expendables used each day and location where they were used

The site logbook becomes part of the permanent site file. Because information contained in the site logbook may be admitted as evidence in cost recovery or other legal proceedings, it is critical that this document be properly maintained.

III. EQUIPMENT AND MATERIALS

- Bound notebook with consecutively numbered pages that cannot be removed

IV. PROCEDURES AND GUIDELINES

1. One current site logbook is maintained per task

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BOTTLE TYPE, PRESERVATIVE AND HOLDING TIMES BY ANALYSIS

Aqueous

Analysis	Bottle Type	Preservative	Holding Time
Acidity	1 liter poly	None	14 days
Alkalinity	1 liter poly	None	14 days
Ammonia (HN3)	1 liter poly	H2SO4 pH<2	28 days
BNA/Semivolatiles	80oz amber	None	7 days
BOD5	1 liter poly	None	48 hours
Bromide (Br)	1 liter poly	None	28 days
CBOD5	1 liter poly	None	48 hours
Chemical Oxygen Demand (COD)	1 liter poly	H2SO4 pH<2	28 days
Chloride (Cl)	1 liter poly	None	28 days
Color	1 liter poly	None	48 hours
Cyanide	1 liter poly	NaOH pH>12	14 days
Dissolved Organic Carbon (DOC)	1 liter poly	H2SO4 pH<2	28 days
EP Tox	1 liter poly	None	None
Fluoride (F)	1 liter poly	None	28 days
Hardness	1 liter poly	HNO3 pH<2	6 months
Hexavalent Chromium (Cr+6)	1 liter poly	None	24 hours
Mercury (Hg)	1 liter poly	HNO3 pH<2	28 days
Metals	1 liter poly	HNO3 pH<2	6 months preserved
Nitrate (NO3)	1 liter poly	None	48 hours
Nitrite (NO2)	1 liter poly	None	48 hours
Nitrite+Nitrate (NO2+NO3)	1 liter poly	H2SO4 pH<2	28 days
Oil and Grease (O&G)	1 liter poly	H2SO4 pH<2	28 days
PCB/Pesticide	80oz amber	None	7 days
Phenol	1 liter poly	H2SO4 pH<2	28 days
Phosphorus (PO4)	1 liter poly	None	48 hours
Silica (Si)	1 liter poly	None	28 days
Sulfate (SO4)	1 liter poly	None	28 days
Sulfide	1 liter poly	None	7 days
Sulfite (SO3)	1 liter poly	None	Immediately
Total Dissolved Solid (TDS)	1 liter poly	None	7 days
Total Kjeldahl Nitrogen (TKN)	1 liter poly	H2SO4 pH<2	28 days
Total Organic Carbon (TOC)	1 liter poly	H2SO4 pH<2	28 days
Total Phosphorus (TP)	1 liter poly	H2SO4 pH<2	28 days
Total Solid (TS)	1 liter poly	None	7 days
Total Suspended Solid (TSS)	1 liter poly	None	7 days
Turbidity	1 liter poly	None	48 hours
Volatiles	3-40ml vials	HCL pH<2	14 days preserved

HCL – Hydrochloric Acid
NaOH – Sodium Hydroxide
HNO3 – Nitric Acid
H2SO4 – Sulfuric Acid

This list does not contain all possible analyses or acceptable bottle types. It was compiled from a table in the "CRL Sample Submission Guidelines (9/18/90)." In the event a desired analysis is not on the list, call the sample manager to get the proper bottle type and preservative.

VI. KEY CHECKS AND ITEMS

- Logbook is initiated with the first onsite activity
- All site activities are recorded.
- Entries must be made daily.

AR300874

SOP No. 13 Photographic Documentation

AR300875

SOP NO. 13: PHOTOGRAPHIC DOCUMENTATION

I. PURPOSE

General guidelines are provided for documenting photographs, videos, etc. taken during field activities. Field personnel will take photographs at every well sampled and at other appropriate times during the remaining RI activities.

II. SCOPE

All photographic documentation must be logged into the logbook with a full description of each record and its key points of interest. At a minimum each photographic documentation entry should include:

- Project Name
- Project Number
- Time
- Date
- Location of the Photograph
- Description of Photograph
- Film Roll Number
- Frame Number
- Name of Photographer

III. EQUIPMENT AND MATERIALS

- Time dated camera
- Extra batteries
- Film
- Site logbook

IV. PROCEDURES AND GUIDELINES

1. Load film into camera. Make sure type of film being used (i.e., ASA and speed) are appropriate for the type of photographs to be taken.

2. Aim and focus at object to be photographed.

3. Record information listed in II. SCOPE into the site logbook beginning with the last page and working backwards.

4. A placard containing photographic information may also be prepared and placed near the object to be photographed. This information will then appear in the photograph with the object. A field logbook entry,

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2. Site logbook is initiated at the start of the first on-site activity

3. Site logbook cover contains:

   - Project name
   - Project Number
   - Site Manager's Name
   - Sequential Book Number
   - Start Date
   - End Date

4. Entries are made every day that onsite RI activities occur.

5. At the beginning of each day, the following information must be recorded:

   - Date
   - Start time
   - Weather
   - List of all personnel present
   - List of all visitors present

6. Record summary of daily site activities and level of personal protection required.

7. Record all sampling information (location, headspace readings, visual observations, sample depth, analytical parameter, preservation, laboratory, etc.).

8. Record site measurements, field instrumentation used and identification number, equipment calibration and use, sample collection equipment, calculations, and field measurements (water levels, free product thickness measurements, pH, and other).

9. All entries should be made in black pen. No erasures are permitted. Incorrect entries should be crossed out with a single strike mark, and should be initialized by person making the correction.

10. At the completion of entries, the logbook must be signed at the bottom of each page by the author.

11. All photographic documentation must be logged into the logbook following procedures outlined in SOP No. 13.

V. ATTACHMENTS

None.

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SOP No. 14 COMBUSTIBLE GAS INDICATOR

AR300878

SOP NO. .14: COMBUSTIBLE GAS INDICATOR (LEL, Meter, Explosimeter)

I. PURPOSE

To provide general description of use and limitations of the combustible gas indicators.

II. SCOPE

A general description of the unit is presented. For a detailed discussion, refer to appropriate manuals.

III. EQUIPMENT AND MATERIALS

A combustible gas indicator, also known as CGI, explosimeter, LEL, LEL/02 (if combined with an oxygen detector.

Operations manual

Calibration gas (75% pentane, 15% oxygen in air)

IV. PROCEDURES AND GUIDELINES

A. GENERAL

A combustible gas indicator measures the lowest concentration of vapors that can explode or burn in the presence of sufficient oxygen and a source of ignition. The indicator response is in percent of the lower explosive limit ("LEL"). Scale range is 0% to 100%.

B. CALIBRATION AND USE

Unit must be calibrated prior to initial daily use and a minimum of once during each 4 hours of use. Calibration is typically done with a 75% pentane, 15% oxygen standard in air, however methane and hexane standards are also available. For a detailed description of calibration and use of the particular type(s) and brand(s) of unit onsite, refer to the operation manual(s).

C. CAUTIONS AND LIMITATIONS

- The combustion gas indicator cannot be used to assess the toxicity of an environment.
- These units are not designed to function in oxygen rich or oxygen deficient environments (greater than 25% or less than 19.5%).

Therefore, they should not be used in confined spaces where the oxygen concentration may potentially fall beyond this range. An LEL/02 or a separate oxygen meter will be used in such environments.

- The instruments have a tolerance range of +/- 40%.
- The combustion gas indicator's sensitivity will be adversely affected by the presence of leaded gasoline vapors, fuming acids, silicones, and silicates.

V. ATTACHMENTS

Explosimeter Calibration Sheet

VI. KEY CHECKS AND ITEMS

- Calibrate often.
- Know and respect limitations.
- Follow the site safety plan.

VII. PREVENTIVE MAINTENANCE

- Refer to the operation manual for maintenance program.
- Keep extra batteries on hand or charged at all times.
- Be careful not to suck water into the probe while sampling.

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CONDUCTIVITY METER CALIBRATION SHEET

			Instrument Readings		
		Analyst	Uncalibrated	Calibrated	
Date	Time	Initials	@75% Pentane	@75% Pentane	Comments

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SOP No. 15 Soil Boring Log Guidelines

AR300882

CONTENTS

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CONTENTS

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SOIL BORING LOG GUIDELINE

SOIL BORING LOG POLICY

This soil boring guideline will be used for all CH2M HILL projects in which soil boring techniques are used during geotechnical field exploration. The purpose of the guideline is to assist CH2M HILL staff in accurately recording and presenting all field data that are necessary to sufficiently describe, label, and package recovered soil samples in a consistent manner. The guideline establishes the minimum kinds of information that must be recorded in the field to adequately characterize recovered soil samples.

Because each of our projects is unique and because job requirements can vary widely, the minimum standards presented in this guideline may need to be supplemented with additional technical descriptions or field test results. However, all soil boring field logs, regardless of special-project circumstances, must include information addressed in this guideline to achieve minimum acceptable standards required by CH2M HILL.

All CH2M HILL staff members are encouraged to present their suggestions for clarification or improvements to this guideline. Please submit all suggestions or comments in writing to the Geotechnical Discipline Group Director.

RECORDING SOIL BORING FIELD DATA

CH2M HILL Standard Form D1586, the Soil Boring Log form, will be used on all CH2M HILL projects for field logging (see Figure 1). Adherence to a standard format for recording data will help streamline our project efforts and ensure a consistent presentation of factual subsurface data. All heading information must be completely filled out on each log sheet used, and all technical items in each column must be addressed in the field.

The boring log should be completed in the field according to the attached instructions. Forms should be filled out neatly and completely. Laboratory testing, if required, should be initiated immediately after completion of the field work. Field classifications of samples should be checked against the laboratory test results, and corrections should be noted, initialed, and dated on the field log.

INSTRUCTIONS FOR COMPLETING SOIL BORING LOG, FORM D1586

Form D1586 is a standard CH2M HILL form that is available in weatherproof paper from all regional form distributors.

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PROJECT NUMBER	BORING NUMBER	SHEET OF

SOIL BORING LOG

PROJECT _____ LOCATION _____

ELEVATION _____ DRILLING CONTRACTOR _____

DRILLING METHOD AND EQUIPMENT _____

WATER LEVEL AND DATE _____ START _____ FINISH _____ LOGGER _____

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)		SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION

Figure 1
SOIL BORING LOG,
FORM D1586

REV 7/86 FORM D

Following are instructions for completing the log forms in the field. See Figure 2 for an example of a field log completed according to the instructions.

Field personnel should review logs on completion for accuracy, clarity, and thoroughness of detail. Samples should also be checked to see that information is correctly recorded on both jar lids and labels and on the log sheets.

If any changes to the soil classification are made on the log forms after completion of the field work, they should be done in red, then initialed, and dated.

Heading Information

Project Number. Use standard region code, contract I.D. (5-digit), and point number designated for field exploration or geotechnical services.

Boring Number. Enter the boring number. A numbering system should be chosen that does not conflict with information recorded for previous exploratory work done at the site. Number the sheets consecutively for each boring. If rock core log sheets are also used, continue the consecutive numbering.

Project. Fill in the name of the project or client.

Location. If stationing, coordinates, mileposts, or similar project layout information is available, indicate the position of the boring with respect to that system, using modifiers such as "approximate" or "estimated" as appropriate. If this information is not available, identify the client facility (e.g., Richland STP, center of Clarifier No. 2 site) or the town and state.

Elevation. Enter the elevation. If it is estimated from a topographic map, or if it is roughly determined using a hand level, use the modifier "approximate." If the elevations are to be surveyed later, or if the elevation is unknown, enter this information.

Drilling Contractor. Enter the name of the drilling company and the city and state where the company is based.

Drilling Method and Equipment. Identify the bit size and type, drilling fluid (e.g., mud, Revert), and method of drilling (e.g., rotary, hollow-stem auger, air track). Information on the drilling equipment (e.g., CME 55, Mobile B61) should also be entered here.

Water Level and Date. Enter the depth at which groundwater is first encountered. If frequent water measurements are taken, the information should be recorded in the Comments

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PROJECT NUMBER	BORING NUMBER	SHEET
DJ2371.65	B-3	1 OF 3

SOIL BORING LOG

JECT Howard Ave Landslide LOCATION Howard & 24th Ave, Centennial, C
/ATION 5136 Feet DRILLING CONTRACTOR Kendall Explorations, Ashcan, Colorado
LLING METHOD AND EQUIPMENT 4-inch H.S. Augers, Mobil B-61 rotary drill via
ER LEVEL AND DATE 3.2 Feet, 8/5/86 START August 4, 1986 FINISH August 8, 1986 LOGGER I.A. Michnor

SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	2.5				Surface material consists of 4 inches AC underlain by 6 inches of 3/4-inch minus base rock		Start Drilling @ 3:00
	4.0	S-1	1.5	1-3-4 (7)	POORLY-GRADED SAND WITH SILT, fine, light brown, wet, loose (SP-SM)		Driller notes water at 4 feet
	5.0						Driller notes very soft drill 4 ft, dark gray, wet silty cuttings
	6.5	S-2	0.9	WOH/12" - 1	ORGANIC SILT, very dark gray to black, wet, very soft (OL); strong H_2S odor; many fine roots up to about 1/4 inch		
	8.0						
	10.0	ST-3	1.3	—	ORGANIC SILT, similar to S-2, except includes fewer roots (by volume)		
	11.5	S-4	1.3	2-2-2 (4)	SILT, very dark gray to black, wet, soft (ML)		water level @ 3.2 feet on 8/5/86 @ 0730
	15.0						Driller notes rough drilling action and chatter @ 13 ft
	15.5	S-5	0.5	60/6"	SILTY GRAVEL, rounded gravel up to about 1 inch maximum observed size, wet, very dense (GM)		
	20.0						Driller notes smoother, firm drilling @ 19 ft
	21.0	S-6	1.0	8-12-50/6"	LEAN CLAY WITH SAND, medium to light green, moist, very stiff (CL),		some angular rock chips @ tip of S-6; poss boulder? rock
	23.0						Driller notes very hard, slow grinding, smooth, drilling action from 21 to 23 ft, possibly bedrock
	23.1	S-7	0	50/1"	NO RECOVERY		
					END SOIL BORING @ 23.1 Feet SEE ROCK CORE LOG FOR CONTINUATION OF B-3		

Figure 2
EXAMPLE OF COMPLETED LOG FORM

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column. If water is not encountered during drilling, or could not be detected because of the drilling method, this information should be noted. Generally, water levels should be measured each morning before resuming drilling and at the completion of each boring. Record date and time of day (for tides, river stage, etc.) of each water level measurement.

Date of Start and Finish. Enter the dates the boring was begun and completed. Time of day may be added if several borings are performed on the same day.

Logger. Enter the first initial and full last name.

Technical Data

Depth Below Surface. Use a depth scale that is appropriate for the sample spacing and for the complexity of subsurface conditions.

Sample Interval. Draw horizontal lines at the top and bottom depth of each sample interval. These lines should extend to the soil description column. For a very short sample interval, the bottom line can be lowered after the interval column to provide room for writing the information (see Figure 2). Enter the depth at the top and bottom of the sample interval.

Sample Type and Number. Enter the sample type and number. For instance, S1 = split spoon, first sample. Number samples consecutively regardless of type. Enter a sample number even if no material was recovered in the sampler.

Sample Recovery. Enter the length to the nearest tenth of a foot of soil sample recovered from the sampler.

Standard Penetration Test Results. In this column enter the number of blows required for each 6 inches of sampler penetration and the "N" value, which is the sum of the blows in the last two 6-inch penetration intervals. A typical standard penetration test involving successive blow counts of 2, 3, and 4 would be recorded as 2-3-4 and (7). The standard penetration test will be terminated if the sampler encounters refusal. Refusal is a penetration of more than 6 inches but less than 12 inches with a blow count of 100, or a penetration of less than 6 inches with a blow count of 50. A partial penetration of 50 blows for 4 inches is recorded as 50/4".

Soil Description. The soil classification should follow the format described in the section below entitled "Field Classification of Soil."

Symbolic Log. This column is usually omitted during fieldwork.

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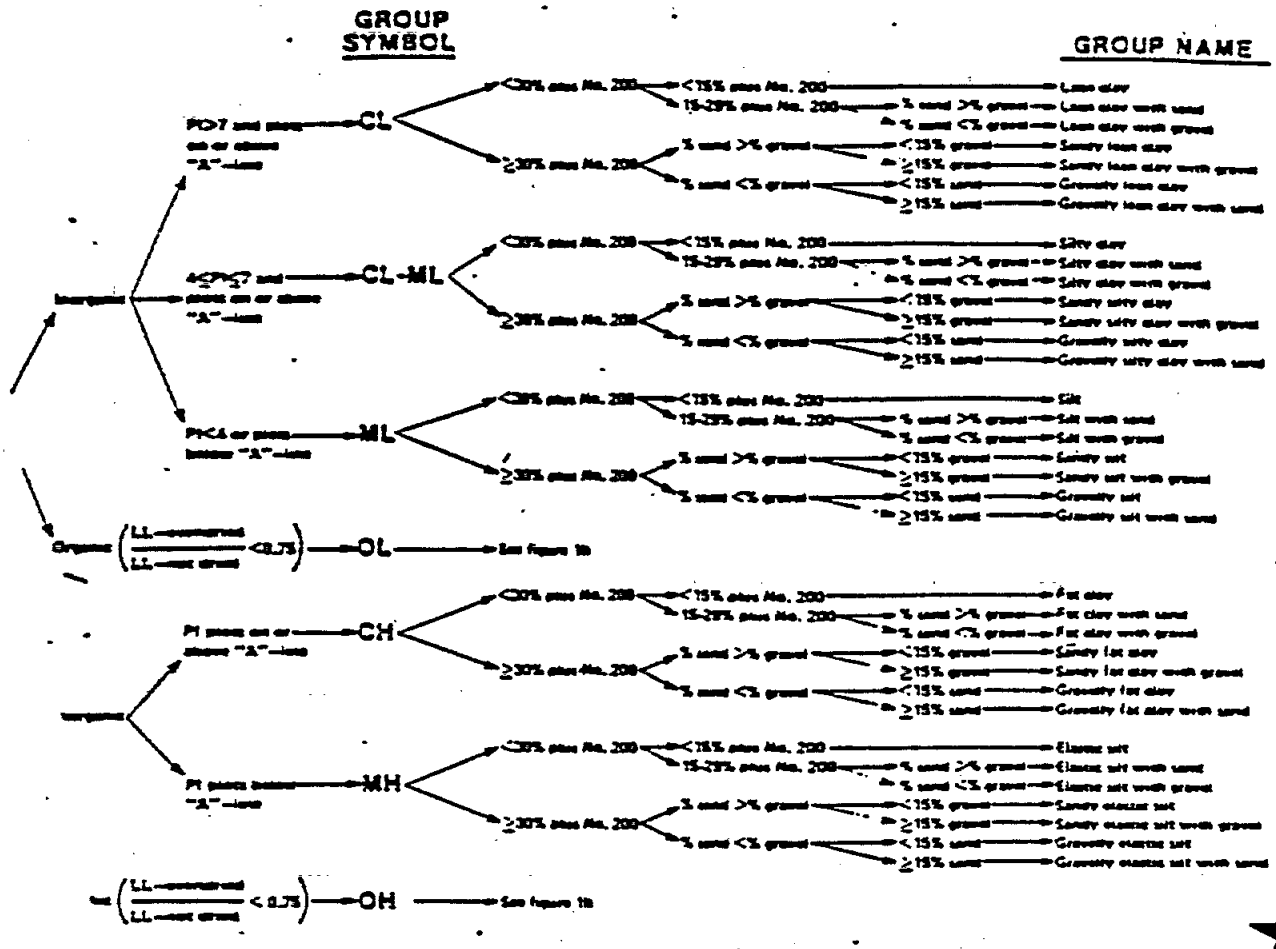

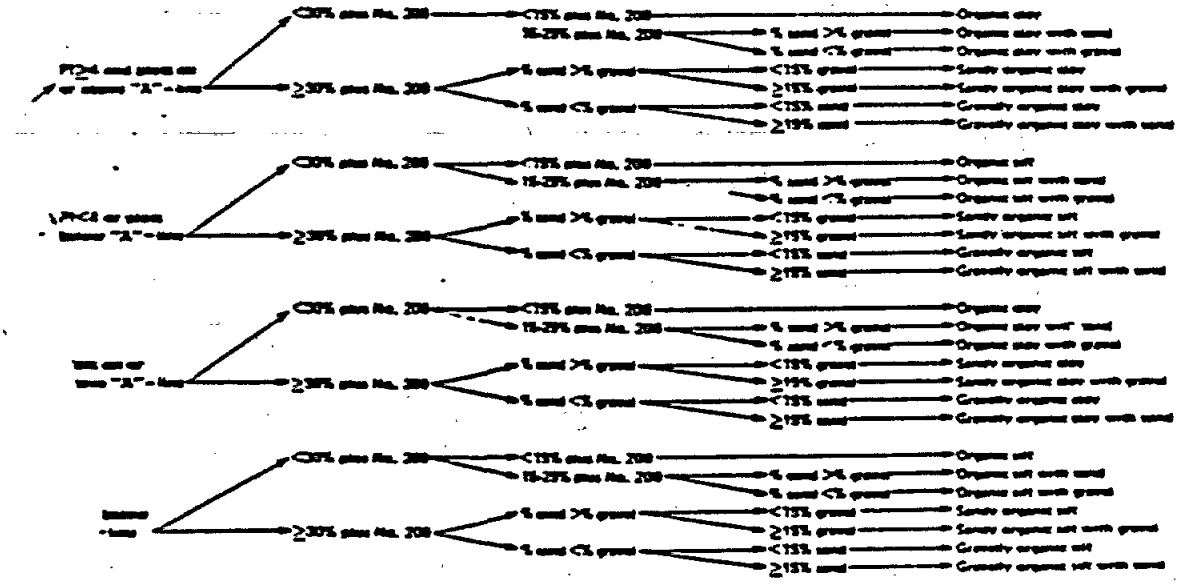

Figure 3
FLOWCHART FOR CLASSIFICATION OF FINE-GRAINED SOIL

AR300890

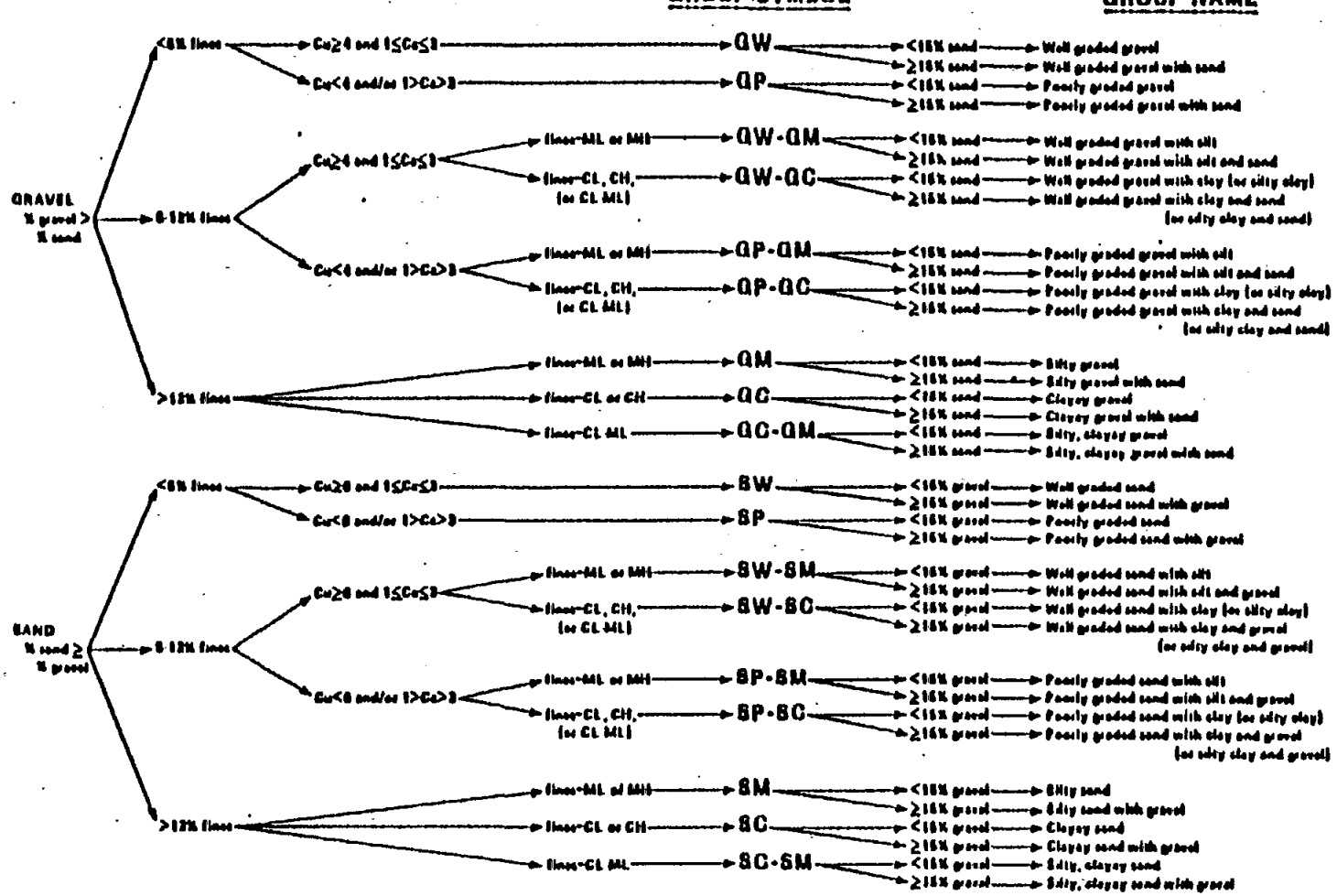

Figure 4
FLOWCHART FOR CLASSIFICATION OF COARSE-GRAINED SOIL

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soil types in a bedded deposit, can be obtained only in the field. Corrections and additions to the field classification can be provided, when necessary, by laboratory testing of the soil samples.

Soil descriptions should be precise and comprehensive without being verbose. The correct overall impression of the soil should not be distorted by excessive emphasis on insignificant details. In general, similarities between consecutive samples should be stressed rather than differences.

Soil descriptions shall be recorded in the Soil Description column for every soil sample collected. The format and order for soil descriptions should be:

1. Soil name (synonymous with ASTM D 2487-85 Group Name) with appropriate modifiers
2. Color
3. Moisture content
4. Relative density or consistency
5. Soil structure or mineralogy
6. Group symbol

This order follows, in general, the format described in ASTM D 2488-84. Examples of soil descriptions are provided in Table 1.

Soil Name

The basic name of a soil shall be identical to the ASTM D 2487-85 Group Name based on visual estimates of gradation and plasticity. The soil name should be capitalized. The only acceptable soil names are those listed in Figures 3 and 4, which are from ASTM D 2487-85.

Examples of acceptable soil names are illustrated by the following:

A soil sample is visually estimated to contain 15 percent gravel, 55 percent sand, 30 percent fines (passing No. 200 sieve). The fines are estimated as either low or highly plastic silt. This sample is SILTY SAND WITH GRAVEL, with a Group Symbol of (SM).

Another soil sample has the following visual estimate: 10 percent gravel, 30 percent sand, and 60 percent fines (passing the No. 200 sieve). The fines are estimated as low plastic silt. This sample is SANDY SILT. The gravel portion is not included in the soil

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Table 1
EXAMPLE SOIL DESCRIPTIONS

POORLY GRADED SAND, fine, well-rounded, light brown, moist, loose (SP)

FAT CLAY, dark gray, moist, stiff (CH)

SILT, light greenish gray, wet, very loose, some mica, lacustrine (ML)

WELL-GRADED SAND WITH GRAVEL, subangular gravel to 0.6 inches max, reddish brown, moist, dense, (SW)

POORLY GRADED SAND WITH SILT, white, wet, medium dense (SP-SM)

ORGANIC SILT WITH SAND, dark brown to black, wet, firm to stiff but spongy undisturbed, becomes soft and sticky when remolded, many fine roots, trace of mica (OH)

SILTY GRAVEL WITH SAND, subrounded gravel to 1.2 inches max, brownish red, moist, very dense, (GM)

INTERLAYERED SILT (60 percent) AND CLAY (40 percent): SILT WITH SAND, nonplastic, sudden reaction to shaking, medium greenish gray, layers mostly 1.5 to 8.3 inches thick; CLAY, dark gray, firm and brittle undisturbed, becomes very soft and sticky when remolded, layers 0.2 to 1.2 inches thick (ML and CH)

SILTY SAND WITH GRAVEL, weak gravel to 1.0 inches max, light yellowish brown, compact, moist, very few small particles of coal, fill (SM)

SANDY ELASTIC SILT, very light gray to white, wet, stiff, weak calcareous cementation, (MH)

SILTY CLAY WITH SAND, dark brownish gray, moist, stiff (ML-CL)

WELL-GRADED GRAVEL WITH SILT, rounded gravel to 1.0 inches max, brown, moist, very dense (GW-GM)

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name because the gravel portion was estimated as less than 15 percent. The Group Symbol is (ML).

The gradation of coarse-grained soil (more than 50 percent retained on No. 200 sieve) is included in the specific soil name in accordance with ASTM D 2487-85. There is no need to further document the gradation. However, the maximum size and angularity or roundedness of gravel and sand-sized particles should be recorded. For fine-grained soil (50 percent or more passing the No. 200 sieve), the name is modified by the appropriate plasticity/elasticity term in accordance with ASTM D 2487-85.

Interlayered soil should each be described starting with the predominant type. An introductory name should be used such as "Interlayered Sand and Silt." Also, the relative proportion of each soil type should be indicated (see Table 1 for example).

Where helpful, the evaluation of plasticity/elasticity can be justified by describing results from any of the visual-manual procedures for identifying fine-grained soils, such as reaction to shaking, toughness of a soil thread, or dry strength as described in ASTM D 2488-84.

Color

The basic color of a soil, such as brown, gray, or red, shall be given. The color term can be modified, if necessary, by adjectives such as light, dark, or mottled. The color description should be kept simple and should not emphasize unimportant color aspects or shades.

Moisture Content

The degree of moisture present in a soil sample should be defined as dry, moist, or wet. Moisture content can be estimated as follows:

Dry	Requires addition of considerable moisture to obtain optimum moisture content
Moist	Near optimum moisture content
Wet	Requires drying to obtain optimum moisture content

Relative Density or Consistency

Relative density of a coarse-grained (cohesionless) soil is based on N-values (ASTM D 1586-84). If the presence of large gravel or disturbance of the sample makes determination of the in situ relative density or consistency

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difficult, then this item should be left out of the description and explained in the Comments column of the soil boring log.

Consistency of fine-grained (cohesive) soil is properly based on results of pocket penetrometer or torvane results. In the absence of this information, consistency can be estimated from N-values. Relationships for determining relative density or consistency of soil samples are given in Tables 2 and 3.

Soil Structure or Mineralogy

Discontinuities and inclusions are important and should be described. Such features include joints or fissures, slickensides, bedding or laminations, veins, root holes, and wood debris.

Significant mineralogical information should be noted. Cementation, abundant mica, or unusual mineralogy should be described, as well as other information such as organic debris or odor.

Residual soils have characteristics of both rock and soil and can be difficult to classify. Relict rock structure should be described and the parent rock identified if possible.

Group Symbol

Each soil description is concluded with the appropriate group symbol from ASTM D 2487-85 (see Figures 3 and 4). The group symbol should be placed in parentheses at the end of the description to indicate that the classification has been estimated.

In accordance with ASTM D 2488-84, dual symbols (e.g., GP-GM or SW-SC) can be used to indicate that a soil is estimated to have between 5 and 12 percent fines. Borderline symbols (e.g., GM/SM or SW/SP) can be used to indicate that a soil sample has been identified as having properties that do not distinctly place the soil into a specific group. Generally, the group name assigned to a soil with a borderline symbol should be the group name for the first symbol. The use of a borderline symbol should not be used indiscriminately. Every effort should be made to first place the soil into a single group.

STANDARD PENETRATION TEST PROCEDURES

Standard Penetration Tests (SPT) are conducted to obtain a measure of the resistance of the soil to penetration of the sampler and to recover a disturbed soil sample. Standard Penetration Tests should be conducted in accordance with ASTM D 1586-84, Penetration Test and Split Barrel Sampling of Soils.

Table 2
RELATIVE DENSITY OF COARSE-GRAINED SOIL
(Developed from Sowers, 1979)

Blows/Ft	Relative Density	Field Test
0-4	Very loose	Easily penetrated with ½-in. steel rod pushed by hand
5-10	Loose	Easily penetrated with ½-in. steel rod pushed by hand
11-30	Medium	Easily penetrated with ½-in. steel rod driven with 5-lb. hammer
31-50	Dense	Penetrated a foot with ½-in. steel rod driven with 5-lb. hammer
>50	Very dense	Penetrated only a few inches with ½-in. steel rod driven with 5-lb. hammer

Table 3
CONSISTENCY OF FINE-GRAINED SOIL
(Developed from Sowers, 1979)

Blows/Ft	Consistency	Pocket Penetrometer (TSF)	Torvane (TSF)	Field Test
<2	Very soft	<0.25	<0.12	Easily penetrated several inches by fist
2-4	Soft	0.25-0.50	0.12-0.25	Easily penetrated several inches by thumb
5-8	Firm	0.50-1.0	0.25-0.5	Can be penetrated several inches by thumb with moderate effort
9-15	Stiff	1.0-2.0	0.5-1.0	Readily indented by thumb but penetrated only with great effort
16-30	Very stiff	2.0-4.0	1.0-2.0	Readily indented by thumbnail
>30	Hard	>4.0	>2.0	Indented with difficulty by thumbnail

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Equipment and Calibration

Before starting the testing, the necessary equipment should be inspected for compliance with the requirements of ASTM D 1586-84. The split-barrel sampler should measure 2 inches O.D., with 1-3/8 inches I.D., and should have a split tube at least 18 inches long. The dimensions should conform with those indicated on Figure 1 of ASTM D 1586-84. The minimum size sampler rod allowed is "A" rod (1-5/8 inches O.D.). A stiffer rod, such as "N" rod (2-5/8 inches O.D.), is required for depths greater than 50 feet. The drive weight assembly should consist of a 140-pound hammer weight, a drive head, and a hammer guide that permits a free fall of 30 inches.

Procedures

Standard Penetration Tests should be conducted at every change of strata or, within a continuous stratum, at intervals not exceeding 5 feet. Before driving the split-barrel sampler, all loose and foreign material should be removed from the bottom of the borehole. It may be helpful to measure the rod "stickup" to ensure that the sampler is being driven from the bottom of the borehole. The Standard Penetration Test should be performed by driving a standard split-barrel sampler 18 inches into undisturbed soil at the bottom of the borehole by a 140-pound guided hammer or ram, falling freely from a height of 30 inches.

The number of blows required to drive the sampler for three 6-inch intervals, for a total of 18 inches, should be observed and recorded on the soil boring log. The sum of the number of blows required to drive the sampler the second and third 6-inch intervals is considered the Standard Penetration Resistance (N) or the "blow-count." If the sampler is driven less than 18 inches, but more than 1 foot, the penetration resistance (N) is that for the last 1 foot of penetration. If less than 1 foot is penetrated, the log shall state the number of blows and the fraction of 1 foot penetrated. If possible, the field logger should observe the sampler being driven and count the blows for each sample attempt.

General Considerations

The following comments and suggestions should be considered when performing Standard Penetration Testing:

1. The borehole should be cleaned out before every sample attempt. Because a minor amount of caving can be expected, the borehole can be considered to be adequately cleaned if no more than 4 inches of loose or foreign material has collected at the bottom of the borehole. A greater amount of caving is sufficient cause to require the hole to be cleaned again.

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2. The ball check valve in the split-barrel sampler should be cleaned and working properly for each sample. Bent, chipped, or damaged shoes should be replaced. The split-barrel halves should not be warped. In case of zero sample recovery (i.e., if the sample is lost during first attempt), a spring catcher should be used during subsequent attempts to facilitate recovery.

3. During SPT sampling, it is important that all rod connections be tight and that the hammer guide be connected securely to the drill rods. If the hammer guide connection becomes loose, much of the hammer energy may be lost because of deflection of the hammer coupling. The lifting rope should not rub against the mast. Each hammer fall should be 30 inches.

4. During SPT sampling, it is important that the drill rods be positioned at the center of the drill hole. This is necessary to preclude the development of friction between drill rods and the walls of the borehole or casing.

5. If the hammer weight is raised by means of a cathead, generally two wraps on the cathead should be used. The optimum number of wraps will vary with the condition of the rope and cathead and the weather. Most importantly, the driller should exercise care to prevent friction of the rope on the cathead during the fall of the hammer.

6. Occasionally, nonstandard procedures or equipment are used for obtaining samples (such as 3-inch O.D. split-barrel samplers, or 300-pound hammers). Any nonstandard practice should be described on the boring log form. Also, the blow counts should be clearly marked as not conforming to SPT values.

SAMPLE LABELING AND PACKAGING

The samples recovered from the borehole are an important part of the boring record and must be properly packaged and labeled. Samples that are improperly or inadequately labeled are useless. The following description outlines the minimum requirements for packaging and labeling of samples.

Disturbed samples should be placed in jars that are marked both on the jar lid and on a label on the side of the jar. Standard CH2M HILL jar labels are available (Form No. 131, Soil Sample Labels) for this purpose. The following information should be clearly marked on the jars: job number, boring number, sample number, sample depth, blow counts, sample recovery, and date. Use an indelible marker or a metal scriber on the jar lid. If moisture content tests are anticipated, jar samples should be tightly sealed, then sent

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to the laboratory and the testing initiated as soon as possible; testing should occur within one week. See Figure 5 for labeling details.

Boxes containing the jars should be labeled on top and on one end with the following information: job name, job number, boring number, sample numbers and sample depths, date, and name. It is helpful to start a new box for each new boring if the boxes are at least one-half full.

FIELD EQUIPMENT CHECKLIST

Table 4 lists equipment and supplies that are necessary or useful for soil boring exploration.

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JAR SAMPLES

OFFICE CVO

PROJECT NO. C12693.A5

T.H. B-101 SAMPLE S-2

DEPTH				
10.0' - 11.5'	BLOWS	7	10	15
	INCHES	6	6	6

DATE 1-15-79 Recov. 1.3'

FORM # 131

SIDE LABEL

C12693.A5

B-101
S-2
10.0' - 11.5'

7-10-15

RECOV. 1.3'

1-15-79

LID

Figure 5
SAMPLE LABELING DETAILS

Table 4
FIELD EQUIPMENT CHECKLIST FOR SOIL BORING LOGGING

Siting

___Lath, flagging, and orange spray paint
___Lumber crayon
___100-foot tape
___Brunton or Silva compass

Logging Equipment

___Soil Boring Guideline
___Clipboard
___Form D1586 on all-weather paper
___Pens/pencils
___Engineer's pocket tape measure with tape lock
___Field notebook on all-weather paper
___Squirt bottle with water
___Spatula
___HCL, 10 percent solution

Sampling and Packaging

___Jars with lids and labels (Form #131)
___Shelby tubes and plastic end caps
___Airtight tape (e.g., electrical)
___Newspaper
___Wax, stove, melting pot, and matches
___Indelible fine felt-tipped markers (e.g., "Sharpie" brand)

Test Equipment

___Pocket penetrometer
___Torvane
___Well sounder

Other

___Camera, film
___Hand lens
___Rags
___Ear protectors
___Screwdrivers
___Hard hat
___Sunscreen
___Insect repellent

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Attachments:

ASTM D-1586-84 Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils

AR300903

Designation: D 1586 – 84 (Reapproved 1992)ε1

Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils[1]

This standard is issued under the fixed designation D 1586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense. Consult the DOD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

ε1 NOTE—Editorial changes were made throughout October 1992.

1. Scope

1.1 This test method describes the procedure, generally known as the Standard Penetration Test (SPT), for driving a split-barrel sampler to obtain a representative soil sample and a measure of the resistance of the soil to penetration of the sampler.

1.2 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For a specific precautionary statement, see 5.4.1.

1.3 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 2487 Test Method for Classification of Soils for Engineering Purposes[2]

D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[2]

D 4220 Practices for Preserving and Transporting Soil Samples[2]

D 4633 Test Method for Stress Wave Energy Measurement for Dynamic Penetrometer Testing Systems[2]

3. Terminology

3.1 *Descriptions of Terms Specific to This Standard*

3.1.1 *anvil*—that portion of the drive-weight assembly which the hammer strikes and through which the hammer energy passes into the drill rods.

3.1.2 *cathead*—the rotating drum or windlass in the rope-cathead lift system around which the operator wraps a rope to lift and drop the hammer by successively tightening and loosening the rope turns around the drum.

3.1.3 *drill rods*—rods used to transmit downward force and torque to the drill bit while drilling a borehole.

3.1.4 *drive-weight assembly*—a device consisting of the hammer, hammer fall guide, the anvil, and any hammer drop system.

3.1.5 *hammer*—that portion of the drive-weight assembly consisting of the 140 ± 2 lb (63.5 ± 1 kg) impact weight which is successively lifted and dropped to provide the energy that accomplishes the sampling and penetration.

3.1.6 *hammer drop system*—that portion of the drive-weight assembly by which the operator accomplishes the lifting and dropping of the hammer to produce the blow.

3.1.7 *hammer fall guide*—that part of the drive-weight assembly used to guide the fall of the hammer.

3.1.8 *N-value*—the blowcount representation of the penetration resistance of the soil. The *N*-value, reported in blows per foot, equals the sum of the number of blows required to drive the sampler over the depth interval of 6 to 18 in. (150 to 450 mm) (see 7.3).

3.1.9 Δ*N*—the number of blows obtained from each of the 6-in. (150-mm) intervals of sampler penetration (see 7.3).

3.1.10 *number of rope turns*—the total contact angle between the rope and the cathead at the beginning of the operator's rope slackening to drop the hammer, divided by 360° (see Fig. 1).

3.1.11 *sampling rods*—rods that connect the drive-weight assembly to the sampler. Drill rods are often used for this purpose.

3.1.12 *SPT*—abbreviation for Standard Penetration Test, a term by which engineers commonly refer to this method.

4. Significance and Use

4.1 This test method provides a soil sample for identification purposes and for laboratory tests appropriate for soil obtained from a sampler that may produce large shear strain disturbance in the sample.

4.2 This test method is used extensively in a great variety of geotechnical exploration projects. Many local correlations and widely published correlations which relate SPT blowcount, or *N*-value, and the engineering behavior of earthworks and foundations are available.

5. Apparatus

5.1 *Drilling Equipment*—Any drilling equipment that provides at the time of sampling a suitably clean open hole before insertion of the sampler and ensures that the penetration test is performed on undisturbed soil shall be acceptable. The following pieces of equipment have proven to be

[1] This method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigations.

Current edition approved Sept. 11, 1984. Published November 1984. Originally published as D 1586 – 58 T. Last previous edition D 1586 – 67 (1974).

[2] *Annual Book of ASTM Standards*, Vol 04.08.

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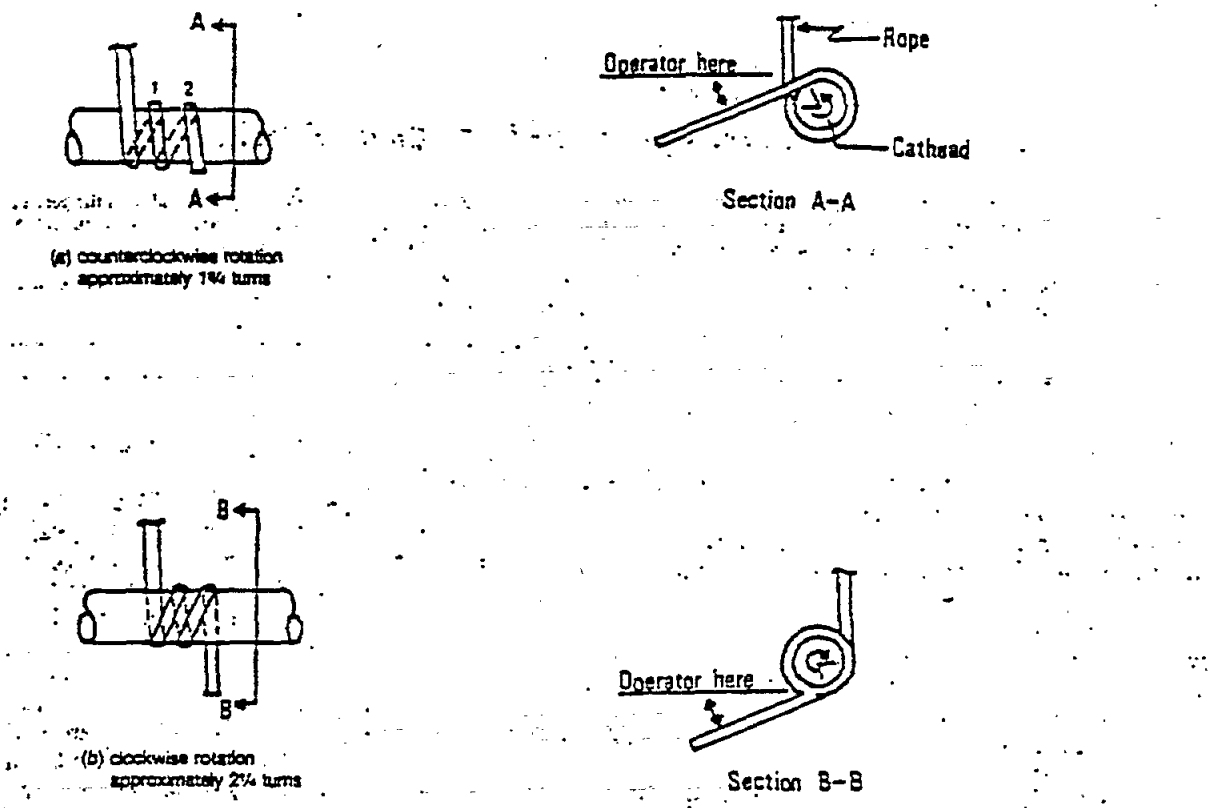

FIG. 1 Definitions of the Number of Rope Turns and the Angle for (a) Counterclockwise Rotation and (b) Clockwise Rotation of the Cathead

suitable for advancing a borehole in some subsurface conditions.

5.1.1 *Drag, Chopping, and Fishtail Bits*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjuction with open-hole rotary drilling or casing-advancement drilling methods. To avoid disturbance of the underlying soil, bottom discharge bits are not permitted; only side discharge bits are permitted.

5.1.2 *Roller-Cone Bits*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advancement drilling methods if the drilling fluid discharge is deflected.

5.1.3 *Hollow-Stem Continuous Flight Augers*, with or without a center bit assembly, may be used to drill the boring. The inside diameter of the hollow-stem augers shall be less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm).

5.1.4 *Solid, Continuous Flight, Bucket and Hand Augers*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used if the soil on the side of the boring does not cave onto the sampler or sampling rods during sampling.

5.2 *Sampling Rods*—Flush-joint steel drill rods shall be used to connect the split-barrel sampler to the drive-weight assembly. The sampling rod shall have a stiffness (moment of inertia) equal to or greater than that of parallel wall "A" rod (a steel rod which has an outside diameter of 1⅜ in. (41.2 mm) and an inside diameter of 1⅛ in. (28.5 mm).

NOTE 1—Recent research and comparative testing indicates the type rod used, with stiffness ranging from "A" size rod to "N" size rod, will usually have a negligible effect on the *N*-values to depths of at least 100 ft (30 m).

5.3 *Split-Barrel Sampler*—The sampler shall be constructed with the dimensions indicated in Fig. 2. The driving shoe shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. The use of liners to produce a constant inside diameter of 1⅜ in. (35 mm) is permitted, but shall be noted on the penetration record if used. The use of a sample retainer basket is permitted, and should also be noted on the penetration record if used.

NOTE 2—Both theory and available test data suggest that *N*-values may increase between 10 to 30 % when liners are used.

5.4 *Drive-Weight Assembly:*

5.4.1 *Hammer and Anvil*—The hammer shall weigh 140 ± 2 lb (63.5 ± 1 kg) and shall be a solid rigid metallic mass. The hammer shall strike the anvil and make steel on steel contact when it is dropped. A hammer fall guide permitting a free fall shall be used. Hammers used with the cathead and rope method shall have an unimpeded overlift capacity of at least 4 in. (100 mm). For safety reasons, the use of a hammer assembly with an internal anvil is encouraged.

NOTE 3—It is suggested that the hammer fall guide be permanently marked to enable the operator or inspector to judge the hammer drop height.

5.4.2 *Hammer Drop System*—Rope-cathead, trip, semi-automatic, or automatic hammer drop systems may be used, providing the lifting apparatus will not cause penetration of

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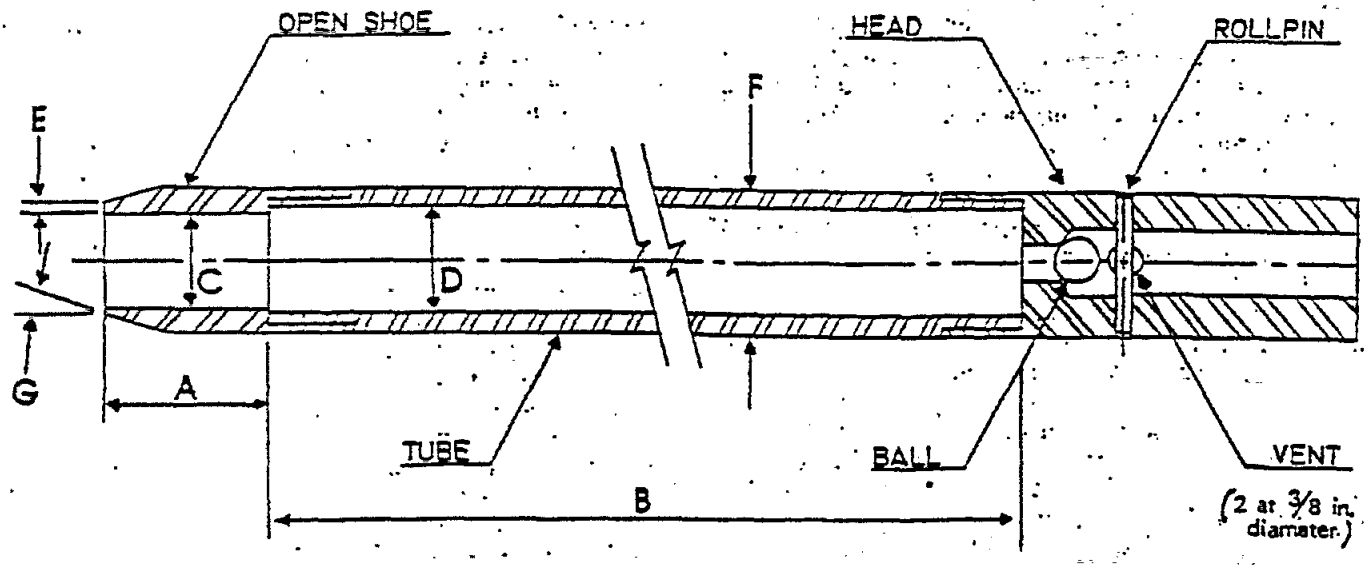

A = 1.0 to 2.0 in. (25 to 50 mm)
B = 18.0 to 30.0 in. (0.457 to 0.762 m)
C = 1.375 ± 0.005 in. (34.93 ± 0.13 mm)
D = 1.50 ± 0.05 − 0.00 in. (38.1 ± 1.3 − 0.0 mm)
E = 0.10 ± 0.02 in. (2.54 ± 0.25 mm)
F = 2.00 ± 0.05 − 0.00 in. (50.8 ± 1.3 − 0.0 mm)
G = 16.0° to 23.0°

The 1½ in. (38 mm) inside diameter split barrel may be used with a 16-gage wall thickness split liner. The penetrating end of the drive shoe may be slightly rounded. Metal or plastic retainers may be used to retain soil samples.

FIG. 2 Split-Barrel Sampler

the sampler while re-engaging and lifting the hammer.

5.5 *Accessory Equipment*—Accessories such as labels, sample containers, data sheets, and groundwater level measuring devices shall be provided in accordance with the requirements of the project and other ASTM standards.

6. Drilling Procedure

6.1 The boring shall be advanced incrementally to permit intermittent or continuous sampling. Test intervals and locations are normally stipulated by the project engineer or geologist. Typically, the intervals selected are 5 ft (1.5 mm) or less in homogeneous strata with test and sampling locations at every change of strata.

6.2 Any drilling procedure that provides a suitably clean and stable hole before insertion of the sampler and assures that the penetration test is performed on essentially undisturbed soil shall be acceptable. Each of the following procedures have proven to be acceptable for some subsurface conditions. The subsurface conditions anticipated should be considered when selecting the drilling method to be used.

6.2.1 Open-hole rotary drilling method.

6.2.2 Continuous flight hollow-stem auger method.

6.2.3 Wash boring method.

6.2.4 Continuous flight solid auger method.

6.3 Several drilling methods produce unacceptable borings. The process of jetting through an open tube sampler and then sampling when the desired depth is reached shall not be permitted. The continuous flight solid auger method shall not be used for advancing the boring below a water table or below the upper confining bed of a confined non-cohesive stratum that is under artesian pressure. Casing may not be advanced below the sampling elevation prior to sampling. Advancing a boring with bottom discharge bits is not permissible. It is not permissible to advance the boring for subsequent insertion of the sampler solely by means of previous sampling with the SPT sampler.

6.4 The drilling fluid level within the boring or hollow-stem augers shall be maintained at or above the in situ groundwater level at all times during drilling, removal of drill rods, and sampling.

7. Sampling and Testing Procedure

7.1 After the boring has been advanced to the desired sampling elevation and excessive cuttings have been removed, prepare for the test with the following sequence of operations.

7.1.1 Attach the split-barrel sampler to the sampling rods and lower into the borehole. Do not allow the sampler to drop onto the soil to be sampled.

7.1.2 Position the hammer above and attach the anvil to the top of the sampling rods. This may be done before the sampling rods and sampler are lowered into the borehole.

7.1.3 Rest the dead weight of the sampler, rods, anvil, and drive weight on the bottom of the boring and apply a seating blow. If excessive cuttings are encountered at the bottom of the boring, remove the sampler and sampling rods from the boring and remove the cuttings.

7.1.4 Mark the drill rods in three successive 6-in. (0.15-m) increments so that the advance of the sampler under the impact of the hammer can be easily observed for each 6-in. (0.15-m) increment.

7.2 Drive the sampler with blows from the 140-lb (63.5-

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kg) hammer and count the number of blows applied in each 6-in. (0.15-m) increment until one of the following occurs:

7.2.1 A total of 50 blows have been applied during any one of the three 6-in. (0.15-m) increments described in 7.1.4.

7.2.2 A total of 100 blows have been applied.

7.2.3 There is no observed advance of the sampler during the application of 10 successive blows of the hammer.

7.2.4 The sampler is advanced the complete 18 in. (0.45 m) without the limiting blow counts occurring as described in 7.2.1, 7.2.2, or 7.2.3.

7.3 Record the number of blows required to effect each 6 in. (0.15 m) of penetration or fraction thereof. The first 6 in. is considered to be a seating drive. The sum of the number of blows required for the second and third 6 in. of penetration is termed the "standard penetration resistance," or the "*N*-value." If the sampler is driven less than 18 in. (0.45 m), as permitted in 7.2.1, 7.2.2, or 7.2.3, the number of blows per each complete 6-in. (0.15-m) increment and per each partial increment shall be recorded on the boring log. For partial increments, the depth of penetration shall be reported to the nearest 1 in. (25 mm), in addition to the number of blows. If the sampler advances below the bottom of the boring under the static weight of the drill rods or the weight of the drill rods plus the static weight of the hammer, this information should be noted on the boring log.

7.4 The raising and dropping of the 140-lb (63.5-kg) hammer shall be accomplished using either of the following two methods:

7.4.1 By using a trip, automatic, or semi-automatic hammer drop system which lifts the 140-lb (63.5-kg) hammer and allows it to drop 30 ± 1.0 in. (0.76 m ± 25 mm) unimpeded.

7.4.2 By using a cathead to pull a rope attached to the hammer. When the cathead and rope method is used the system and operation shall conform to the following:

7.4.2.1 The cathead shall be essentially free of rust, oil, or grease and have a diameter in the range of 6 to 10 in. (150 to 250 mm).

7.4.2.2 The cathead should be operated at a minimum speed of rotation of 100 RPM, or the approximate speed of rotation shall be reported on the boring log.

7.4.2.3 No more than 2¼ rope turns on the cathead may be used during the performance of the penetration test, as shown in Fig. 1.

NOTE 4—The operator should generally use either 1¾ or 2¼ rope turns, depending upon whether or not the rope comes off the top (1¾ turns) or the bottom (2¼ turns) of the cathead. It is generally known and accepted that 2¾ or more rope turns considerably impedes the fall of the hammer and should not be used to perform the test. The cathead rope should be maintained in a relatively dry, clean, and unfrayed condition.

7.4.2.4 For each hammer blow, a 30-in. (0.76-m) lift and drop shall be employed by the operator. The operation of pulling and throwing the rope shall be performed rhythmically without holding the rope at the top of the stroke.

7.5 Bring the sampler to the surface and open. Record the percent recovery or the length of sample recovered. Describe the soil samples recovered as to composition, color, stratification, and condition, then place one or more representative portions of the sample into sealable moisture-proof containers (jars) without ramming or distorting any apparent stratification. Seal each container to prevent evaporation soil moisture. Affix labels to the containers bearing designation, boring number, sample depth, and the b count per 6-in. (0.15-m) increment. Protect the sam against extreme temperature changes. If there is a soil cha within the sampler; make a jar for each stratum and not location in the sampler barrel.

8. Report

8.1 Drilling information shall be recorded in the field shall include the following:

8.1.1 Name and location of job,

8.1.2 Names of crew,

8.1.3 Type and make of drilling machine,

8.1.4 Weather conditions,

8.1.5 Date and time of start and finish of boring,

8.1.6 Boring number and location (station and coor nates, if available and applicable),

8.1.7 Surface elevation, if available,

8.1.8 Method of advancing and cleaning the boring,

8.1.9 Method of keeping boring open,

8.1.10 Depth of water surface and drilling depth at time of a noted loss of drilling fluid, and time and date wh reading or notation was made,

8.1.11 Location of strata changes,

8.1.12 Size of casing, depth of cased portion of boring,

8.1.13 Equipment and method of driving sampler,

8.1.14 Type sampler and length and inside diameter barrel (note use of liners),

8.1.15 Size, type, and section length of the sampling ro and

8.1.16 Remarks.

8.2 Data obtained for each sample shall be recorded in t field and shall include the following:

8.2.1 Sample depth and, if utilized, the sample numbe

8.2.2 Description of soil,

8.2.3 Strata changes within sample,

8.2.4 Sampler penetration and recovery lengths, and

8.2.5 Number of blows per 6-in. (0.15-m) or parti increment.

9. Precision and Bias

9.1 *Precision*—A valid estimate of test precision has n been determined because it is too costly to conduct th necessary inter-laboratory (field) tests. Subcommitt D18.02 welcomes proposals to allow development of a val precision statement.

9.2 *Bias*—Because there is no reference material for th test method, there can be no bias statement.

9.3 Variations in *N*-values of 100 % or more have be observed when using different standard penetration te apparatus and drillers for adjacent borings in the same so formation. Current opinion, based on field experienc indicates that when using the same apparatus and drille *N*-values in the same soil can be reproduced with a coeff cient of variation of about 10 %.

9.4 The use of faulty equipment, such as an extreme massive or damaged anvil, a rusty cathead, a low spee cathead, an old, oily rope, or massive or poorly lubricate rope sheaves can significantly contribute to differences i *N*-values obtained between operator-drill rig systems.

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9.5 The variability in *N*-values produced by different drill rigs and operators may be reduced by measuring that part of the hammer energy delivered into the drill rods from the sampler and adjusting *N* on the basis of comparative energies. A method for energy measurement and *N*-value adjustment is given in Test Method D 4633.

10. Keywords

10.1 blow count; in-situ test; penetration resistance; split-barrel sampling; standard penetration test

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, PA 19103.

AR300908

Attachment B
Health and Safety Plan

AR300909

CH2M HILL HEALTH AND SAFETY PLAN

This health and safety plan will be kept onsite during field activities and will be reviewed and updated as necessary. It adopts, by reference, the standards of practice (SOP) contained in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual, Volumes 1 and 2*, and other applicable CH2M HILL SOPs as appropriate. The site safety coordinator (SSC) is to be familiar with these SOPs. In addition, this plan adopts procedures contained in the work plan for the project.

1.0 PROJECT INFORMATION AND DESCRIPTION

CLIENT OR OWNER: U.S. Environmental Protection Agency - Region III

PROJECT NO: NAE63191.PP.WP

PROJECT MANAGER: Juliana Hess

OFFICE: NJO

SITE NAME: Fischer and Porter

SITE ADDRESS: County Line and Jacksonville Roads, Warminster, PA

DATE HEALTH AND SAFETY PLAN PREPARED: October 5, 1994

DATE(S) OF INITIAL VISIT: October 7, 1994

DATE(S) OF SITE WORK: October 1994 through December 1995

SITE ACCESS: The site may be accessed by the main driveway off of County Line Road.

SITE SIZE: Approximately 40 acres.

SITE TOPOGRAPHY: The Fischer and Porter site is relatively flat. Most of the site is covered with pavement for onsite parking.

SITE DESCRIPTION AND HISTORY: The Fischer & Porter Site (the Site), is a National Priorities List (NPL) site located in Warminster, Bucks County, Pennsylvania. As can be seen on Figure 1-1 and Figure 1-2, the Site is located at the intersection of County Line and Jacksonville Roads. The Site is an active industrial facility with few areas of contamination. In the late 1970s, trichloroethene (TCE) and other volatile organic compounds were detected in production wells for the City of Warminster and Hatboro adjacent to the Site. In 1980, Fischer & Porter initiated a groundwater investigation at the Site to evaluate the potential impact of volatile organics from the Site on groundwater. The results of this investigation conducted by SMC-Martin Environmental Consultants (SMC) indicated that Fischer & Porter was contributing to an isolated plume from the larger area of groundwater contamination, located southwest of the Site.

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In 1984, Fischer & Porter entered into a Consent Decree (CD) with EPA to pump three on-site wells, and to operate an air stripper to treat the contaminated water from the three wells. The CD stipulated that influent to and effluent from the treatment system would be monitored for TCE and tetrachloroethene (PCE). Finally, Fischer and Porter agreed to pay $300,000 and $45,000 to Hatboro and Warminster Heights Water Authorities, respectively, to support the treatment of those water supplies, and further, to pay $40,000 to the Hatboro Water Authority annually for 5 years to support operation and maintenance of its treatment system. Both Hatboro and Warminster Heights Water Authorities have installed air stripping towers on several of the wells affected by the volatile organic plume. Fischer and Porter currently send quarterly monitoring reports to EPA, pursuant to the decree. According to the CD, the 5 year remedial action review was due in Fiscal Year 1989.

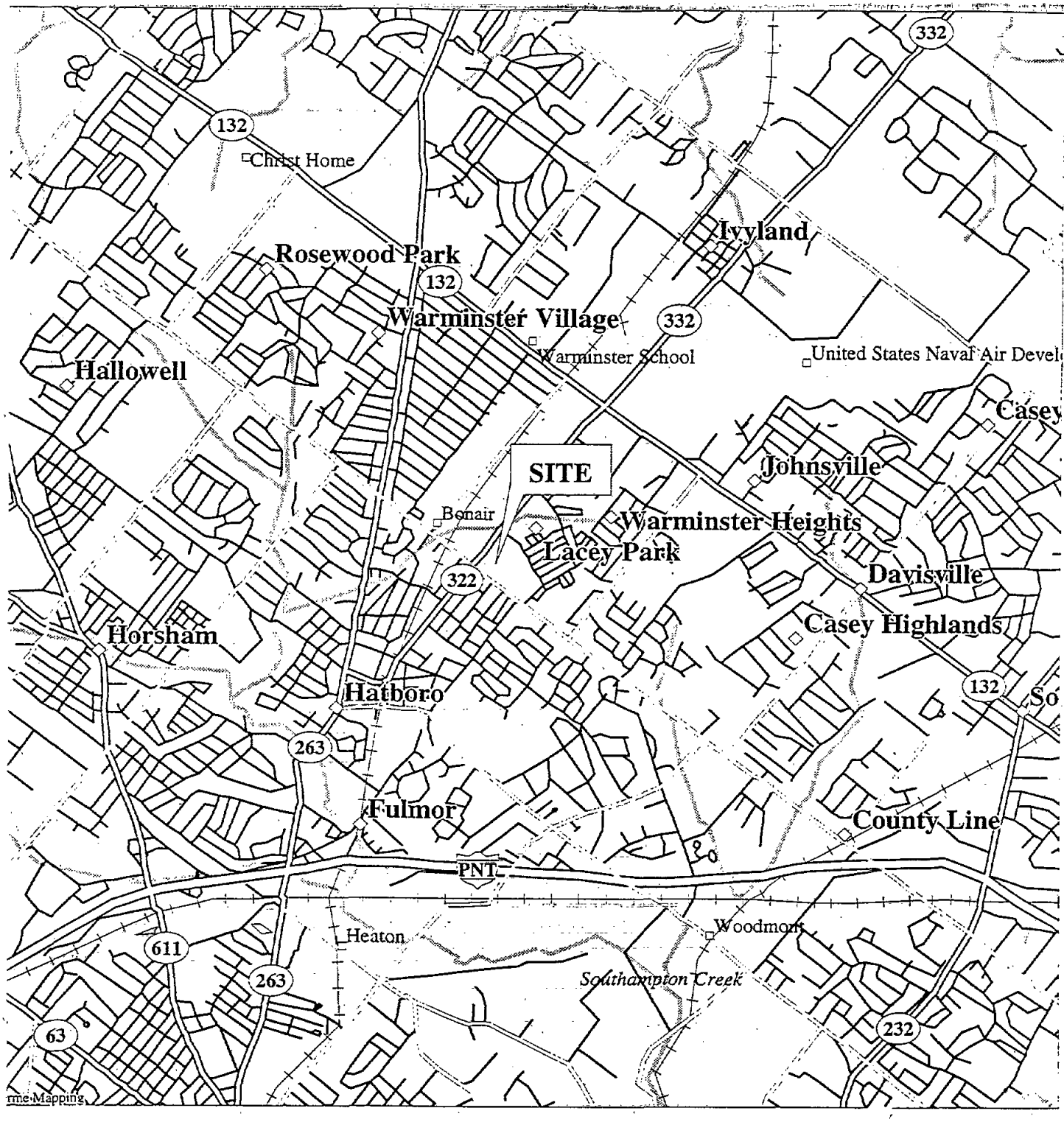
Most of the studies performed at the Site have involved hydrogeological investigations to evaluate the rate and extent of migration of volatile organics in groundwater. These studies include the previously mentioned SMC study (1980), a BCM 1986 study, and the quarterly monitoring of three on-site wells by Fischer & Porter. Other studies include sampling of water supply systems and observation wells in the vicinity of the Site by NUS Corporation in 1985, under contract to EPA Region III. These studies are also included in the Jacobs Engineering Group, Inc. report of 1988. Studies into the source(s) of volatile organic contamination on the Site are limited to the Ecology and Environment (E&E) report of 1985 on collection of multi-media samples to assist in identifying sources. It should be noted that the 1985 E&E report was prepared by a third party (not EPA) and was not in accordance with the EPA Contract Laboratory Program (CLP) protocols. Therefore, the validity of this information is questionable. A total of 27 oil, water, and sludge samples were collected, in addition to the augering of 9 boreholes where 40 soil samples were collected. The results indicated varying concentrations of volatile organics at the Site. These volatile organics are listed in Table 3.9 of this HASP.

In the 1985 E&E report, several areas were identified as significant contamination sources. These areas include the drum storage area, the waste compacting area, the area in and around the waste oil tank, and the area northwest of the Colburn Lab.

As part of the Site hydrogeologic investigations, 12 monitoring wells were installed. Fischer & Porter also operated 2 production wells on the Site, although both wells are currently utilized as part of the groundwater extraction and treatment system (Wells No. 1 and No. 2). Also included in the extraction system is Well No. 7. The three groundwater production wells are being pumped at a combined rate of 75 gallons per minute. The water is being treated in an air stripper. The effluent is then discharged to a stream. Fischer & Porter has also installed an oil-recovery system on one of the wells to remove an oil layer that exists on the water table. This oil layer is highly contaminated with TCE.

The Site consists of unconsolidated weathered shale and siltstone deposits, underlain by shale, siltstone, and sandstone bedrock of the Stockton Formation. The location of the water table is variable (20 to 30 feet below ground surface) and is sometimes perched above the shale/weathered shale interface (less than 10 feet below ground surface), or is at the interface. Movement of groundwater has been documented through fractured bedrock and is reported to be very complex (SMC 1980).

AR300911



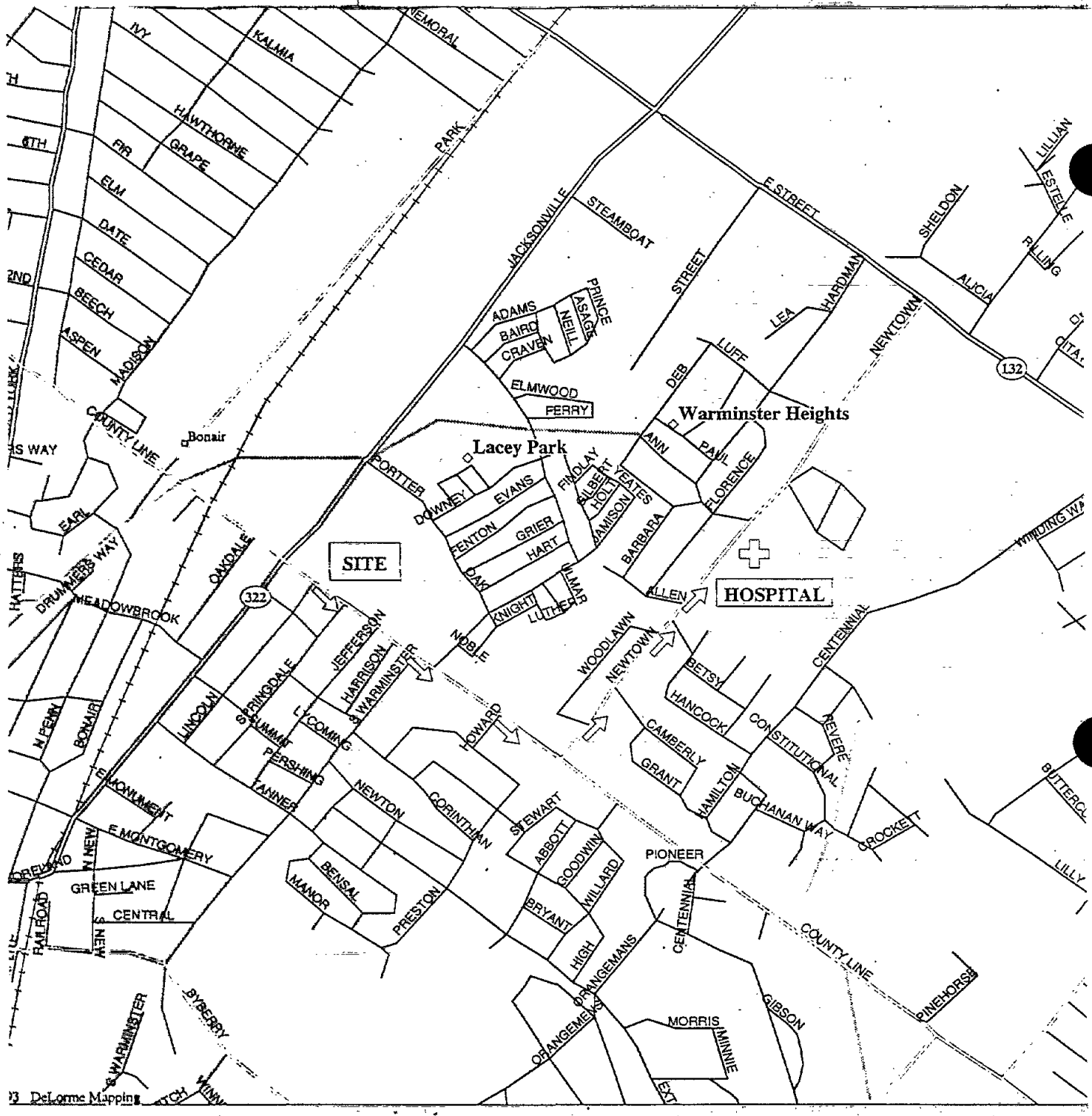
ılation Center
: Route
Feature
n, Small City
state, Turnpike
ıty Boundary
et, Road
· Ramps

Major Street/Road
State Route
Interstate Highway
Railroad
River
Open Water

Scale 1:43,750 (at center)
5000 Feet
1000 Meters

Figure 1-1
SITE LOCATION
Mag 13.00
Wed Oct 05 17:39:10 1994

AR300912



END

- Population Center
-) State Route
- Geo Feature
- Town, Small City
- County Boundary
- Street, Road
- Major Street/Road
- State Route
- Railroad
- River

Scale 1:15,625 (at center)

1000 Feet

500 Meters

Figure 1-2

HOSPITAL ROUTE
Mag 15.00
Wed Oct 05 17:41:20 1994

AR300913

2.0 PROJECT ORGANIZATION AND TASKS TO BE PERFORMED UNDER THIS PLAN

2.1 PROJECT ORGANIZATION

James Freeney/EPA	EPA Remedial Project Manager
Mike Tilchin/WDC	ARCS Program Manager
Juliana Hess/NJO	Site Manager
Scott Vozza/NJO	Field Team Leader/Hydrogeologist
John Longo/NJO	Health and Safety Manager

2.2 DESCRIPTION OF TASKS

Refer to project documents (i.e., Work Plan) for detailed task information. A health and safety risk analysis has been performed for each task. Risk analyses results are incorporated into this plan through task-specific hazard controls, monitoring, and protection requirements.

Health and Safety procedures for activities to be performed by CH2M HILL personnel at the Fischer and Porter site will be implemented as outlined in this HASP. Any task(s) not identified within the body of this HASP must be addressed in an addendum to this plan, before field work for these task(s) begin.

The activities to be performed at the site by CH2M HILL personnel will include performing or providing oversight of the following subcontractor activities.

- Horizontal survey of 35 soil boring points.
- Monitoring well installation.
- Groundwater sampling.
- Water level measurements.
- Hydrogeologic test/packer test and pump test.
- Surface water/sediment sampling
- RI waste sampling
- Removal of RI wastes

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2.3 DESCRIPTION OF SUBCONTRACTORS

(REFERENCE SECTION 3, *CORPORATE HEALTH AND SAFETY PROGRAM MANUAL*)

When specified in the project documents (e.g., contract), this plan may cover those subcontractors contracted with CH2M HILL. However, this plan does not address hazards specific to specialty subcontractor's work (e.g., drill rig safety as it applies to the operation of the rig). The specialty subcontractor is responsible for health and safety procedures and plans specific to their work. Subcontractors must comply with an established health and safety plan; CH2M HILL must monitor and enforce compliance with the established plan.

Barry Isett & Associates
Consulting Engineers & Surveyors
828 W. Main Street
Norristown, PA 19401
215-278-0166
Contact: Chip Hazel

A drilling subcontractor and a waste disposal subcontractor has yet to be procured for this project.

All subcontractors will comply with the provisions stated in Appendix A: Certification of Training, Medical, and Safety Requirements of their contract. The signed and dated Appendix A must be presented to CH2M HILL before subcontractor begins work on the site.

2.4 DESCRIPTION OF CONTRACTORS

(REFERENCE SECTION 3, *CORPORATE HEALTH AND SAFETY PROGRAM MANUAL*)

This plan does not cover contractors that are not contracted with CH2M HILL. CH2M HILL is not responsible for directing contractor personnel; CH2M HILL personnel are not to direct the details of the contractor's work, including health and safety. When the contractor is in control of the site, request that the contractor conduct a briefing of their health and safety practices and to describe how they apply to CH2M HILL's activities. Request a copy of the contractor's health and safety plan.

NA

AR300915

3.0 HAZARD EVALUATION AND CONTROL

3.1 HEAT AND COLD STRESS (REFERENCE CH2M HILL SOP HS-09)

3.1.1 HEALTH STRESS PREVENTION

- Drink 16 ounces of water before beginning work, such as in the morning or after lunch. Disposable 4-ounce cups and water maintained at 50° to 60°F should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Take regular breaks in a cool, preferably air-conditioned area. Do not use alcohol in place of water or other non-alcoholic fluids. Decrease the intake of coffee during working hours. Monitor for signs of heat stress.
- Acclimate to site work conditions by slowly increasing workloads, e.g., do not begin site work with extremely demanding activities.
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices, however, add weight, and their use should be balanced against efficiency.
- Use mobile showers or hose down facilities to reduce body temperature and cool protective clothing.
- During hot weather, conduct field activities in the early morning or evening, if possible.
- Provide adequate shelter to protect personnel against heat which can decrease physical efficiency and increase the probability of heat stress.
- In hot weather, rotate shifts of workers.
- Maintain good hygiene standards by frequent changes of clothing and showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should consult medical personnel.

3.1.2 SYMPTOMS AND TREATMENT OF HEAT STRESS

Heat Disorder	Signs/Symptoms	Treatment	Prevention Measures
Heat Syncope	Sluggishness or fainting while standing erect or immobile in heat.	Remove to cooler area. Rest in recumbent position. Increase fluid intake. Recovery is usually prompt and complete.	Acclimatization and intermittent activity (see below under "heat stroke").
Heat Rash (miliaria rubra; "prickly heat")	Profuse, tiny, raised, red blister-like vesicles on affected areas, along with pricking sensations during heat exposure.	Mild drying lotions, powders and skin cleanliness to dry skin and prevent infection.	Allow skin to dry between heat exposures.
Heat Cramps	Painful spasms of muscles used during work (arms, legs, or abdomen); onset during or after workhours.	Remove to cooler area. Rest in recumbent position. Increase fluid intake.	Acclimatization and intermittent activity (see below under "heat stroke").
Heat Exhaustion	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or hectic flush; may faint on standing with rapid thready pulse and low blood pressure; oral temperature normal or low	Remove to cooler area. Rest in recumbent position with head in low position. Administer fluids by mouth. Seek medical attention.	Acclimatization and intermittent activity (see below under "heat stroke").

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3.1.2 SYMPTOMS AND TREATMENT OF HEAT STRESS			
Heat Stroke	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.	Cool rapidly by soaking in cool (not cold) water. Call ambulance and get medical attention immediately!!	Acclimatize workers using an intermittent break-in schedule for 5 to 7 days, with plenty of rest periods. Ample drinking water must be available at all times and taken frequently during the workday.

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3.2 GENERAL PHYSICAL (SAFETY) HAZARDS AND CONTROLS

Engineering and administrative controls are generally to be implemented by the party in control of the site or hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees must, at a minimum, remain aware of hazards affecting them, regardless of who is responsible for controlling the hazards.

Hazard (Refer to SOP)	Engineering or Administrative Controls	Tasks					
		Drilling Activities	Groundwater Sampling	Surveying	Surface Water & Sediment Sampling	Pump & Packer Testing	RI Waste Sampling and Removal
Flying debris/objects (HS-07)	Provide shielding and PPE; maintain distance.	X					
Noise > 85 dBA	Noise protection and monitoring required.	X				X	
Steep terrain/unstable surface	Brace and shore equipment.				X		X
Gas cylinders (HS-21)	Instruct employees in the safe use of compressed gases. Make certain gas cylinders are properly anchored and chained. Keep cylinders away from ignition sources.	X	X				
Electrical shock (Section 10.4)	Make certain third wire is properly grounded. Do not tamper with electrical wiring unless qualified to do so. Ground as appropriate.					X	
Suspended loads (Section 10.0)	Work not permitted under suspended loads.	X	X	X			
Moving vehicles (Section 10.3)	Back-up alarm required for heavy equipment. Observer remains in contact with operator and signals safe back-up. Personnel to remain outside of turning radius.	X					X
Overhead electrical wires (Section 10.2)	Heavy equipment (e.g., drill rig) to remain at least 15 feet from overhead powerline for powerlines of 50 kV or less. For each Kv > 50, increase distance ½ foot.	X					
Buried utilities, drums, tanks, etc. (Section 3.3)	Locate buried utilities, drums, tanks, etc. prior to digging or drilling and mark location.	X					
Slip, trip, fall hazards	Use wood pallets or similar devices in muddy work areas. Provide slip resistant surfaces.	X	X	X	X	X	X
Back injury (HS-29)	Use proper lifting techniques, or provide mechanical lifting aids.	X	X	X	X	X	X
Confined space entry (Section 9.0)	Space must be evaluated by qualified person. Additional controls and monitoring, and an approved entry permit are generally required.						

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3.2 GENERAL PHYSICAL (SAFETY) HAZARDS AND CONTROLS

Engineering and administrative controls are generally to be implemented by the party in control of the site or hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees must, at a minimum, remain aware of hazards affecting them, regardless of who is responsible for controlling the hazards.

Hazard (Refer to SOP)	Engineering or Administrative Controls	Tasks					
		Drilling Activities	Groundwater Sampling	Surveying	Surface Water & Sediment Sampling	Pump & Packer Testing	RI Waste Sampling and Removal
Trenches/excavations (HS-32)	Make certain trench meets OSHA standard before entering. All excavations > 5 feet deep must be sloped or shored. Excavations > 4 feet deep must have a ladder every 25 feet. If not entering trench, remain 2 feet from edge of trench at all times.						
Protruding objects	Flag visible objects.	X	X	X			
Visible lightning	Cease work.	X	X	X	X	X	X
Vehicle traffic (HS-24)	Provide temporary traffic controls, including trained flaggers and lookouts. Implement traffic control program when required.	X	X	X			
Stairways, ladders, and scaffolds (HS-25)	Stairways or ladders are generally required where there is a break in elevation of 19 inches or more. Keep access ways clear. Equipment provided must meet OSHA specifications. Document employee training.						
Elevated work area/falls (HS-31)	Provide guardrail, safety net, floor covers, body harness, and monitoring system, where applicable. Document employee training.						
Work where equipment must shut down (HS-33)	Shut down and isolate equipment, apply lockout/tagout devices, and verify that equipment won't start. Document required employee training.	X					

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3.2.1 COLD STRESS PREVENTION

- Be aware of symptoms of cold-related disorders and ***wear proper clothing for the anticipated field work.***
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (windchill index) and the National Safety Council.
- ***Windchill Index.*** This measure relates the dry bulb temperature and the wind velocity. It is used only to estimate the combined effect of wind and low air temperatures on exposed skin. The windchill index is sometimes limited in its usefulness because the index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For this reason, it is used only as a guideline to warn workers when they are in a situation that can cause cold-related illnesses. Used in conjunction with the NSC guidelines, the windchill index provides a starting point for adjusting work and warmup schedules.
- ***NSC Work/Warmup Schedule Guidelines.*** The cold exposure limits recommended by the National Safety Council can be used in conjunction with the windchill index to estimate a work and warmup schedule for field work. The guidelines are not absolute; ***workers should be monitored for symptoms of cold-related illness.*** If symptoms are not observed, the work interval can be increased.
- The windchill index and NSC guidelines are found in the CH2M HILL *Manual* Standard of Practice HS-09.

3.2.2 SYMPTOMS AND TREATMENT OF COLD STRESS

Immersion (Trench) Foot	Frostbite	Hypothermia
Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Seek medical treatment immediately.	Remove victim to a warm place. Rewarm area quickly in warm (not hot) water. Have victim drink warm fluids--not coffee or alcohol. Do not break any blisters. Elevate the injured area and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids--not coffee or alcohol. Get medical attention.

3.3 PROCEDURES TO LOCATE BURIED UTILITIES

<u>Local Utility Mark-Out Service</u>
Name: PA One Call
Phone: 1-800-248-1786

- Where available, obtain facility utility diagrams.
- Review location of sanitary and storm sewers, electrical conduits, water supply lines, natural gas lines, and fuel tanks and lines.
- Review proposed locations of intrusive work with facility personnel knowledgeable in utility locations. Check locations against information from utility mark-out service.
- Clear locations with a utility locating instrument (e.g., metal detector), where applicable.
- Where necessary (e.g., uncertainty of utility locations), excavation or drilling of initial interval should be conducted manually.
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in auger or split-spoon advancement).

3.4 BIOLOGICAL HAZARDS AND CONTROLS

Hazard and Location	Control Measures
Snakes are typically found in underbrush or tall grassy areas.	If a snake is encountered, stay calm and look around; there may be others present. Turn around and walk away on the same path on which you approached the snake. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart (if possible). Seek medial attention immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Carry the victim, or have him/her walk slowly, if the victim must be moved. Try to identify the type of snake (note color, size, patterns, and markings).
Poison ivy, poison oak, and poison sumac are typically found in brush or wooded areas. They are more commonly found is moist areas or along the edges of wooded areas.	Become familiar with identity of plants. Wear protective clothing that covers exposed skin. Avoid contact with plants and outside of protective clothing. If skin is contacted, wash area with soap and water immediately. If reaction is severe or worsens, seek medial attention.
Bloodborne pathogen exposure may occur when rendering first aid, or contacting medical or other potentially infectious material, or contacting landfill waste or waste streams containing such infectious material.	Training is required prior to task involving potential exposure. Exposure controls and PPE are required as specified in CH2M HILL SOP HS-36 *Bloodborne Pathogens*. Vaccination may be recommended prior to participating in task where exposure is a potential.
Other Potential Biological Hazards:	

3.5 TICK BITES (REFERENCE CH2M HILL HS-43, *TICK BITES*)

Ticks are typically **located** in wooded areas, bushes, tall grass, and brush. Ticks are either black, black and red, or brown in color, and can be up to one quarter-inch in size.

Prevention against tick bites includes: wearing tightly woven, light colored clothing with long sleeves, and pant legs tucked into boots or socks; spraying only outside of clothing with insect repellant containing permethrin or permanone, and spraying skin with DEET; avoiding tick areas; and showering and checking yourself for ticks as soon as possible.

If bitten carefully remove tick with tweezers, grasping the tick as close as possible to the point of attachment while being careful not to crush the tick. After removing the tick, wash hands and disinfect and press bite area. The removed tick should be saved.

Look for **symptoms** of lyme disease or Rocky Mountain Spotted Fever (RMSF). Lyme: rash that looks like a "bulls-eye", with small welt in center, several days to weeks after tick bite. RMSF: Rash comprising red spots under skin, 3 to 10 days after tick bite. For both, chills, fever, headache, fatigue, stiff neck, bone pain. If symptoms appear, seek medical attention.

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3.6 RADIOLOGICAL HAZARDS AND CONTROLS

Refer to the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual*, for standards of practice for operating in contaminated areas.

Hazards	Controls
N/A	

3.8 HAZARDS POSED BY CHEMICALS BROUGHT ONSITE

Refer to CH2M HILL *Hazard Communication Program Manual* which is available from the corporate human resources department in denver, in addition to the regional office human resource manager. The project manager is to request material safety data sheets (MSDSs) from the client, contractors, and subcontractors for chemicals that CH2M HILL employees are potentially exposed to.

Chemical	Quantity	Location
Nitric Acid	<1 liter	Support zone
Hydrochloric Acid	<1 liter	Support zone
Isobutline	1 cylinder	Support zone
Pentane	1 cylinder	Support zone
Methanol	<1 gallon	Support and decontamination zone
Hexane	<1 gallon	Support and decontamination zone
TSP	<1 liter	Support and decontamination zone
Sulfuric Acid	<1 liter	Support zone

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3.9 CONTAMINANTS OF CONCERN (REFER TO PROJECT FILES FOR MORE DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[1] Concentration (ppm)		Exposure Limit[2]	IDLH[3]	Symptoms and Effects of Exposure	PIP[4] (eV)
TCE	.069 .023	FP-01 (GW) FP-20 (soil)[b]	25 ppm	Ca[5] 1,000 ppm	Head, vertl; vis dist, tremors, som, nau, vomit; irrit eyes; derm; card arrhy, pares; [carc]	7.44 eV
PCE	.04 .011	FP-02 (GW) FP-15 (soil)[b]	25 ppm	Ca[5] 500 ppm	Irrit. eyes, nose throat; hav; flush face, neck; vertl, dizz, inco; head som; skin eryt; liver damage	9.32 eV
Methylene Chlorids	.0057 .005	FP-01 (GW) FP-32 (soil)[b]	500 ppm	Ca[5] 5,000 ppm	Ftg, weak, sleepiness, li-head; limbs numb, tingle; nau; irrit eyes, skin;	11.32 eV
1,1 Dichloroethane	.0007 .03	FP-01 (GW) FP-24 (soil)[b]	100 ppm	4,000 ppm	CNS depres; skin irrit, liver, kidney damage	11.06 eV
Chloroform	.0008	FP-01 (GW)	2 ppm	Ca[5] 1,000 ppm	Dizz, mental dullness, nau, disorientation; head, ftg; anes; hepatomegaly; irrit eyes; skin;	11.42 eV
Toluene	.0001 .074	FP-02 (GW) FP-12 (soil)[b]	100 ppm	2,000 ppm	Ftg, weak; conf, euph, dizz, head; dilated pupils, lac; ner, musc ftg, insom; pares; derm	8.82 eV
1,1,1-TCA	.0009 .006	FP-01 (GW) FP-20 (soil)[b]	350 ppm	1,000 ppm	Head, lass, CNS depres, poor equi; irrit eyes; derm; card arrhy	1,100 eV
TPH[a]	3400	FP-24 (GW)	.2 mg/m^3	Ca[5] 700 ppm	Derm, bron, [carc]	NA
Acetone	0.17	FP-12 (soil)[b]	250 ppm	20,000 ppm	Irrit eyes, nose, throat; head, dizz; derm	9.69 eV
Methyl chloride	.002	FP-06 (soil)[b]	Ca[5] 50 ppm	10,000 ppm	Dizz, nau, vomit; vis dist; stagger; slur speech, convuls, coma; liver, kidney damage; frostbite	11.28 eV
Bromomethane	.007	FP-06 (soil)[b]	Ca[5] 5 ppm	2,000 ppm	Head; vis dist; verti, nau, vomit, mal hand tremor; convuls; dysp; irrit eyes, skin irrit, vesic	10.54 eV
Ethyl benzene	.21	FP-16 (soil)[b]	100 ppm	2,000 ppm	Irrit eyes, muc membrane; head, derm; narco canc	8.76 eV
Xylene	.42	FP-16 (soil)[b]	100 ppm	1,000 ppm	Dizz, excitement, drow, inco, staggering gait; irrit eyes, nose, throat; corneal vacuolization anor, nau, vomot, abdom pain; derm	8.56 eV
Z-Butanone	.033	FP-12 (soil)[b]	200 ppm	3,000 ppm	Irrit eyes, nose head, dizz, vomit	9.54 eV

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3.9 CONTAMINANTS OF CONCERN (REFER TO PROJECT FILES FOR MORE DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[1] Concentration (ppm)	Exposure Limit[2]	IDLH[3]	Symptoms and Effects of Exposure	PIP[4] (eV)
Vinyl chloride	.021 FP-24 (soil)[b]	1 ppm	Ca[5]	Weak; abdom pain, GI bleeding; hepatomegalu; pallor or cyan of extremities	9.99 eV
Benzene	.001 FP-29 (soil)[b]	0.1 ppm	Ca[5]	Irrit eyes, nose, resp sys; gidd, head, nau, staggering gait; fig, anor, lass; derm, bone, marrow depres;	9.42 eV

Note 1: Location refers to physical location. Abbreviations specify media:
A (AIR) D (DRUMS) F (FLASH) GW (GROUNDWATER) L (LAGOON)
TK (TANK) S (SOIL) SL (SLUDGE) SW (SURFACE WATER)

Note 2: Appropriate value of PEL, REL, or TLV listed.

Note 3: IDLH = Immediately dangerous to life and health (units are the same as specified exposure limit units for that contaminant).

Note 4: PIP = photoionization potential.

Note 5: Ca = NIOSH has identified this contaminant as an occupational carcinogen.

Note 5: NL = no limit found in reference materials.

[a] = Limits as coal tar pitch volatiles.

[b] = FP soil borings correspond to the SB soil borings on Figure 3-1 and 3-2.

3.10 POTENTIAL ROUTES OF EXPOSURE

DERMAL: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 5.0.	INHALATION: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring as specified in Sections 5.0 and 6.0, respectively.	OTHER: Inadvertent ingestion of contaminated media. This route should not present a concern, provided good hygiene practices are followed (e.g., wash hands and face before eating).

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4.0 PERSONNEL

4.1 CH2M HILL EMPLOYEES (REFERENCE CH2M HILL SOP HS-01, *MEDICAL SURVEILLANCE*, AND HS-02, *HEALTH AND SAFETY TRAINING*)

Employees listed below are enrolled in the CH2M HILL health and safety recovery center and meet the medical surveillance, 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training requirements of OSHA 29CFR1910.120. Employees designated "SSC" have received 8 hours of supervisor and 8 hours of instrument training and can serve as site safety coordinator (SSC) for the level of protection indicated. There must be one SSC present during any task performed in exclusion or decontamination zones with the potential for exposure to health and safety hazards. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. There must be one FA-CPR designated employee present during any task performed in exclusion or decontamination zones with the potential for exposure to safety and health hazards. The "buddy system" requirements of OSHA 29CFR1910.120 are to be met at all times.

Employee Name	Office	Responsibility	SSC/FA-CPR
Juliana Hess	NJO	Site Manager	
Scott Vozza	NJO	Field Team Leader Site Safety Coordinator	Level C SSC; FA-CPR
Greg Waller	NJO	Field Team Member	Level D SSC; FA-CPR
Laura Gavin	NJO	Field Team Member	Level C SSC; FA-CPR
Terri Boehm	NJO	Field Team Member	Level D SSC; FA-CPR
Rob MacEwen	NJO	Field Team Member	Level B SSC; FA-CPR
Peter Walter	NJO	Field Team Member	FA-CPR

Pregnant employees are to be informed of and follow procedures in CH2M HILL's SOP HS-04, *Reproduction Protection*. The basic provisions of SOP HS-04 are as follows.

- Obtaining a physician's statement of the employee's ability to perform hazardous activities is required.
- Information regarding potential reproduction hazards is available to the employee.
- Reassignment may be required, based on physician's recommendation.

4.2 FIELD TEAM CHAIN OF COMMAND AND COMMUNICATION PROCEDURES

4.2.1 CLIENT

Contact Name: James Feeney/EPA
Phone: (215) 597-8309
Facility Contact Name: William H. Gross/Fischer & Porter
Phone: (215) 674-6789

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4.2.2 CH2M HILL

Site Manager: Juliana Hess/NJO/(201) 316-9300, ext. 4547
Health and Safety Manager: John Longo/NJO/(201) 316-9300, ext. 4543
Field Team Leader/Site Safety Coordinator: Scott Vozza/NJO/(201) 316-9300, ext. 4537

The Site Safety Coordinator is responsible for contacting the Project Manager. In general, the Project Manager will contact the client. The Health and Safety Manager should be contacted as appropriate.

4.2.3 SUBCONTRACTOR - Barry Isett & Associates

Contact Name: Chip Hazel
Phone: (215) 278-0166

Subcontractor - Drilling subcontractor is yet to be determined.

General health and safety communications with subcontractors contracted with CH2M HILL, and covered by this plan, are as follows:

- Request that subcontractor (if specialty subcontractor) submit safety or health plan applicable to their expertise (e.g., drill rig safety plan, or nuclear density gauge [NDG] health plan); attach the reviewed plan.
- Supply subcontractors with a copy of this plan and brief them on its provisions.
- Health and safety communications are to be directed to the subcontractor-designated safety representative.
- Notify the subcontractor-designated representative if an apparent hazard (e.g., violation of established plan) is observed. Specialty subcontractors are responsible for mitigating hazards (e.g., a drill rig safety hazard).
- If a hazard condition persists, warn subcontractor. Stop work affected by hazard, as a last resort, if hazard is not eliminated.
- When an apparent imminent danger exists, promptly remove all affected personnel. Notify the project manager.
- Consistent violations of this health and safety plan by subcontractor may result in termination of their subcontract.

4.2.4 CONTRACTOR

Contact Name:
Phone:

General health and safety communications with contractors not contracted with CH2M HILL are as follows:

- Request that contractor brief CH2M HILL on contractor health and safety plan, with regard to how the plan affects CH2M HILL employees onsite.
- If acceptable to the client, direct health and safety communications to the contractor PM or other onsite contractor-designated representative. CH2M HILL employees are not to direct the details of contractor's work, or advise on health and safety (e.g., how the contractor corrects unsafe conditions).

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- As soon as possible, notify the party controlling the work activity that poses a hazard to CH2M HILL personnel. The contractor is responsible for mitigating hazards. Notify the project manager; the project manager will notify the client. Document oral notification in project records (i.e., field logbook).
- If a hazardous condition endangering a CH2M HILL employee persists, inform the contractor and the project manager (project manager will contact the client) that CH2M HILL cannot execute the assigned work until the hazard it mitigated.
- When an apparent imminent danger exists, orally warn the person(s) in danger and orally notify the contractor promptly. When an imminent danger involves a CH2M HILL employee, remove the employee and suspend CH2M HILL work immediately, until the hazard has been mitigated. Inform the project manager and contractor promptly.
- The SSC or project manager must notify the client and CH2M HILL health and safety staff when (1) the contractor fails to remedy an unsafe condition effecting CH2M HILL personnel, (2) the contractor does not remedy the hazardous condition within a reasonable period of time, (3) the contractor repeatedly creates the hazardous condition, (4) a serious injury or death occurs, or (5) health and safety inspections by OSHA or other agencies occur.

5.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

(REFERENCE CH2M HILL SOP HS-07, *PERSONAL PROTECTIVE EQUIPMENT*, and HS-08, *RESPIRATORY PROTECTION*)

Task	Level	PPE [a]		
		Body	Head	Respirator
Surveying, packer test Water level measurements Surface water/sediment sampling RI waste disposal	D	Work clothes; steel toed leather work boots; work gloves, or surgical nitrile gloves, as applicable.	Hardhat[b] Safety glasses Ear protection[c]	None Required
Groundwater sampling Drilling activities/monitoring well installation RI waste sampling	D	Polycoated tyvek; steel toed chemical-resistant boots, OR steel toed leather work boots with outer rubber boot covers; inner nitrile surgical glove, AND outer chemical-resistant nitrile glove.	Hardhat[b] Splash shield[b] Safety glasses Ear protection[c]	None Required
Tasks where upgrade is required as per Section 5.1 or 6.0	C	Polycoated tyvek; steel toed chemical-resistant boots, OR steel toed leather work boots with outer rubber boot covers; inner nitrile surgical glove, AND outer chemical-resistant nitrile glove.	Hardhat[b] Ear protection[c]	APR, full face, MSA Ultratwin or equivalent; with MSA GMC-H combination cartridges, or equivalent

[a] Modifications are as indicated above. CH2M HILL will not provide PPE to any individual, except for CH2M HILL employees.
[b] Hardhat and splash shield areas are to determined by the SSC.
[c] Ear protection should be worn while working around drill rig, or other noise-producing equipment.

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5.1 REASONS TO UPGRADE OR DOWNGRADE LEVEL OF PROTECTION

Upgrade	Downgrade
• Request of individual performing task. • Change in work task that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels (Section 6.0) exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decreases the hazard. • Change in work task that will reduce contact with hazardous materials.

6.0 AIR MONITORING SPECIFICATIONS (REFERENCE CH2M HILL SOP HS-06, *AIR MONITORING*)

Instrument	Tasks	Action Levels[1]	Frequency	Calibration
PID: HNu 11.7 eV probe or equivalent	GW sampling Drilling activities Packer/pump test RI waste sampling	0-1 ppm Level D 1-5 ppm Level C >5 ppm Stop work, re-evaluate; may require Level B	Drilling-minimum-each time auger is removed from borehole or periodically during advancement of auger, whichever is sooner. GW Sampling/pump test/packer test-Initially when well is open and minimum at beginning of sampling and 30 min. thereafter.	Daily
CGI: MSA 260, or equivalent	Drilling activiites	0-10% LEL No explosion hazard 10-25% LEL Potential explosion hazard >25% LEL Explosion hazard; evacuate or vent	Continuous	Daily
O_2 Meter: MSA 260, or equivalent	Drilling activities	>25.0% O_2 Explosion hazard; evacuate or vent 20.9% O_2 Normal O_2 <19.5% O_2 O_2 deficient; vent or use SCBA	Continuous	Daily
Colormetric Tube:	GW sampling Drilling activities Packer/pump test RI waste sampling	0-1 ppm Level D or level C depends on PID reading >1 ppm Level B	After PID reading in the breathing zone is greater than 0.5 ppm above background	Not Applicable

Note 1: Action levels are for breathing zone readings, above background.

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6.1 CALIBRATION SPECIFICATION

Instrument	Gas	Span	Reading	Method
PID: HNU, 10.2 eV probe	100 ppm isobutylene	9.8 ± 2.0	55 ppm	1.5 l/m reg T-tubing 0.25 l/m reg direct tubing
PID: HNU, 11.7 ev probe	100 ppm isobutylene	5.0 ± 2.0	68 ppm	1.5 l/m reg T-tubing 0.25 l/m reg direct tubing
FID: OVA-128	100 ppm methane	3.0 ± 1.5	100 ppm	1.5 l/m reg T-tubing
CGI: MSA 260, 261, 360, or 361	0.75% pentane	N/A	50% LEL ± 5 % LEL	1.5 l/m reg direct tubing

6.2 AIR SAMPLING

Method and Description: N/A

Personnel:

Areas:

Results to be interpreted by:

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7.0 DECONTAMINATION SPECIFICATION (REFERENCE CH2M HILL SOP HS-13, *DECONTAMINATION*)

SSC to monitor the effectiveness of decontamination procedures. Decontamination procedures found to be ineffective will be modified by the SSC.

Personnel	Sample Equipment	Heavy Equipment
• Boot wash/rinse	• Wash/rinse equipment	• Power wash
• Glove wash/rinse	• Solvent rinse equipment	• Steam clean
• Outer glove removal	• Solvent disposal method:	• Water disposal method:
• Body suit removal	Contained in 55-gallon drum for proper disposal	Contained in 55-gallon drum for proper disposal
• Inner glove removal		
• Respirator removal		
• Hand wash/rinse		
• Face wash/rinse		
• Shower ASAP		

- PPE disposal method: Municipal waste unless PPE appears visually chemically contaminated
- Water disposal method: Contained in 55-gallon drums for proper disposal.

7.1 DIAGRAM OF PERSONNEL DECONTAMINATION LINE

Figure 7-1 illustrates typical establishment of work zones, including decontamination line. Work zones are to be modified by the SSC to accommodate task-specific requirements.

8.0 SPILL CONTAINMENT PROCEDURES

Sorbent materials will be made available to contain incidental spills that may result from CH2M HILL activities.

9.0 CONFINED SPACE ENTRY

Confined space entry requires an additional health and safety procedures and a permit. Refer to CH2M HILL SOP HS-17, contained in the *Corporate Health and Safety Program and Training Manual.*

When planned activities are not to include confined space entry, permit-required confined spaces accessible to CH2M HILL personnel are to be identified before task begins. The SSC is to confirm that permit spaces are properly posted, or that employees are informed of their location and informed of their hazards.

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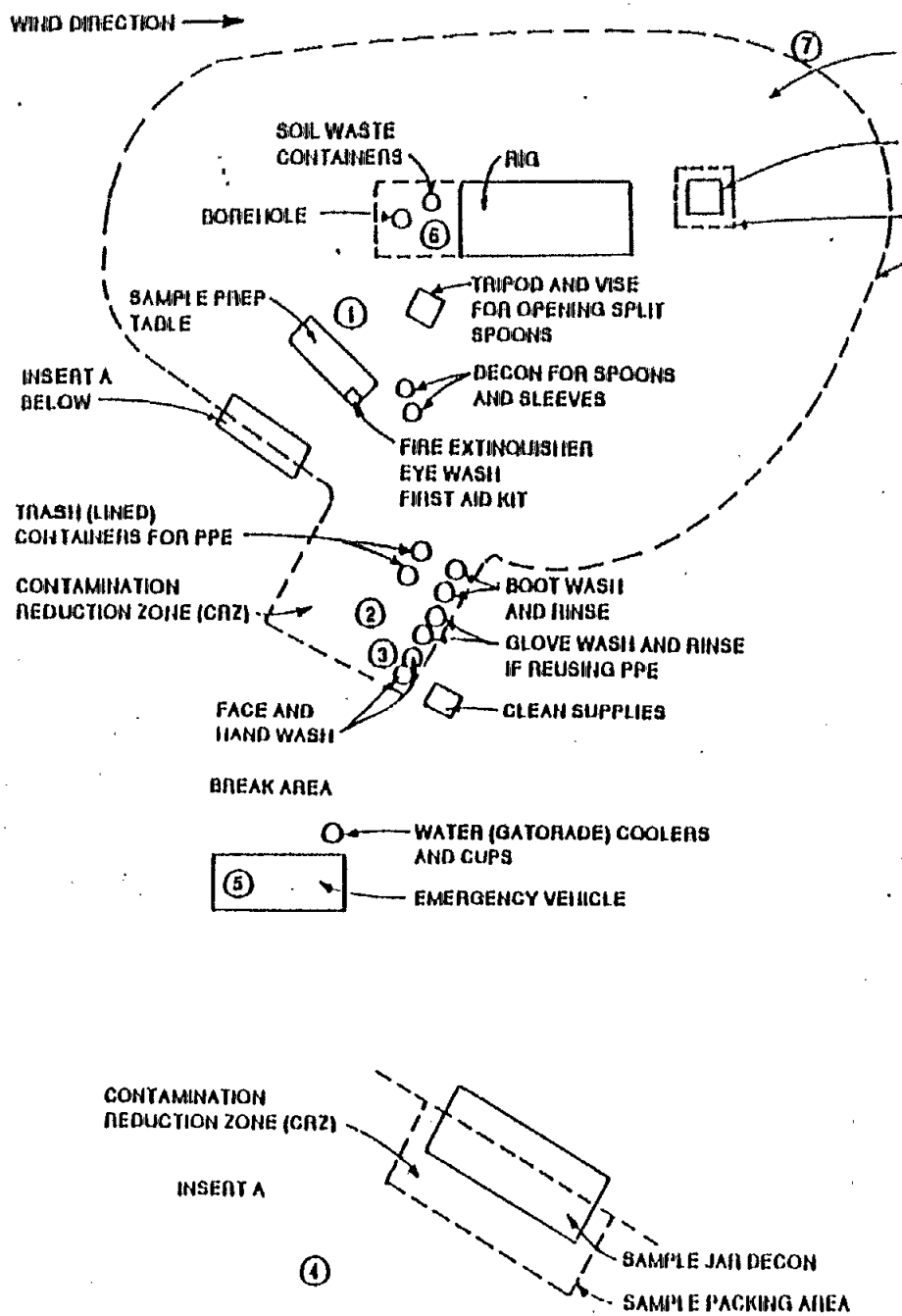

NOTES:

1 PREP AREA UPWIND, OPEN SPOONS, MONITOR, PHOTO AND LOG, PUT INTO SAMPLE JAR.

2 PERSONNEL TO USE CONTAMINATION REDUCTION CORRIDOR - BOOT WASH, FACE AND HAND WASH AS APPROPRIATE.

3 FACE AND HAND WASH WITH SPRAYERS, SOAP, AND DISPOSABLE TOWELS

4 INSERT "A" WOULD ALLOW ONE PERSON TO REMAIN IN THE CONTAMINATION REDUCTION AREA TO LOG SAMPLES, COMPLETE SAMPLE PREP AND RETRIEVE MATERIALS FROM THE CLEAN AREA, WHILE ONE PERSON REMAINS SUITED UP IN MODIFIED LEVEL TO COLLECT SAMPLES.

5 VEHICLE WITH KEYS IN IGNITION LIST OF EMERGENCY RESPONSE PROCEDURES, ROUTE MAP TO EMERGENCY ROOM, AND EMERGENCY CONTACT NUMBERS.

6 RIG ORIENTATION MAY VARY BASED UPON THE EXPECTED HAZARDS. PERSONNEL AT LOCATIONS WHERE HIGH LEVELS OF METHANE OR OTHER FLAMMABLE GASES ARE EXPECTED SHOULD CONSIDER PLACING IGNITION SOURCES SUCH AS THE RIG ENGINES UPWIND FROM THE BOREHOLE.

7 POST ZONE(S) APPROPRIATELY, BASED ON POTENTIAL HAZARDS PRESENT

8 THIS IS AN EXAMPLE TO BE USED AS A GUIDE, AND MAY BE MODIFIED TO MEET VARYING SITE CONDITIONS FOR DRILLING AND OTHER TASKS.

Figure 7-1

TYPICAL EXCLUSION ZONE
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10.0 WORK PROCEDURES

10.1 WORK PRACTICES

- No spark sources within exclusion or decontamination zones.
- Avoid visibly contaminated areas.
- No eating, drinking, or smoking in contaminated areas, or exclusion or decontamination zones.
- SSC to establish areas for eating, drinking, smoking.
- No contact lenses in exclusion or decontamination zones.
- No facial hair that would interfere with respirator fit if Level C or B is anticipated.
- Site work will be performed during daylight hours whenever possible. Any work conducted during hours of darkness will require enough illumination intensity "to read a newspaper without difficulty."

10.2 DRILL RIG SAFETY PROCEDURES (REFERENCE CH2M HILL SOP HS-35, *DRILLING*)

This section covers general safety requirements for working around a drill rig. CH2M HILL employees who work around drill rigs should remain aware of drill rig hazards, and the general safety procedures when working with drilling operations. NOTE that the driller (a specialty subcontractor) is responsible for safe drill rig operations and the safety of his employees. CH2M HILL employees are not to operate the drill rig, or assist the driller in the operation of the drilling.

General work practices to be followed while working around a drill rig include:

- The drill rig is not to be operated in inclement weather.
- The driller is to verify that the rig is properly leveled and stabilized before raising the mast.
- Personnel should be cleared from the sides and rear of the rig before the mast is raised.
- The driller is not to drive the rig with the mast in the raised position.
- The driller must check for overhead power lines before raising the mast. A minimum distance of 15 feet, between mast and overhead lines (<50 kV), is recommended. Increased separation may be required for lines greater than 50 kV.
- Personnel should stand clear before rig start-up.
- The driller is to verify that the rig is in neutral when the operator is not at the controls.
- Become familiar with the hazards associated with the drilling method used (i.e., cable tool, air rotary, hollow-stem auger, etc.).
- Do not wear loose fitting clothing, watches, etc, that could get caught in moving parts.
- Do not smoke or permit other spark-producing equipment around the drill rig.
- The drill rig must be equipped with a kill wire or switch, and personnel are to be informed of its location.
- Be aware and stand clear of heavy objects that are hoisted overhead.
- The driller is to verify that the rig is properly maintained in accordance with the drilling company's maintenance program.
- The driller is to verify that all machine guards are in place while the rig is in operation.
- The driller is responsible for housekeeping (maintaining a clean work area).
- The drill rig should be equipped with at least one fire extinguisher.

In the event the drill rig comes into contact with electrical wires and becomes electrically energized, do not touch any part of the rig or any person in contact with the rig, and stay as far away as possible. Notify emergency personnel immediately.

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10.3 HEAVY EQUIPMENT SAFETY PROCEDURES (REFERENCE CH2M HILL HS-27, *HEAVY EQUIPMENT*)

- Become familiar with hazards particular to the equipment being used.
- Always confirm that operator is aware of your location--particularly when you approach or pass by equipment.
- Do not count on back up alarms always functioning. Look around when alarm sounds.
- Do not ride equipment not designed for passengers.
- Do not climb on operating equipment.
- Do not place yourself between fixed and moving parts or objects.
- Do not stand adjacent to the equipment.
- Stay clear of equipment on cross slopes and unstable terrain.
- Stay clear of pile-driving operations.
- Remain outside of the turning radius of the equipment.
- Operators using all terrain vehicles (ATV) must be trained; other ATV requirements may apply.

10.4 ELECTRICAL SAFETY PROCEDURES (REFERENCE CH2M HILL HS-23, *ELECTRICAL*)

- Operate and maintain equipment according to manufacturer's instructions.
- Use only extension cords that are three-wire grounded. Cords passing through work areas must be covered or elevated to protect from damage.
- Use only electrical tools and equipment that area either effectively grounded or double-insulated UL approved.
- Properly label switches, fuses, and circuit breakers.
- Remove cord from an outlet by grasping the plug, not pulling the cord.
- Protect all electrical equipment, tools, switches, etc., from elements.
- Avoid physical contact with power circuit.
- Only qualified electricians are to install and work on electrical circuits and equipment.

10.5 FIRE PREVENTION AND CONTROL (REFERENCE CH2M HILL HS-22, *FIRE PREVENTION AND CONTROL*)

The potential for fires on project sites is real. The following practices and procedures are to be followed:

- Appropriate fire fighting equipment must be available onsite.
- Extinguishers are to be inspected and maintained.
- Open flames are prohibited in the vicinity of flammable materials.
- Combustible materials stored outside should be at least 10 feet from the building.
- Unnecessary combustible materials and flammable or combustible liquids must not be allowed to accumulate.
- Flammable or combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

10.6 SITE CONTROL MEASURES

- Site safety coordinator (SSC) to conduct site safety briefing (see below) before starting field activities, or as tasks and site conditions change.
- Site safety briefing topics: general discussion of health and safety plan; site specific hazards; location of work zones; PPE requirements; equipment; special procedures; emergencies.
- SSC records safety briefing attendance in logbook, and documents topics discussed.
- Post OSHA job site poster in a central and conspicuous location at the site.
- Determine wind direction.

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- Establish work zones: support, decontamination, and exclusion zones, and delineate work zones with flagging or cones as appropriate. Support zone upwind of site.
- Establish decontamination procedures, including respirator decontamination procedures, and test.
- Utilize access control at the entry and exit from each work zone.
- Chemicals to be stored in proper containers.
- MSDSs are available for onsite chemicals employees exposed to.
- Establish onsite communications. These should consist of:
  - Line of sight/hand signals
  - Air horn
  - Two-way radio or cellular phone if available
- Establish offsite communications.
- Establish "buddy" system.
- Establish procedures for disposal of material generated onsite.
- Initial air monitoring conducted by SSC in appropriate level of protection.
- SSC to conduct periodic inspections of work practices to determine effectiveness of this plan. Deficiencies to be noted, reported to the HSM, and corrected.

11.0 EMERGENCY RESPONSE PLAN (REFERENCE CH2M HILL SOP HS-12, *EMERGENCY RESPONSE*)

11.1 PRE-EMERGENCY PLANNING

The SSC performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with the facility and local emergency service providers as appropriate.

- Review facility emergency/contingency plans, where applicable.
- Locate nearest telephone; determine onsite communications available (e.g., two-way radio, air horn).
- Identify and communicate chemical, safety, radiological, biological hazards.
- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate to onsite personnel. Evacuation routes and assembly areas are shown on Figure 11-1.
- Post site map marked with location of emergency equipment and supplies.
- Review any changed site conditions, onsite operations, or personnel availability, with respect to emergency response procedures.
- Evaluate capabilities of local response teams, where applicable.
- Where appropriate and acceptable to the client, inform emergency room/ambulance service and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, chemical and vapor releases.
- Review notification procedures for contacting CH2M HILL's medical consultant and team member's occupational physician.
- Rehearse the emergency response plan once prior to site activities, including driving route to the hospital.
- Brief new workers on the emergency response plan.
- SSC will evaluate any emergency response actions and initiate appropriate follow-up actions.

11.2 EMERGENCY EQUIPMENT AND SUPPLIES

The SSC should mark the locations of emergency equipment on the site map and post the map.

Emergency Equipment and Supplies	Location
20 lb ABC fire extinguisher	To be determined in the field
First aid kit	To be determined in the field
Eye wash	To be determined in the field
Stretcher or blanket	To be determined in the field
Potable water	
Other facility or additional equipment	

11.3 EMERGENCY MEDICAL TREATMENT

- Contact CH2M HILL's medical consultant for advise and guidance on medical treatment.
- The SSC will assume charge during a medical emergency until the ambulance arrives, or the injured person is admitted to the emergency room.
- Prevent further injury.
- Initiate first aid and CPR where feasible.
- Get medical attention immediately.
- Perform decontamination where feasible; Lifesaving and first aid or medical treatment do take priority.
- Notify the field team leader and project manager of the injury.
- Make certain that injured person is accompanied to emergency room.
- Notify the health and safety manager.
- Notify the injured person's human resources department.
- Prepare an incident report. Submit this to the corporate director health and safety (WDC) and corporate human resources department (DEN) within 48 hours.
- When contacting the medical consultant, state that it is a CH2M HILL matter, provide your name, your phone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.

11.4 EVACUATION

- Evacuation routes will be designated by SSC prior to beginning of work.
- Onsite and offsite assembly points will be designated prior to beginning of work.
- Personnel will exit the exclusion zone and assemble at the onsite assembly point upon hearing the emergency signal for evacuation.
- Personnel will assemble at the offsite point upon hearing the emergency signal for a site evacuation.
- The SSC and a "buddy" will remain onsite after the site has been evacuated (if possible) to assist local responders and advise them of the nature and location of the incident.
- SSC accounts for all personnel in the onsite assembly zone.
- A person designated by the SSC (prior to work) will account for personnel at the offsite assembly area.
- The SSC is to write up the incident as soon as possible after it occurs, and submit a report to the corporate director health and safety.

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11.5 EVACUATION ROUTES AND ASSEMBLY POINTS

Evacuation routes and assembly areas (and alternate routes and assembly areas) are specified on Figure 11-1.

11.6 EVACUATION SIGNALS

Signal	Meaning
Grasping throat with hand	Emergency -- Help me
Thumbs up	OK; understood
Grasping buddy's wrist	Leave area now
Continuous sounding of horn	Emergency; leave site now

11.7 INCIDENT RESPONSE

In the event of fires, explosions, or chemical releases, actions to be taken should include the following:

- Shut down CH2M HILL operations and evacuate the immediate work area.
- Account for personnel at the designated assembly area(s).
- Notify appropriate response personnel.
- Assess the need for site evacuation, and evacuate site as warranted.

Note that small fires or spills posing minimal safety or health hazards may be controlled instead of implementing a work area evacuation.

12.0 EMERGENCY RESPONSE TELEPHONE NUMBERS

SITE ADDRESS: Fischer & Porter
125 E. County Line Road
Warminster, PA 18974-4995
Phone: (215) 674-6789

Police: Warminster Police Department — **Phone:** 911[1] (verify) 215/672-1000

Fire: Warminster Fire Department — **Phone:** 911[1] (verify) 215/674-3333

Ambulance: Warminster Fire/Ambulance Squad — **Phone:** 911[1] (verify) 215/674-3333

Water: Warminster Water & Sewer Authority — **Phone:** 215/675-3301

Sewer: Upper Moreland-Hatboro Joint Sewer Authority — **Phone:** 215/659-3975

Gas/Electric: Philadelphia Electric Co. — **Phone:** 800/841-4141

Note 1: When using a cellular phone outside the phone's normal calling area, caution should be exercised in relying on the cellular phone to activate 911. When outside the normal calling area, the cellular service carrier should connect the caller with emergency services in the area where the call was originated from – however this may not occur. Back-up emergency services phone numbers should be provided when relying on a cellular phone to activate 911.

Hospital: Warminster General Hospital — **Phone:** (215) 441-6600
Address: 225 Newtown Rd., Warminster, PA

Route To Hospital:
Make a left out of the site onto E. County Line Road. At the second traffic light (Newtown Rd.) make a left. Follow Newtown Road for 3 blocks (approx. 1/2 mile). Hospital is on the right.

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12.1 GOVERNMENT AGENCIES INVOLVED IN PROJECT

Federal: US EPA **Phone:** 215/597-8309

State: N/A **Phone:** N/A

Local: N/A **Phone:** N/A

13.0 EMERGENCY CONTACTS

If an injury occurs, notify the injured person's personnel office as soon as possible after obtaining medical attention for the injured. Notification MUST be made within 24 hours of the injury.

CH2M HILL Medical Consultant Dr. Elayne F. Theriault Environmental Medical Resources, Inc. Atlanta, Georgia 800/229-3674 OR 404/455-0818 (After hours calls will be returned within 20 minutes.)	**Occupational Physician (Regional or Local)** Dr. Michael Basista 557 Broad Street Bloomfield, New Jersey 07003 201/680-8300
Corporate Director Health and Safety Name: Marty Mathamel/WDC Phone: 703/471-1441	**Site Safety Coordinator (SSC)** Name: Scott Vozza/NJO Phone: 201/316-9300
Medical and Training Administrator Name: Vicki Kambic/WDC Phone: 703/471-1441	**Regional Manager** Name: Bud Ahearn/WDC Phone: 703/471-1441
Health and Safety Manager (HSM) Name: John Longo/NJO Phone: 201/316-9300	**Project Manager** Name: Juliana Hess/NJO Phone: 201/316-9300
Radiation Health Manager (RHM) Name: Frank Patelka/ORO Phone: 615/483-9032	**Regional Human Resources Department** Name: Susan Thomas/DEN Phone: 303/771-0952
Client Name: US EPA Phone: 215/597-8309	**Corporate Human Resources Department** Name: Susan Thomas/DEN Phone: 303/771-0952
Federal Express Dangerous Goods Shipping Phone: 800/238-5355 **CH2M HILL Emergency Number for Shipping Dangerous Goods** Phone: 800/255-3924	

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14.0 APPROVAL

This site safety plan has been written for use by CH2M HILL. CH2M HILL claims no responsibility for its use by others, unless specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if these conditions change.

WRITTEN BY: **Robert P. MacEwen** **DATE:** **10/05/94**

APPROVED BY: **John Longo/NJO** **DATE:** **10/06/94**

14.1 AMENDMENTS

CHANGES MADE BY: **DATE:**

CHANGES TO PLAN:

AMENDMENT APPROVED BY: **DATE:**

15.0 DISTRIBUTION

Name	Office	Responsibility	Number of Copies
Cindy Carr	WDC	Senior Program Assistant	1
John Longo	NJO	Health and Safety Manager/Approver	1
Juliana Hess	NJO	Site Manager	1
Scott Vozza	NJO	Field Team Leader/SSC	2

16.0 ATTACHMENTS

Attachment 1: Employee signoff
Attachment 2: Applicable MSDSs

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ATTACHMENT 1

EMPLOYEE SIGNOFF

The employees listed below have been provided a copy of this health and safety plan, have read and understood it, and agree to abide by its provisions.

EMPLOYEE NAME	EMPLOYEE SIGNATURE / DATE

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Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Section 1: Material Identification

n-Hexane Description: *n*-Hexane is the chief constituent of petroleum ether or ligroin. Used to determine the refractive index of minerals; and as a mercury replacement in thermometers (usually with blue or red dye).
Other Designations: Normal-hexane; C_6H_{14}; CAS No. 0110-54-3.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide* (Genium ref. 73) for a suppliers list.
Comments: See *MSDS Collection*, No. 397A, for isohexanes.

R 1
I 3
S 2
K 4

NFPA

HMIS
H 1
F 3
R 0
PPG*
* Sec. 8

Section 2: Ingredients and Occupational Exposure Limits

n-Hexane, ca 100%*

OSHA PEL
8-hr TWA: 50 ppm, 180 mg/m³

ACGIH TLV, 1988-89
TLV-TWA: 50 ppm, 180 mg/m³

Toxicity Data†
Human, inhalation, TC_{Lo}: 5000 ppm/10 min
Rat, oral, LD_{50}: 28,710 mg/kg

* *n*-Hexane is this product's major component; however, possible contaminants are other isomers of hexane, C_5 to C_7 saturated hydrocarbons, C_5 to C_7 olefinic hydrocarbons, and aromatic hydrocarbons.
† See NIOSH, *RTECS* (MN9275000), for additional data with references to reproductive, irritative, and neurological effects.

Section 3: Physical Data

Boiling Point: 156.11 °F (68.95 °C)
Melting Point: ca -139 °F (-95 °C)
Vapor Pressure: 124 torr at 68 °F (20 °C)
Vapor Density (Air = 1): 3.0

Molecular Weight: 86 g/mol
Specific Gravity (H_2O = 1): 0.66 at 68 °F (20 °C)
Water Solubility: Insoluble

Appearance and Odor: A clear, colorless, mobile, volatile, flammable liquid; a mild hydrocarbon odor.

Section 4: Fire and Explosion Data

Flash Point: -22 °F (-30 °C) CC	Autoignition Temperature: 473 °F (223 °C)	LEL: 1.2% v/v	UEL: 8% v/v

Extinguishing Media: Use carbon dioxide (CO_2), foams, or dry chemical to put out *n*-hexane fires. Never direct solid streams of water into burning pools of liquid since this can scatter and spread the fire. Use water sprays to cool fire-exposed containers, prevent dangerous pressure rise and/or rupture, disperse vapors, and flush unignited spills away from sensitive exposures.
Unusual Fire or Explosion Hazards: *n*-Hexane is a very flammable, volatile liquid which burns like gasoline. It represents a dangerous fire and explosion hazard. Since it evaporates quickly, the resulting denser-than-air vapors can flow along surfaces, collect in low-lying or enclosed areas like sumps and utility rooms, reach distant sources of ignition, and flash back to the original liquid.
Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

Section 5: Reactivity Data

Stability/Polymerization: *n*-Hexane is stable at room temperature during routine operations. Hazardous polymerization cannot occur.
Chemical Incompatibilities: *n*-Hexane can react violently with strong oxidizing agents.
Conditions to Avoid: Never expose this liquid to any ignition source (heat, sparks, open flames, or uninsulated heating elements).
Hazardous Products of Decomposition: Thermal oxidative degradation of *n*-hexane can produce carbon dioxide and toxic carbon monoxide (CO).

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Section 6. Health Hazard Data

Carcinogenicity: Neither the NTP, IARC, nor OSHA lists *n*-hexane as a carcinogen.
Summary of Risks: The metabolic products of *in vivo* partial oxidation of *n*-hexane include 2, 5-hexanedione. This metabolite is the most highly neurotoxic compound formed from *n*-hexane. Occupational exposures to *n*-hexane are associated with chronic neurotoxic damage to the central nervous system (CNS) and the peripheral nervous system (PNS). The effects are not permanent: Genium reference 100 notes that recovery from neuropathy is usually complete within a year after the exposure. Methyl *n*-butyl ketone (MBK) (*MSDS Collection*, No. 425) produces the neurotoxic metabolite 2, 5-hexadione in even greater quantities than the *n*-hexane. Prevent simultaneous exposures to *n*-hexane and MBK. Genium reference 89 notes: "...concurrent exposure to methyl ethyl ketone, and possibly other chemicals or drugs which boost liver oxidative mechanisms, reduces the time for neuropathy to appear as a result of exposure to both *n*-hexane and MBK." Medical Conditions Aggravated by Long-Term Exposure: CNS and PNS disorders, vision defects, and memory diminution. Target Organs: Skin, eyes, CNS, PNS. Primary Entry: Inhalation, skin contact. Acute Effects: Irritation of eyes, nose, and upper respiratory tract (URT); dermal erythema (abnormally red skin from capillary congestion), edema (abnormal accumulation of clear, watery fluid in body tissue), and vesiculation (blistering). Acute inhalation causes headache, dizziness, nausea, narcosis, and coma. High concentrations may act as asphyxiants. Chronic Effects: Anorexia, nausea, weight loss, malaise; muscular weakness, pain, and spasms in extremities; neurotoxic effects like sensorimotor polyneuropathy, generalized polyneuropathy, and other degenerative changes in the peripheral nervous system (PNS).
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min. Skin: After rinsing affected area with flooding amounts of water, wash it with soap and water. Inhalation: Remove exposed person to fresh air and support breathing as needed. Have a qualified medical personnel administer oxygen as required. Ingestion: Never induce vomiting! Severe aspiration hazard exists. If vomiting occurs spontaneously, lower victim's head to the knee level. Never give anything by mouth to an unconscious or convulsing person. Administer several ounces of edible oil to drink.
After first aid, get appropriate in-plant, paramedic, or community medical attention and support.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: *Design and practice a n-hexane spill control and countermeasure plan (SCCP).* When a spill occurs, notify safety personnel, evacuate unnecessary personnel, eliminate heat and ignition sources, provide maximum explosion-proof ventilation, and implement the SCCP. Cleanup personnel should wear fireproof personal protective equipment (Sec. 8).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Subpart Z)
EPA Designations
Assigned the RCRA Hazardous Waste No. D001 (40 CFR 261.21, Ignitability)
Assigned as a CERCLA Hazardous Substance (40 CFR 302.4), Reportable Quantity (RQ): 100 lb (45.4 kg)
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Where splashing is possible, wear a full face shield. Respirator: Wear a NIOSH-approved respirator if necessary. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres. Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PEL standard (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by eliminating it at its source (Genium ref. 103). Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, washing facilities, and properly serviced fire extinguishers. Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Launder contaminated clothing before wearing. Remove this material from your shoes and equipment. Other: Preplacement and periodic medical exams focusing on the skin and the central nervous system are advised.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics. Handle this flammable, volatile material with appropriate caution.

Section 9. Special Precautions and Comments

Storage Requirements: Store *n*-hexane in closed containers in a cool, dry, well-ventilated, fireproof area away from heat and ignition sources and incompatible chemicals. Protect these containers from physical damage; shield them from direct sunlight.
Engineering Controls: To prevent static sparks, electrically ground and bond all containers, tank cars, and pipes used in shipping, receiving, or transferring operations in production and storage areas. All electrical services, including lights, must be sparkproof.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Hexane
DOT Hazard Class: Flammable liquid
DOT ID No. : UN1208
DOT Label: Flammable liquid
DOT Packaging Requirements: 49 CFR 173.119
DOT Packaging Exceptions: 49 CFR 173.118

IMO Shipping Name: Hexane *(and its isomers)*
IMO Hazard Class: 3.1
IMO Label: Flammable liquid
IMDG Packaging Group: II

MSDS Collection References: 1, 6, 7, 84-94, 100, 116, 117, 119, 120, 122
Prepared by: PJ Igoe, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: W Silverman, MD

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METHANOL
METHANOL
METHANOL

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY NUMBER: (201) 796-7100
CHEMTREC ASSISTANCE: (800) 424-9300

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 67-56-1

SUBSTANCE: **METHANOL**

TRADE NAMES/SYNONYMS:
METHYL ALCOHOL; WOOD ALCOHOL; METHYL HYDROXIDE; CARBINOL; MONOHYDROXYMETHANE; WOOD SPIRIT; WOOD NAPHTHA; METHYLOL; COLONIAL SPIRIT; COLUMBIAN SPIRIT; PYROXYLIC SPIRIT; COULOMATIC (R) CONDITIONER SOLUTION; STANDARD WATER IN METHANOL; STCC 4909230; UN 1230; RCRA U154; A454; A452; A936; A408; A947; A935; BP1105; A412; A411; A433P; SW2;; SC95; A452SK; A408SK; A412P; A434; A412SK; A450; A433S; CH40; ACC14280

CHEMICAL FAMILY:
HYDROXYL, ALIPHATIC

MOLECULAR FORMULA: C-H3-O-H

MOLECULAR WEIGHT: 32.04

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: METHYL ALCOHOL (METHANOL) PERCENT: 100
CAS# 67-56-1

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
METHYL ALCOHOL (METHANOL):
200 PPM (262 MG/M3) OSHA TWA (SKIN); 250 PPM (328 MG/M3) OSHA STEL
200 PPM (262 MG/M3) ACGIH TWA (SKIN); 250 PPM (328 MG/M3) ACGIH STEL
200 PPM (262 MG/M3) NIOSH RECOMMENDED TWA (SKIN);
250 PPM (328 MG/M3) NIOSH RECOMMENDED STEL
200 PPM (262 MG/M3) DFG MAK TWA (SKIN);
400 PPM (524 MG/M3) DFG MAK 30 MINUTE PEAK, AVERAGE VALUE, 4 TIMES/SHIFT

MEASUREMENT METHOD: SILICA GEL TUBE; WATER; GAS CHROMATOGRAPHY WITH FLAME IONIZATION DETECTION; (NIOSH VOL. III # 2000, METHANOL).

5000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

PHYSICAL DATA

DESCRIPTION: CLEAR, COLORLESS LIQUID WITH A CHARACTERISTIC ALCOHOLIC ODOR.

BOILING POINT: 149 F (65 C) MELTING POINT: -137 F (-94 C)

SPECIFIC GRAVITY: 0.7914 VAPOR PRESSURE: 97.25 MMHG @ 20 C

SOLVENT SOLUBILITY: ETHER, BENZENE, ALCOHOL, ACETONE, CHLOROFORM, ETHANOL.

VISCOSITY: 0.59 CPS @ 20 C

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT, FLAME, OR OXIDIZERS.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE

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VAPOR-AIR MIXTURES ARE EXPLOSIVE.

FLASH POINT: 52 F (11 C) (CC) UPPER EXPLOSIVE LIMIT: 36.0%

LOWER EXPLOSIVE LIMIT: 6.0% AUTOIGNITION TEMP.: 725 F (385 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR ALCOHOL-RESISTANT FOAM (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL-RESISTANT FOAM (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF YOU CAN DO IT WITHOUT RISK. DIKE FIRE-CONTROL WATER FOR LATER DISPOSAL; DO NOT SCATTER THE MATERIAL. APPLY COOLING WATER TO SIDES OF CONTAINERS THAT ARE EXPOSED TO FLAMES UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM ENDS OF TANKS. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF TANK DUE TO FIRE. ISOLATE FOR 1/2 MILE IN ALL DIRECTIONS IF TANK, RAIL CAR OR TANK TRUCK IS INVOLVED IN FIRE (1990 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.5, GUIDE PAGE 28).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG, SOLID STREAMS MAY NOT BE EFFECTIVE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER. APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS, KEEP UPWIND.

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49 CFR 172.101:
  FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49 CFR 172.101 AND SUBPART E:
  FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49 CFR 173.119
EXCEPTIONS: 49 CFR 173.118

TOXICITY

METHYL ALCOHOL (METHANOL):
IRRITATION DATA: 20 MG/24 HOURS SKIN-RABBIT MODERATE; 40 MG EYE-RABBIT MODERATE; 100 MG/24 HOURS EYE-RABBIT MODERATE.
TOXICITY DATA: 85,000 MG/M3 INHALATION-HUMAN TCLO; 300 PPM INHALATION-HUMAN TCLO; 64,000 PPM/4 HOURS INHALATION-RAT LC50; 1000 PPM INHALATION-MONKEY LCLO; 50 GM/M3/2 HOURS INHALATION-MOUSE LCLO; 44,000 MG/M3/6 HOURS INHALATION-CAT LCLO; 15,800 MG/KG SKIN-RABBIT LD50; 393 MG/KG SKIN-MONKEY LDLO; 428 MG/KG ORAL-HUMAN LDLO; 143 MG/KG ORAL-HUMAN LDLO; 5422 MG/KG ORAL-MAN LDLO; 3429 MG/KG ORAL-MAN TDLO; 4 GM/KG ORAL-WOMAN TDLO; 7 GM/KG ORAL-MONKEY LD50; 5628 MG/KG ORAL-RAT LD50; 7300 MG/KG ORAL-MOUSE LD50; 14,200 MG/KG ORAL-RABBIT LD50; 7500 MG/KG ORAL-DOG LDLO; 9800 MG/KG SUBCUTANEOUS-MOUSE LD50; 2131 MG/KG INTRAVENOUS-RAT LD50; 4710 MG/KG INTRAVENOUS-MOUSE LD50; 8907 MG/KG INTRAVENOUS-RABBIT LD50; 4641 MG/KG INTRAVENOUS-CAT LDLO; 7529 MG/KG INTRAPERITONEAL-RAT LD50; 10,765 MG/KG INTRAPERITONEAL-MOUSE LD50; 1826 MG/KG INTRAPERITONEAL-RABBIT LD50; 3556 MG/KG INTRAPERITONEAL-GUINEA PIG LD50; 8555 MG/KG INTRAPERITONEAL-HAMSTER LD50; 59 GM/KG PARENTERAL-FROG LDLO; 868 MG/KG UNREPORTED-MAN LDLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS).
CARCINOGEN STATUS: NONE.
LOCAL EFFECTS: IRRITANT- SKIN, EYE.
ACUTE TOXICITY LEVEL: SLIGHTLY TOXIC BY INHALATION, DERMAL ABSORPTION, INGESTION.
TARGET EFFECTS: CENTRAL NERVOUS SYSTEM DEPRESSANT; NEUROTOXIN.
AT INCREASED RISK FROM EXPOSURE: PERSONS WITH KIDNEY, EYE OR SKIN DISORDERS.

HEALTH EFFECTS AND FIRST AID

GAIT, TWITCHING, COLIC, CONSTIPATION, NYSTAGMUS, AND BLEPHAROSPASM. SYMPTOMS FROM OCCUPATIONAL EXPOSURE INCLUDE PARESTHESIAS, NUMBNESS AND SHOOTING PAINS IN THE HANDS AND FOREARMS. METABOLIC ACIDOSIS, AND EFFECTS ON THE EYES AND CENTRAL NERVOUS SYSTEM MAY OCCUR AS DETAILED IN ACUTE INGESTION.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE EFFECTS AS IN ACUTE INGESTION. REPEATED EXPOSURE TO 200-375 PPM CAUSED RECURRENT HEADACHES IN WORKERS. EXPOSURE FOR 4 YEARS TO 1200-8000 PPM RESULTED IN MARKED DIMINUTION OF VISION AND ENLARGEMENT OF THE LIVER IN A WORKMAN.

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REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
METHYL ALCOHOL (METHANOL):
IRRITANT/NARCOTIC/NEUROTOXIN.
ACUTE EXPOSURE- CONTACT WITH LIQUID MAY CAUSE IRRITATION. SKIN ABSORPTION MAY OCCUR AND CAUSE METABOLIC ACIDOSIS AND EFFECTS ON THE EYES AND CENTRAL NERVOUS SYSTEM AS DETAILED IN ACUTE INGESTION.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH THE LIQUID MAY CAUSE DEFATTING OF THE SKIN RESULTING IN ERYTHEMA, SCALING, AND ECZEMATOID DERMATITIS. CHRONIC ABSORPTION MAY RESULT METABOLIC ACIDOSIS AND EFFECTS AS DETAILED IN ACUTE INGESTION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
METHYL ALCOHOL (METHANOL):
IRRITANT.
ACUTE EXPOSURE- VAPORS MAY CAUSE IRRITATION. HIGH CONCENTRATIONS HAVE BEEN REPORTED TO CAUSE VIOLENT INFLAMMATION OF THE CONJUNCTIVA AND EPITHELIAL DEFECTS ON THE CORNEA. MILD IRRITATION MAY OCCUR WITH DILUTE SOLUTIONS; THE UNDILUTED LIQUID HAS PRODUCED MODERATE CORNEAL OPACITY AND CONJUNCTIVAL REDNESS IN RABBITS. APPLICATION OF A DROP OF METHANOL IN RABBIT EYES CAUSED A MILD REVERSIBLE REACTION, GRADED 3 ON A SCALE OF 1-10 AFTER 24 HOURS.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
METHYL ALCOHOL (METHANOL):
NARCOTIC/NEUROTOXIN.
ACUTE EXPOSURE- MAY CAUSE MILD AND TRANSIENT INEBRIATION AND SUBSEQUENT DROWSINESS FOLLOWED BY AN ASYMPTOMATIC PERIOD LASTING 8-48 HOURS. FOLLOWING THE DELAY, COUGHING, DYSPNEA, HEADACHE, DULLNESS, WEAKNESS, VERTIGO OR DIZZINESS, NAUSEA, VOMITING, OCCASIONAL DIARRHEA, ANOREXIA, VIOLENT PAIN IN THE BACK, ABDOMEN, AND EXTREMITIES, RESTLESSNESS, APATHY OR DELIRIUM, AND RARELY, EXCITEMENT AND MANIA MAY OCCUR. RAPID, SHALLOW RESPIRATION DUE TO METABOLIC ACIDOSIS, COLD AND CLAMMY SKIN, HYPOTENSION, CYANOSIS, OPISTHOTONOS, CONVULSIONS, MILD TACHYCARDIA, CARDIAC DEPRESSION, PERIPHERAL NEURITIS, CEREBRAL AND PULMONARY EDEMA, UNCONSCIOUSNESS, AND COMA ARE POSSIBLE. EFFECTS ON THE EYE MAY INCLUDE OPTIC NEURITIS, BLURRED OR DIMMED VISION, DILATED, UNRESPONSIVE PUPILS, PTOSIS, EYE PAIN, CONCENTRIC CONSTRICTION OF VISUAL FIELDS, DIPLOPIA, CHANGE IN COLOR PERCEPTION, PHOTOPHOBIA, AND OPTIC NERVE ATROPHY. PARTIAL BLINDNESS OR POSSIBLY DELAYED TRANSIENT OR PERMANENT BLINDNESS MAY OCCUR. BILATERAL SENSORINEURAL DEAFNESS HAS BEEN REPORTED IN A SINGLE CASE. LIVER, KIDNEY, HEART, STOMACH, INTESTINAL AND PANCREATIC DAMAGE MAY ALSO OCCUR. DEATH MAY BE DUE TO RESPIRATORY FAILURE OR RARELY FROM CIRCULATORY COLLAPSE. AS LITTLE AS 15 ML HAS CAUSED BLINDNESS; THE USUAL FATAL DOSE IS 60-240 ML. PROLONGED ASTHENIA AND IRREVERSIBLE EFFECTS ON THE NERVOUS SYSTEM INCLUDING DIFFICULTY IN SPEECH, MOTOR DYSFUNCTION WITH RIGIDITY, SPASTICITY, AND HYPOKINESIS HAVE BEEN REPORTED.
CHRONIC EXPOSURE- REPEATED INGESTION MAY CAUSE VISUAL IMPAIRMENT AND BLINDNESS AND OTHER SYSTEMIC EFFECTS AS DETAILED IN ACUTE INGESTION. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

FIRST AID- IF INGESTION OF METHANOL IS DISCOVERED WITHIN 2 HOURS, GIVE SYRUP OF IPECAC. LAVAGE THOROUGHLY WITH 2-4 L OF TAP WATER WITH SODIUM BICARBONATE (20 G/L) ADDED. GET MEDICAL ATTENTION IMMEDIATELY. LAVAGE SHOULD BE PERFORMED BY QUALIFIED MEDICAL PERSONNEL (DREISBACH, HANDBOOK OF POISONING, 12TH ED.).

ANTIDOTE:

METHANOL POISONING:
GIVE ETHANOL, 50% (100 PROOF), 1.5 ML/KG ORALLY INITIALLY, DILUTED TO NOT MORE THAN 5% SOLUTION, FOLLOWED BY 0.6-1.0 ML/KG EVERY 2 HOURS ORALLY OR INTRAVENOUSLY FOR 4 DAYS IN ORDER TO REDUCE METABOLISM OF METHANOL AND TO ALLOW TIME FOR ITS EXCRETION. BLOOD ETHANOL LEVEL SHOULD BE IN THE RANGE OF 1-1.5 MG/ML (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). ANTIDOTE SHOULD BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL.

ORAL OR INTRAVENOUS ADMINISTRATION OF 4-METHYLPYRAZOLE INHIBITS ALCOHOL DEHYDROGENASE AND HAS BEEN USED EFFECTIVELY AS AN ANTIDOTE FOR METHANOL OR ETHYLENE GLYCOL POISONING (ELLENHORN AND BARCELOUX, MEDICAL TOXICOLOGY).

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REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
METHYL ALCOHOL (METHANOL):
- ACETYL BROMIDE; VIOLENT REACTION WITH FORMATION OF HYDROGEN BROMIDE.
- ALKYLALUMINUM SOLUTIONS; VIOLENT REACTION.
- ALUMINUM; CORRODES.
- BARIUM PERCHLORATE; DISTILLATION YIELDS HIGHLY EXPLOSIVE ALKYL PERCHLORATE.
- BERYLLIUM HYDRIDE; VIOLENT REACTION, EVEN AT -196 C.
- BROMINE; VIGOROUSLY EXOTHERMIC REACTION.
- CALCIUM CARBIDE; VIOLENT REACTION.
- CHLORINE; POSSIBLE IGNITION AND EXPLOSION HAZARD.
- CHLOROFORM AND SODIUM HYDROXIDE; EXPLOSIVE REACTION.
- CHROMIUM TRIOXIDE (CHROMIC ANHYDRIDE); POSSIBLE IGNITION.
- CYANURIC CHLORIDE; VIOLENT REACTION.
- DICHLOROMETHANE; POSSIBLE IGNITION AND EXPLOSION.
- DIETHYL ZINC; POSSIBLE IGNITION AND EXPLOSION.
- HYDROGEN PEROXIDE + WATER; EXPLOSION HAZARD.
- IODINE + ETHANOL + MERCURIC OXIDE; EXPLOSION HAZARD.
- LEAD; CORRODES.
- LEAD PERCHLORATE; EXPLOSION HAZARD.
- MAGNESIUM; VIOLENT REACTION.
- MAGNESIUM (POWDERED); MIXTURES ARE CAPABLE OF DETONATION.
- METALS; INCOMPATIBLE.
- NICKEL; POSSIBLE IGNITION IN THE PRESENCE OF NICKEL CATALYST.
- NITRIC ACID (CONCENTRATED); MIXTURES OF GREATER THAN 25% ACID MAY DECOMPOSE VIOLENTLY.
- OXIDIZERS (STRONG); FIRE AND EXPLOSION HAZARD.
- PERCHLORIC ACID; EXPLOSION HAZARD.
- PHOSPHOROUS TRIOXIDE; POSSIBLE VIOLENT REACTION AND IGNITION.
- PLASTICS, RUBBER, COATINGS; MAY BE ATTACKED.
- POTASSIUM; POSSIBLE DANGEROUS REACTION.
- POTASSIUM HYDROXIDE + CHLOROFORM; EXOTHERMIC REACTION.
- POTASSIUM TERT-BUTOXIDE; FIRE AND EXPLOSION HAZARD.
- SODIUM + CHLOROFORM; POSSIBLE EXPLOSION.
- SODIUM HYPOCHLORITE; EXPLOSION HAZARD.
- SODIUM METHOXIDE + CHLOROFORM; VIOLENT REACTION.
- SULFURIC ACID; FIRE AND EXPLOSION HAZARD.
- ZINC; EXPLOSION HAZARD.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

STORE IN ACCORDANCE WITH 29 CFR 1910.106.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

DISPOSAL

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262, EPA HAZARDOUS WASTE NUMBER U164.

****

CONDITIONS TO AVOID

SPILL AND LEAK PROCEDURES

SOIL SPILL:
DIG HOLDING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.

DIKE FLOW OF SPILLED MATERIAL USING SOIL OR SANDBAGS OR FOAMED BARRIERS SUCH AS POLYURETHANE OR CONCRETE.

AIR SPILL:

DR3009145

APPLY WATER SPRAY TO KNOCK DOWN VAPORS.

WATER SPILL:
ALLOW SPILLED MATERIAL TO AERATE.

LIMIT SPILL MOTION AND DISPERSION WITH NATURAL BARRIERS OR OIL SPILL CONTROL BOOMS.

USE SUCTION HOSES TO REMOVE TRAPPED SPILL MATERIAL.

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS; FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 5000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.
VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS; NIOSH CRITERIA DOCUMENTS OR BY THE U.S. DEPARTMENT OF LABOR, 29 CFR 1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

METHYL ALCOHOL (METHANOL):

2000 PPM- ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

5000 PPM- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS-FLOW MODE.

10,000 PPM- ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR THAT HAS A TIGHT-FITTING FACEPIECE AND IS OPERATED IN A CONTINUOUS-FLOW MODE.

25,000 PPM- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY APPROPRIATE ESCAPE-TYPE, SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

ANY SELF-CONTAINED BREATHING APPARATUS THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

ANY SUPPLIED-AIR RESPIRATOR THAT HAS A FULL FACEPIECE AND IS OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

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EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

EMERGENCY EYE WASH: WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

CREATION DATE: 09/25/84 REVISION DATE: 07/31/91

-ADDITIONAL INFORMATION-

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AR300947

AIR PRODUCTS

BYRNE SPECIALTY GASES

Byrne Specialty Gases, Inc.
514 S. River Street
Seattle, Washington 98108 (206) 764-4633

Specialty Ga Material Safe Data She

ERGENCY PHONE (800) 523-9374 PENNSYLVANIA (800) 322-9082	PRODUCT NAME ISOBUTYLENE	CAS #115-11-7
L PRODUCTS AND CHEMICALS, INC. X 538 LENTOWN, PA 18105 5) 481-4257	TRADE NAME AND SYNONYMS Isobutylene CHEMICAL NAME AND SYNONYMS Isobutylene, Isobutene, 2-Methylpropene	
UE DATE D REVISIONS 04/78, 06/85	FORMULA (iso) C_4H_8	CHEMICAL FAMILY Alkene

HEALTH HAZARD DATA

IE WEIGHTED AVERAGE EXPOSURE LIMIT

See last page.

MPTOMS OF EXPOSURE

halation: Moderate concentrations which exclude an adequate supply of oxygen to the lungs cause dizziness, owsiness and eventual unconsciousness. It also has a very mild anesthetic effect which might cause lack of ordination or lessened mental alertness.

kin and Eye Contact: It is mildly irritating to mucous membranes. Due to its rapid rate of evaporation, isobutylene n cause tissue freezing or frostbite on contact.

XICOLOGICAL PROPERTIES

obutylene has a very mild anesthetic effect, however, the major health hazard is the exclusion of an adequate pply of oxygen to the lungs.

ostbite effects are a change in color of the skin to gray or white possibly followed by blistering.

COMMENDED FIRST AID TREATMENT

OMPT MEDICAL ATTENTION IS REQUIRED IN ALL CASES OF OVEREXPOSURE TO ISOBUTYLENE. RES-E PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS AND MUST BE /ARE OF EXTREME FIRE AND EXPLOSION HAZARD.

alation: Move exposed personnel to an uncontaminated area. If not breathing, give artificial respiration, prefera- mouth-to-mouth. If breathing is difficult, give oxygen. Medical assistance should be sought immediately.

n Contact or Frostbite: Remove contaminated clothing and flush affected areas with lukewarm water. DO NOT E HOT WATER. A physician should see the patient promptly if the cryogenic "burn" has caused blistering of skin or deep tissue freezing.

Information contained in this material safety data sheet is offered without charge for use by technically qualified personnel at their discretion and risk. All statements, technical information and recommendations contained herein are based on tests and data which we believe to be reliable, but the accuracy or completeness thereof is not guaranteed and no warranty of any kind is made with respect thereto. This information is not intended as a license to operate under or a recommendation to practice or infringe any patent of this Company or others covering any process, composition of matter or use.

Since the Company shall have no control of the use of the product described herein, the Company assumes no liability for loss or damage incurred from the proper or improper use of such product.

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES

Isobutylene is flammable over a wide range in air.

PHYSICAL DATA

BOILING POINT 19.6°F (−6.9°C)	LIQUID DENSITY AT BOILING POINT 39.1 lb/ft³ (626 kg/m³)
VAPOR PRESSURE @ 70°F (21.1°C) = 39 psia (269 kPa)	GAS DENSITY AT 70°F, 1 atm 0.148 lb/ft³ (2.37 kg/m³)
SOLUBILITY IN WATER Insoluble	FREEZING POINT −220.6°F (−140.3°C)

APPEARANCE AND ODOR

Colorless gas with an unpleasant odor similar to that which is emitted when burning anthracite coal.

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) See last page.	AUTO IGNITION TEMPERATURE 869°F (465°C)	FLAMMABLE LIMITS % BY VOLUME LEL 1.8 UEL 9.6

EXTINGUISHING MEDIA Water, carbon dioxide, dry chemical	ELECTRICAL CLASSIFICATION Class 1, Group not specifie

SPECIAL FIRE FIGHTING PROCEDURES

Keep cylinder(s) cool with water spray from a distance. If possible without risk, move cylinder(s) away from fire area. If possible without risk, stop the flow of gas to a fire. Allow gas fire to burn itself out. (Continued on last page

UNUSUAL FIRE AND EXPLOSION HAZARDS

Isobutylene is denser than air and can travel considerable distances to an ignition source and flash back. Cylinder(s) may explode or vent when exposed to fire.

REACTIVITY DATA

STABILITY Unstable		CONDITIONS TO AVOID
Stable	X	

INCOMPATIBILITY (Materials to avoid)

Oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS

None

HAZARDOUS POLYMERIZATION May Occur		CONDITIONS TO AVOID
Will Not Occur	X	

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with an inert gas prior to attempting repairs. If leak is in container or container valve, call the "800" emergency phone number listed herein.

WASTE DISPOSAL METHOD

All Federal, State and Local regulations regarding health and pollution should be followed in waste disposal. Contact Air Products for specific recommendations. Do not dispose of unused quantities.

(Continued on last page

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IRATORY PROTECTION (Specify type) Positive pressure air line with mask or self-contained breathing apparatus should be available for emergency use.

ILATION Hood with forced ventilation	**LOCAL EXHAUST** To prevent accumulation above the LEL	**SPECIAL**
	MECHANICAL (General) In accordance with electrical codes	**OTHER**

ECTIVE GLOVES
Plastic or rubber

PROTECTION
Safety goggles or glasses

ER PROTECTIVE EQUIPMENT
Safety shoes, safety shower, eyewash "fountain."

SPECIAL PRECAUTIONS*

AL LABELING INFORMATION
OT Shipping Name: Liquified petroleum gas DOT Hazard Class: Flammable gas
OT Shipping Label: Flammable gas ID No.: UN 1075

AL HANDLING RECOMMENDATIONS
only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder move- t. Use a pressure reducing regulator when connecting cylinder to lower pressure (< 250 psig) piping or sys- . Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check or trap in the discharge line to prevent hazardous back flow into the cylinder.

additional recommendations consult the Air Products Specialty Gas Catalog Safety and Technical Information ion or Compressed Gas Association Pamphlet P-1.

AL STORAGE RECOMMENDATIONS
ct cylinders from physical damage. Store in cool, dry, well-ventilated area of non-combustible construction from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored ceed 130°F (54°C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cyl- s being stored for excessive periods of time. Post "No Smoking or Open Flames" signs in the storage or use There should be no sources of ignition in the storage or use area.

dditional recommendations consult the Air Products Specialty Gas Catalog Safety and Technical Information on or Compressed Gas Association Pamphlet P-1.

AL PACKAGING RECOMMENDATIONS
utylene is noncorrosive and may be used with any common structural material.

R RECOMMENDATIONS OR PRECAUTIONS
-ground and bond all lines and equipment associated with the isobutylene system. Electrical equipment d be non-sparking or explosion proof. Compressed gas cylinders should not be refilled except by qualified ilers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner n his (written) consent is a violation of Federal Law (49CFR).

*Various Government agencies (i.e., Department of Transportation, Occupational Safety and Health Administration, Food and Drug Administration and others) may have specific regulations concerning the transportation, handling, storage or use of this product which will not be reflected in this data sheet. The customer should review these regulations to ensure that he is in full compliance.

Specialty Gas Department
Air Products and Chemicals, Inc.
Box 538, Allentown, PA 18105
(215) 481-4257

AIR PRODUCTS

TIME WEIGHTED AVERAGE EXPOSURE LIMIT (Continued)

Isobutylene is defined as a simple asphyxiant. Oxygen levels should be maintained at greater than 18 molar percent at normal atmospheric pressure which is equivalent to a partial pressure of 135 mm Hg. (ACGIH 1984–85)

FLASH POINT (Method Used) (Continued)

−105°F (−76°C) Closed Cup

SPECIAL FIRE FIGHTING PROCEDURES (Continued)

Ventilate low areas where flammable or explosive mixtures may form.

WASTE DISPOSAL METHOD (Continued)

Return the properly labeled shipping container to Air Products for disposal with valve(s) tightly closed, outlet seal(s) secured and valve protection cap in place. For emergency disposal assistance, call the "800" emergency phone number listed herein.

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TN: SAFETY DIRECTOR
ZM HILL INC
BOX 4200
STON VA 22090
RK THOMPSON

DATE: 11/06/87
CUST = 924476 P.O. = W6530

M A T E R I A L S A F E T Y D A T A S H E E T

IDENTIFICATION

PRODUCT = 13495-4 NAME: PENTANE, 99+%, SPECTROPHOTOMETRIC GRADE
CAS = 109-66-0

TOXICITY HAZARDS

ECS = RZ9450000
PENTANE
XICITY DATA
IVN-MUS LD50:446 MG/KG JPMSAE 67,566,78
VIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 600 PPM; STEL 750 PPM 85INA8 5,463,86
MSHA STANDARD-AIR:TWA 500 PPM (1475 MG/M3) OTLVS= 3,200,71
OSHA STANDARD-AIR:TWA 1000 PPM FEREAC 39,23540,74
NIOSH REL TO ALKANES-AIR:TWA 350 MG/M3 MMWR== 34(1S),6S,85
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, DECEMBER 1986
NIOSH ANALYTICAL METHODS: SEE HYDROCARBONS, BP 36-126 C, 1500

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMAT

HEALTH HAZARD DATA

UTE EFFECTS
HARMFUL IF INHALED OR SWALLOWED.
VAPOR OR MIST IS IRRITATING TO THE EYES, MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
CAUSES SKIN IRRITATION.
EXPOSURE CAN CAUSE:
DAMAGE TO THE LUNGS
RST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

PHYSICAL DATA

MELTING POINT: -130 C
BOILING POINT: 35 C TO 36 C
SPECIFIC GRAVITY: 0.626
VAPOR DENSITY: 2.48
VAPOR PRESSURE: 776.0 MM @ 37.8 C

FIRE AND EXPLOSION HAZARD DATA

LOWER EXPLOSION LEVEL: 1.5%
UPPER EXPLOSION LEVEL: 7.8%
FLASH POINT: -57 F

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MATERIAL SAFETY DATA SHEET

CATALOG # 15495-4 NAME: PENTANE, 99+%, SPECTROPHOTOMETRIC GR

EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.
DO NOT USE WATER.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
USE WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS.
UNUSUAL FIRE AND EXPLOSION HAZARDS
EXTREMELY FLAMMABLE.
VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.
CONTAINER EXPLOSION MAY OCCUR UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
OXIDIZING AGENTS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
SHUT OFF ALL SOURCES OF IGNITION.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH AN ACTIVATED CARBON ADSORBENT, TAKE UP AND PLACE IN CLOSE CONTAINERS. TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLET
WASTE DISPOSAL METHOD
BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS MATERIAL IS HIGHLY FLAMMABLE.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

CHEMICAL SAFETY GOGGLES.
SAFETY SHOWER AND EYE BATH.
MECHANICAL EXHAUST REQUIRED.
RUBBER GLOVES.
NIOSH/MSHA-APPROVED RESPIRATOR.
DO NOT BREATHE VAPOR.
AVOID CONTACT WITH EYES, SKIN AND CLOTHING.
WASH THOROUGHLY AFTER HANDLING.
IRRITANT.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.
OPEN CAREFULLY.
MAY DEVELOP PRESSURE.
HANDLE AND STORE UNDER NITROGEN.
REFRIGERATE.

ADDITIONAL PRECAUTIONS AND COMMENTS

NOT APPLICABLE

AR300953

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MATERIAL SAFETY DATA SHEET

CATALOG # 15449-4 NAME: PENTANE, 99+%, SPECTROPHOTOMETRIC GRADE

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Aldrich Chemie N.V.S.A.
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Aldrich-Chemie
Aldrich Chemical Co. Ltd.
Aldrich-Chemie Gmbh & Co. KG

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NNNITRIC ACIDNN

MATERIAL SAFETY DATA SHEET

SHER SCIENTIFIC
EDICAL DIVISION
RIAGENE LANE
IR LAWN NJ 07410
01) 796-7100

EMERGENCY CONTACTS
OASTON L. PELLORI
(201) 796-7100

DATE: 01/10/86
PO NBR: N/A
ACCT: 111594-01
INDEX: 15-8400-70256
CAT NO: A2005212

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FORMATION FOR THEIR PARTICULAR PURPOSES.

SUBSTANCE IDENTIFICATION

CAS-NUMBER 7697-37-2

BSTANCE: NNNITRIC ACIDNN

RADE NAMES/SYNONYMS: AQUA FORTIS; HYDROGEN NITRATE; AZOTIC ACID;
ITRYL HYDROXIDE; A-200; A-200C; A-200S; A-196; A-202; A-204-C

EMICAL FAMILY:
INORGANIC ACID

OLECULAR FORMULA: H-N-O3 MOL WT 63.02

FPCA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

ERCENT: 70 COMPONENT: HYDROGEN NITRATE

ERCENT: 30 COMPONENT: WATER

THER CONTAMINANTS: NONE

XPOSURE LIMITS:
PPM (5 MG/M3) OSHA TWA; 2 PPM NIOSH RECOMMENDED TWA;
PPM ACGIH TWA; 4 PPM ACGIH STEL

PHYSICAL DATA

ESCRIPTION: COLORLESS FUMING LIQUID WITH AN ACRID ODOR; SUFFOCATING
ORES. THE ODOR IS NOT CONSIDERED AN ADEQUATE WARNING PROPERTY.

OILING POINT: 181 F (83 C) MELTING POINT: -44 F (-42 C)

SPECIFIC GRAVITY: 1.5 VAPOR PRESSURE: 42 MMHG @ 25 C

AR300955

EVAPORATION RATE: NOT AVAILABLE SOLUBILITY IN WATER: MISCIBLE

SOLVENT SOLUBILITY: ETHER ODOR THRESHOLD: <5.0 PPM VAPOR DENSITY: 2.2

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
INCREASES THE FLAMMABILITY OF COMBUSTIBLES, ORGANIC MATERIAL, AND READILY OXIDIZABLE MATERIALS, CAUSING IGNITION OF SOME. SEVERE EXPLOSION HAZARD BY REACTION WITH MANY INCOMPATIBLES, INCLUDING METALLIC POWDERS, CARBIDES, HYDROGEN SULFIDE, AND TURPENTINE. IN OR NEAR FIRE, MATERIAL EMITS TOXIC AND REACTIVE NITROGEN OXIDES AS GASES.

FLASH POINT: NONCOMBUSTIBLE

FIREFIGHTING MEDIA:
WATER SPRAY

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES; ELSE WITHDRAW FROM AREA AND LET FIRE BURN (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

EXTINGUISH USING AGENTS INDICATED. IF LARGE AMOUNTS OF COMBUSTIBLE MATERIALS ARE INVOLVED, USE WATER SPRAY OR FOG IN FLOODING AMOUNTS. USE WATER SPRAY TO ABSORB CORROSIVE VAPORS. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING CORROSIVE VAPORS; KEEP UPWIND

TOXICITY

410 MG/KG ORAL-HUMAN LDLO; 110 MG/KG UNKNOWN-MAN LDLO;
CARCINOGEN STATUS: NONE.
NITRIC ACID IS A SEVERE EYE, MUCOUS MEMBRANE, AND SKIN IRRITANT.

HEALTH EFFECTS AND FIRST AID

INHALATION:
CORROSIVE. 100 PPM IS IMMEDIATELY DANGEROUS TO LIFE AND HEALTH.
ACUTE EXPOSURE- MAY CAUSE COUGHING, HEADACHE, DIZZINESS, AND WEAKNESS. DELAYED SYMPTOMS MAY INCLUDE DRYNESS OF THE THROAT AND NOSE, CHEST PAIN OR TIGHTNESS, DYSPNEA, FROTHY SPUTUM, HYPOTENSION AND CYANOSIS FOLLOWED BY PNEUMONITIS AND PULMONARY EDEMA, WHICH MAY BE FATAL. IF PATIENT RECOVERS, SCAR TISSUE MAY CAUSE STRICTURE OF THE PYLORUS OR ESOPHAGUS;

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE CAUSES DENTAL EROSION FOLLOWED BY JAW NECROSIS, CHRONIC COUGH AND BRONCHITIS OR CHEMICAL PNEUMONITIS AND GASTROINTESTINAL DISTURBANCES.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST.

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ACUTE EXPOSURE- DIRECT CONTACT WITH LIQUID OR CONCENTRATED VAPOR CAUSES IMMEDIATE SEVERE AND PENETRATING BURNS, STAINING THE SKIN YELLOW OR YELLOWISH-BROWN.

CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION.

IF CONTACT
CORROSIVE.
ACUTE EXPOSURE- DIRECT CONTACT WITH THE LIQUID MAY CAUSE PAIN, PHOTOPHOBIA, TEARING, EDEMA, CORNEAL ULCERATION, SEVERE BURNS, AND NECROSIS OF THE DEEPER TISSUES WITH PERMANENT DAMAGE AND BLINDNESS IS POSSIBLE.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). IN PRESENCE OF BURNS, APPLY STERILE BANDAGES LOOSELY WITHOUT MEDICATION. GET MEDICAL ATTENTION.

INGESTION
CORROSIVE.
ACUTE EXPOSURE- IMMEDIATE PAIN IN THE MOUTH, THROAT, AND STOMACH MAY BE FOLLOWED BY VOMITING, AND DIARRHEA OF DARK PRECIPITATED BLOOD, HYPOTENSION, DELIRIUM, ANURIA, SEVERE, POSSIBLY FATAL, CIRCULATORY COLLAPSE, AND ASPHYXIA FROM EDEMA OF THE GLOTTIS ARE POSSIBLE. BURNS OF THE GASTROINTESTINAL TRACT MAY BE SEVERE ENOUGH TO CAUSE PERFORATION OF THE ESOPHAGUS AND STOMACH WHICH MAY BE FOLLOWED BY MEDIASTINITUS OR PERITONITIS, INDICATED BY FEVER.

FIRST AID- IF VICTIM IS CONSCIOUS, GIVE HIM LARGE QUANTITIES OF WATER IMMEDIATELY TO DILUTE THE ACID. DO NOT INDUCE VOMITING. GIVE PATIENT 1 OUNCE (30 ML) OF MILK OF MAGNESIA. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES. HOWEVER NITRIC VAPOR AND/OR NITRIC OXIDES ARE QUIETLY EVOLVED. ALSO SUNLIGHT CATALYSES THE FORMATION OF THE OXIDES AND THIS GIVES A YELLOW COLOR TO THE CONCENTRATED ACID.

INCOMPATIBILITIES
EASILY OXIDIZED SUBSTANCES, EXAMPLES FOLLOW

EXPLOSION: ACETONITRILE, CESIUM CARBIDE, CUPRIC NITRIDE, CYANIDES, 1,2-DIAMINOETHANE BISTRIMETHYL GOLD, DINITROTOLUENE, EPICHLORHYDRIN, 5-ETHYL-2-METHYL PYRIDINE, CYCLOPENTADIENE, BENZENE, TOLUENE, METALS, METAL CARBIDES, 4-METHYLCYCLOHEXANONE, NITROBENZENE AND WATER, NITROMETHANE, POLYBROMOSILANES, PHOSPHORUS TRICHLORIDE, POTASSIUM HYPOPHOSPHITE (ON EVAPORATION), RUBIDIUM CARBIDE, SELENIUM TRIPHOSPHIDE, SULFUR DIOXIDES, THIOCYANATES,

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THIOCYANIC ACID METAL SALTS, THIOPHENES, TETRABORANE, TRICADMIUM DIPHOSPHIDE, TRITHIOACETONE.
PROBABLE EXPLOSION: ACETONE AND ACETIC ACID, SULFURIC ACID AND GLYCERIDES, TRIAZINE AND TRIFLUOROACETIC ANHYDRIDE @ 54 C.
POSSIBLE EXPLOSION: ACETIC ACID, 2-AMINOTHIAZOLE AND SULFURIC ACID, CYANATES, 1,3-CYCLOPENTADIENE, FLUORINE, IACYIC ACID AND HYDROGEN FLUORIDE, MESITYLENE, ORGANIC SUBSTANCES AND SULFURIC ACID, ORGANIC SUBSTANCES AND PERCHLORATES, PHTHALIC ACID OR PHTHALIC ANHYDRIDE AND SULFURIC ACID, REDUCING AGENTS, SULFURIC ACID, TITANIUM ALLOY.
EXPLOSION BY FRICTION OR IMPACT: ACETIC ANHYDRIDE.
EXPLOSIVE OXIDATION: NON-METAL OXIDES- ARSINE, PHOSPHINE, OR TETRABORANE, DIPHENYLDISTIBENE.
POSSIBLE EXPLOSION BY IMPACT : TITANIUM-MAGNESIUM ALLOY.
VIOLENT REACTION: ACRYLONITRILE, ALCOHOLS, ARSINE, CARBON (PULVERIZED), CHLORINE TRIFLUORIDE, CUPROUS NITRIDE, CYCLIC KETONES, CYCLOHEXANOL, ETHANOL, GERMANIUM, HYDRAZINE, SULFUR HALIDES, SULFURIC ACID AND TEREPHTHALIC ACID, THIOALDEHYDES OR THIOKETONES, URANIUM, URANIUM ALLOYS.
VIOLENT OXIDATION: ACETONE AND SULFURIC ACID, SULFAMIC ACID.
VIOLENT DECOMPOSITION: BUTANETHIOL, PHOSPHINE.
VIOLENT DECOMPOSITION RESULTING IN IGNITION: CROTONALDEHYDE, TETRAPHOSPHORUS TRIIODIDE.
POSSIBLE VIOLENT REACTION: ANTIMONY.
POSSIBLE VIOLENT EXOTHERMIC REACTION: ANION EXCHANGE RESIN.
INTENSE EXOTHERMIC REACTION: ACROLEIN, ALLYL ALCOHOL, ALLYL CHLORIDE, 2-AMINOETHANOL, AMMONIUM HYDROXIDE, BISMUTH, N-BUTYRALDEHYDE, CHLOROSULFONIC ACID, CRESOL, CUMENE, DIISOPROPYL ETHER, ETHYLENEDIAMINE, POLYALKENES, GLYOXAL, ISOPRENE, MESITYL OXIDE, 2-METHYL-5-ETHYLPYRIDINE, OLEUM, PROPYLENE OXIDE, PROPIOLACTONE (BETA-), PYRIDENE, SODIUM HYDROXIDE, VINYL ACETATE, VINYLIDENE CHLORIDE.
INTENSE REACTION: DIETHYLETHER, HYDRAZOIC ACID, P-XYLENE IN THE PRESENCE OF SULFURIC ACID, SELENIUM, SODIUM AZIDE, TOLUENE, TRIMETHYLTRIOXANE.
IGNITION WITH POSSIBLE EXPLOSION: HYDROGEN TELLURIDE.
IGNITION: ANILINE, BORON PHOSPHIDE, BROMINE PENTAFLUORIDE, N-BUTYLMERCAPTAN, CALCIUM HYPOPHOSPHITE, DIBORANE, DIPHENYL TIN, N-ETHYL ANILINE, ETHYL PHOSPHINE, FURFURYL ALCOHOL, HALOGEN PHOSPHIDES, HYDROGEN IODIDES, LITHIUM, METALS, PHOSPHONIUM IODIDE, PHOSPHORUS, SELENIUM HYDRIDE, SODIUM, TERPENES, TOLUIDINE, TRIETHYLGALLIUM MORPHETHYL ETHER COMPLEX, UNS-DIMETHYLHYDRAZINE.
POSSIBLE IGNITION: AMMONIA, ANION EXCHANGE RESIN AND CHROMITES OR DICHROMATE, AROMATIC AMINES, DIVINYL ETHER, DIENE OR ACETYLENE DERIVATIVES, LITHIUM, REDUCING AGENTS.
INCANDESCENT REACTION: BORON, FERROUS OXIDE (POWDER), HYDROGEN SULFIDE, LITHIUM SILICIDE, SELENIUM HYDRIDE, MAGNESIUM PHOSPHIDE, MANGANESE, ZINC.
FORMATION OF HIGHLY EXPLOSIVE PRODUCTS: NITROAROMATIC HYDROCARBONS.
TION OF EXPLOSIVE PRODUCTS: ACETYLENE, 4-CHLORO-2-NITROANILINE, CYCLO-
NE, CYCLOHEXYLAMINE, 2,6-DI-T-BUTYL PHENOL, DICHLOROMETHANE, ETHANOL AND
DE, 5-ETHYL-2-PICOLINE, HYDROGEN PEROXIDE AND KETONES, HYDROGEN PEROXIDE
MERCURIC OXIDE, HYDROGEN PEROXIDE AND THIOUREA, INDANE AND SULFURIC
), METAL SALICYLATES, PHENYLORTHOPHOSPHORIC ACID DISODIUM SALT, TITANIUM.
TION OF POSSIBLY EXPLOSIVE PRODUCTS: BENZOTHIOPHENE DERIVATIVES.
TION OF EASILY COMBUSTIBLE ESTER: CELLULOSE.
ATABLE MIXTURE (DEPENDING ON AMOUNT OF WATER PRESENT): NITROBENZENE.

POSITION:
POSES ON EXPOSURE TO AIR OR ORGANIC MATTER, OR WITH HEAT, TO RELEASE
Y TOXIC FUMES OR OXIDES OF NITROGEN, INCLUDING NITRIC OXIDE AND NITROGEN
DE, AND HYDROGEN NITRATE. REACTS WITH THE FOLLOWING TO RELEASE TOXIC
S: SULFIDES, CARBONATES, CYANIDES. VIOLENT REACTION WITH ALL CARBIDES,
AS MIXTURE EVOLVED (N2O4) REACTS STRONGLY WITH HYDROCARBONS, FLUORINE, OR

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YMERIZATION:
I NOT OCCUR.

****

CONDITIONS TO AVOID

T IGNITE COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). REACTS VIOLENTLY
TH WATER AND FUELS. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN TANKS AND
PPER CARS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD. AVOID
NTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS, INCLUDING THOSE MATERIALS
D CLASSES OF MATERIALS LISTED IN THE REACTIVITY SECTION. HEATING MAY
REASE THE EVOLUTION OF NITRIC ACID VAPOR AND/OR NITROGEN OXIDES (GASES)
BOVE AN ACCEPTABLE LEVEL.

****

SPILL AND LEAK PROCEDURES

CUPATIONAL SPILL:
EP COMBUSTIBLES (WOOD, PAPER, OIL AND OTHER EASILY OXIDIZABLE MATERIALS)
AY FROM SPILLED MATERIAL. WEAR PERSONAL PROTECTIVE EQUIPMENT. DO NOT TOUCH
ILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO
DUCE VAPORS. DILUTE SPILLS OR LEAKS WITH PLENTY OF WATER. NEUTRALIZE
SIDUE WITH (A) ALKALI, SUCH AS SODA ASH, LIME, LIMESTONE) OR (B) OTHER
ITABLE NEUTRALIZATION MATERIALS. ADEQUATE VENTILATION IS REQUIRED TO
MINATE ANY NITROGEN OXIDES RELEASED AND, IF SODA ASH OR LIMESTONE IS USED,
02 ABSORB WITH EXCESS SODA ASH, SCOOP UP AND PLACE IN A SUITABLE D.O. GLASS
R PLASTIC CONTAINER AND CLOSE. LABEL 'OXIDIZER'. KEEP OUT OF SEWERS AND WATER
URSES. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.
ENTILATE CLOSED SPACES BEFORE ENTERING.

PROTECTIVE EQUIPMENT

NTILATION:
ROVIDE LOCAL EXHAUST VENTILATION, PROCESS ENCLOSURE OR GENERAL DILUTION
NTILATION TO MEET PERMISSABLE EXPOSURE LIMITS REQUIREMENTS. EQUIPMENT MUST
OR-RESISTANT.

UNIT TO 100 MG/M3-
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE
OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.
TYPE 'C' SUPPLIED-AIR RESPIRATOR OPERATED IN PRESSURE-DEMAND
OR OTHER POSITIVE-PRESSURE OR CONTINUOUS FLOW MODE.

S, INCLUDING THE IDLH LEVEL, 250 MG/M3-
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE
OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE,
OR USE EQUIVALENT RESPIRATOR.

IREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE
OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

LOTHING:
MPLOYEE MUST WEAR IMPERVIOUS CLOTHING AS NECESSARY TO AVOID ANY POSSIBILITY

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OF CONTACT WITH CHEMICAL.

GLOVES:
WEAR IMPERVIOUS GLOVES AS NECESSARY TO AVOID ANY POSSIBILITY OF CONTACT WITH SUBSTANCE. PREFERRED MATERIALS: VITON OR BARRIER.

EYE PROTECTION:
WEAR FACESHIELD (8 INCH MINIMUM) AND VENTED SAFETY GOGGLES. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - ALLIED FISHER SCIENTIFIC
CREATION DATE: 02/10/85 REVISION DATE: 10/21/85

-ADDITIONAL INFORMATION-
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AR300960

r CYANAMID

ERIAL SAFETY DATA

MSDS NO. 0243-04
CAS NO. 007664-93-9
DATE: 01/30/90

UCT TIFICATION

PRODUCT NAME:	Sulfuric Acid,60 degree Be',66 degree Be', 98-100%
SYNONYMS:	Sulfuric acid; oil of vitriol
CHEMICAL FAMILY:	Inorganic acid
MOLECULAR FORMULA:	H2SO4
MOLECULAR WGT.:	98.00

IING

DANGER! CAUSES SEVERE BURNS OF EYES AND SKIN

LATED PONENTS

COMPONENT	CAS. NO.	%	TWA/CEILING	REFERENCE
Sulfuric Acid	007664-93-9	80-100	1 mg/M3	OSHA/ACGIH

HAZARD G

Fire 0
Health 3 2 Reactivity
Special

FIRE: Materials that will not burn.
HEALTH: Materials which on short exposure could cause serious temporary or residual injury even though prompt medical treatment were given.
REACTIVITY: Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate. Also materials which may react violently with water or which may form potentially explosive mixtures with water.

H HAZARD RMATION

EFFECTS OF OVEREXPOSURE:

Ingestion of Sulfuric Acid can cause mucous membrane burns, abdominal pain, respiratory distress (secondary to epiglottal edema) shock, renal failure and lesions or perforations of the esophagus and gastrointestinal tract. Concentrated solutions are extremely corrosive and may cause severe skin burns. Repeated contact with dilute solutions may cause skin irritation and dermatitis. Severe damage to the eyes can occur very rapidly and concentrated solutions may cause totally irreversible damage, complete corneal opacity or perforation of the globe. Inhalation of low concentrations of vapors can cause irritation of the respiratory tract. Overexposure to higher concentrations cause bronchoconstriction and laryngeal spasm or laryngeal edema.

FIRST AID:

In case of skin contact, remove contaminated clothing without delay. Wear impervious gloves. Cleanse skin thoroughly with soap and water. Do not omit cleaning hair or under fingernails if contaminated. Do not reuse clothing without laundering. Do not reuse contaminated leatherware.
In case of eye contact, immediately irrigate with plenty of water for 15 minutes. Obtain medical attention without delay.

Sulfuric Acid,60 degree Be',66 degree Be', 98-100%

If vapor of this material is inhaled, remove from exposure. Administer oxygen if there is difficulty in breathing. Give artificial respiration if person is not breathing and continue until normal breathing is established. Obtain medical attention without delay.

EXPOSURE CONTROL METHODS

Utilize a closed system process where feasible. Where this material is not used in a closed system, good enclosure and local exhaust ventilation should be provided to control exposure. Food, beverages, and tobacco products should not be carried, stored, or consumed where this material is in use. Before eating, drinking, or smoking, wash face and hands with soap and water. Prevent eye and skin contact. Wear the special protective equipment specified below for operations where eye or skin contact can occur. Prevent contamination of skin or clothing when removing protective equipment. Provide eyewash fountain and safety shower in close proximity to points of potential exposure. Where exposures are below the PEL no respiratory protection is required. Where exposures exceed the PEL use respirator approved by NIOSH or full protective suit with air supply appropriate for the material and level of exposure. See "GUIDE TO INDUSTRIAL RESPIRATORY PROTECTION"(NIOSH). Special protective equipment - To prevent skin contact wear skin protection, such as impervious gloves, apron, workpants, long sleeve workshirt, or disposable coveralls. To prevent eye contact wear eye protection such as chemical splash proof goggles or face shield.

FIRE AND EXPLOSION HAZARD INFORMATION

FLASH POINT:	Not Applicable
FLAMMABLE LIMITS (% BY VOL):	Not Applicable
AUTOIGNITION TEMP:	Not Available
DECOMPOSITION TEMP:	Not Available
FIRE FIGHTING:	Sulfuric acid will not burn, but it is capable of igniting finely divided combustible materials on contact. May react violently organic materials and water with the evolution of heat. Fires involving a small amount of combustibles may be smothered b chemical. Use water on combustibles burning in vicinity of aci use care as water applied to the acid results in severe generatic of heat and may cause boiling and splattering. Wear self-conta positive pressure breathing apparatus and full firefighting protective clothing. See Exposure Control Methods for special protective clothing.

REACTIVITY DATA

STABILITY:	Stable
CONDITIONS TO AVOID:	None known
POLYMERIZATION:	Will Not Occur
CONDITIONS TO AVOID:	None known
INCOMPATIBLE MATERIALS:	Water, many metals, and strong alkali materials. Contact with carbides, chlorates, fulminates, nitrates, or picrates may cause violent reaction/explosion or form unstable compounds. Contact with organic materials, particularly organic acids, acetates and anhydrides may result in highly exothermic reaction. Contact with metal may release explosive hydrogen gas. Contact with finely divided organic material may cause fire.
HAZARDOUS DECOMPOSITION PRODUCTS:	Thermal decomposition or combustion

ıric Acid,60 degree Bé,66 degree Bé, 98-100%

may produce sulfur trioxide and/or sulfur dioxide. Toxic and explosive hydrogen sulfide may be formed under certain conditions.

ICAL PERTIES	APPEARANCE AND ODOR:	Clear to slightly cloudy, oily liquid; odorless to slightly pungent odor
	BOILING POINT:	640 F(338 C)
	MELTING POINT:	Sulfuric Acid 98%: 37.4 F; 3.0 C - Sulfuric Acid 100%: 51.0 F; 10.49 C
	VAPOR PRESSURE:	Variable function of temperature and concentration
	SPECIFIC GRAVITY:	1.4-1.8
	VAPOR DENSITY:	Not Available
	% VOLATILE (BY VOL):	0-20 (water by weight)
	OCTANOL/H2O PARTITION COEF.:	Not Applicable
	pH:	Variable function of temperature and concentration: (0.01 N = 2.1; 0.10 N = 1.2; 1.0 N = 0.3)
	SATURATION IN AIR (BY VOL):	Not Available
	EVAPORATION RATE:	Not Available
	SOLUBILITY IN WATER:	Complete

OR LEAK EDURES	STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:	Where exposure level is not known, wear NIOSH approved positive pressure self-contained respirator. Where exposure level is known, wear NIOSH approved respirator suitable for level of exposure. Wear the same protective equipment as in Exposure Control Methods, except acid hood and suit should be worn when spraying or splashing can occur. Dilute spill cautiously with 5 or 6 volumes of water and neutralize gradually with soda ash or lime. Do not allow unneutralized acid to get into sewers containing sulfides, because of the danger of evolving hydrogen sulfide gas. For further information on Sulfuric Acid, consult the American Cyanamid brochure PRT 225.

E DISPOSAL	Disposal must be made in accordance with applicable governmental regulations.

AL AUTIONS	HANDLING AND STORAGE/OTHER:	Sulfuric acid attacks many metals, releasing flammable hydrogen gas. Extremely hazardous in contact with many materials, particularly explosives. Hydrogen gas can accumulate in metal tanks containing acid. Do not smoke or have other sources of ignition around open drums or tanks containing acid. When diluting, always add acid to water. Never add water to acid. Protect against physical damage to containers and contact with incompatible materials. Do not strike tank fittings with tools or other hard objects.

. SHIPPING RMATION	PROPER SHIPPING NAME:	SULFURIC ACID
	HAZARD CLASS:	CORROSIVE MATERIAL
	UN/NA:	UN1830

Sulfuric Acid,60 degree Be',66 degree Be', 98-100%

D.O.T. HAZARDOUS SUBSTANCES:	(Reportable Quantity of Product) SULFURIC ACID(C) (1,073 lbs-93.2%)
D.O.T. LABEL REQUIRED:	Corrosive

TSCA INFORMATION

This product is manufactured in compliance with all provisions of the Toxic Substances Control Act, 15 U.S.C.

ENVIRONMENTAL INFORMATION

The following components are defined as toxic chemicals subject to reporting requirements of Section 313 of Title III and of 40 CFR 372 or subject to other EPA regulations.

			SARA TITLE III				
COMPONENT	CAS. NO.	%	TPQ (lbs.)	RQ (lbs.)	5313	RCRA	TSCA
Sulfuric Acid	007664-93-9	80-100	1000	1000	YES	NONE	NO

PRODUCT CLASSIFICATION UNDER SECTION 311 OF SARA

ACUTE (Y)	CHRONIC (N)	FIRE (N)	REACTIVE (Y)	PRESSURE (N)

Marvin A. Friedman, Ph.D., Director of Toxicology and Product Safe

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J.T.BAKER INC. 222 RED SCHOOL LANE, PHILLIPSBURG, NJ 08865
M A T E R I A L S A F E T Y D A T A S H E E T
24-HOUR EMERGENCY TELEPHONE — (201) 859-2151
TREC # (800) 424-9300 — NATIONAL RESPONSE CENTER # (300) 424-8802

HYDROCHLORIC ACID PAGE: 1

: 05/01/89 ISSUED: 05/16/89

INC., 222 RED SCHOOL LANE, PHILLIPSBURG, NJ 08865

SECTION 1 - PRODUCT IDENTIFICATION

AME: HYDROCHLORIC ACID
NONYMS: MURIATIC ACID; CHLOROHYDRIC ACID; HYDROGEN CHLORIDE, AQUEOUS
FAMILY: INORGANIC ACIDS
HCL
T.: 36.46
7647-01-0
CS NO.: MM4025000
SE: LABORATORY REAGENT
ODES: 9530,9546,9537,9529,9543,4800,9539,9547,5367,9535,9549,9548
9537,9544,9540,9534,9542,6900

PRECAUTIONARY LABELING

-T-DATA= SYSTEM

HEALTH	-	3	SEVERE (POISON)
FLAMMABILITY	-	0	NONE
REACTIVITY	-	2	MODERATE
CONTACT	-	3	SEVERE (CORROSIVE)

Y PROTECTIVE EQUIPMENT

. SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

U.S. PRECAUTIONARY LABELING

POISON DANGER
VERE BURNS. MAY BE FATAL IF SWALLOWED OR INHALED.
T IN EYES, ON SKIN, ON CLOTHING. DO NOT BREATHE VAPOR. CAUSES DAMAGE
ATORY SYSTEM (LUNGS), EYES AND SKIN. KEEP IN TIGHTLY CLOSED
. LOOSEN CLOSURE CAUTIOUSLY. USE WITH ADEQUATE VENTILATION. WASH
Y AFTER HANDLING. IN CASE OF SPILL NEUTRALIZE WITH SODA ASH OR LIME
IN DRY CONTAINER.

CONTINUED ON PAGE: 2

PRECAUTIONARY LABELING (CONTINUED)

INTERNATIONAL LABELING

STATING TO EYES AND SKIN.
P OUT OF REACH OF CHILDREN. IN CASE OF CONTACT WITH EYES, RINSE IMMEDIATEL
H PLENTY OF WATER AND SEEK MEDICAL ADVICE.

-T-DATA- STORAGE COLOR CODE: WHITE (CORROSIVE)

SECTION II - COMPONENTS

PONENT	CAS NO.	WEIGHT %	OSHA/PEL	ACGIH/TLV
ROCHLORIC ACID	7647-01-0	33-40	5 PPM	5 PPM
ER	7732-18-5	60-67	N/E	N/E

SECTION III - PHYSICAL DATA

LING POINT: 110 C (230 F) AT 760 MM HG)

VAPOR PRESSURE (MMHG): N/A

TING POINT: -25 C (-13 F) AT 760 MM HG)

VAPOR DENSITY (AIR=1): 1.3

CIFIC GRAVITY: 1.19 (H2O=1)

EVAPORATION RATE: N/A

UBILITY(H2O): COMPLETE (100%)

% VOLATILES BY VOLUME: 100 (21 C)

1.0 -- (0.1M SOLUTION)

R THRESHOLD (PPM): N/A

PHYSICAL STATE: LIQUID

FFICIENT WATER/OIL DISTRIBUTION: N/A

EARANCE & ODOR: CLEAR, COLORLESS FUMING LIQUID. PUNGENT ODOR.

CONTINUED ON PAGE: 3

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

JINT (CLOSED CUP): N/A NFPA 704M RATING: 3-0-0

ITION TEMPERATURE: N/A

E LIMITS: UPPER - N/A LOWER - N/A

TINGUISHING MEDIA
EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

FIRE-FIGHTING PROCEDURES
EFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED
ATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE
E. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE
ER TO KEEP FIRE-EXPOSED CONTAINERS COOL. DO NOT GET WATER INSIDE
TAINERS.

FIRE & EXPLOSION HAZARDS
EMIT HYDROGEN GAS UPON CONTACT WITH METAL.

ASES PRODUCED
ROGEN CHLORIDE, HYDROGEN

ON DATA-SENSITIVITY TO MECHANICAL IMPACT
E IDENTIFIED.

ON DATA-SENSITIVITY TO STATIC DISCHARGE
E IDENTIFIED.

SECTION V - HEALTH HAZARD DATA

LD LIMIT VALUE (TLV/TWA): 7 MG/M3 (5 PPM)

ILING) IS FOR HYDROGEN CHLORIDE.

ERM EXPOSURE LIMIT (STEL): NOT ESTABLISHED

IBLE EXPOSURE LIMIT (PEL): 7 MG/M3 (5 PPM)

ILING) IS FOR HYDROGEN CHLORIDE.

CONTINUED ON PAGE: 4

SECTION V - HEALTH HAZARD DATA (CONTINUED)

ITY OF COMPONENTS

PERITONEAL MOUSE LD50 FOR HYDROCHLORIC ACID	40	MG/KG
RABBIT LD50 FOR HYDROCHLORIC ACID	900	MG/KG
ATION-1HR RAT LC50 FOR HYDROCHLORIC ACID	3124	PPM
PERITONEAL MOUSE LD50 FOR WATER	190	G/KG
IVENOUS MOUSE LD50 FOR WATER	25	G/KG

INOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

INOGENICITY
NONE IDENTIFIED.

DUCTIVE EFFECTS
NONE IDENTIFIED.

ITS OF OVEREXPOSURE

INHALATION: PULMONARY EDEMA, CIRCULATORY FAILURE, RESPIRATORY SYSTEM DAMAGE, COLLAPSE, COUGHING, DIFFICULT BREATHING

SKIN-CONTACT: SEVERE BURNS

EYE CONTACT: SEVERE BURNS

SKIN ABSORPTION: NONE IDENTIFIED

INGESTION: IS HARMFUL AND MAY BE FATAL, SEVERE BURNS TO MOUTH, THROAT, AND STOMACH, NAUSEA, VOMITING

CHRONIC EFFECTS: NONE IDENTIFIED

ET ORGANS
RESPIRATORY SYSTEM, EYES, SKIN

AL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ARY ROUTES OF ENTRY
INGESTION, INHALATION, SKIN CONTACT, EYE CONTACT

CONTINUED ON PAGE: 5

SECTION V - HEALTH HAZARD DATA (CONTINUED)

Y AND FIRST AID PROCEDURES

STION: CALL A PHYSICIAN. IF SWALLOWED, DO NOT INDUCE VOMITING. IF CONSCIOUS, GIVE WATER, MILK, OR MILK OF MAGNESIA.

LATION: IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

CONTACT: IN CASE OF CONTACT, IMMEDIATELY FLUSH SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. WASH CLOTHING BEFORE RE-USE.

CONTACT: IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.

SARA/TITLE III HAZARD CATEGORIES AND LISTS

ES CHRONIC: YES FLAMMABILITY: NO PRESSURE: NO REACTIVITY: NO

Y HAZARDOUS SUBSTANCE: YES CONTAINS HYDROGEN CHLORIDE (RQ = 1 LB, TPQ = 500 LBS)
AZARDOUS SUBSTANCE: YES CONTAINS HYDROCHLORIC ACID (RQ = 5000 LBS)
EMICALS: YES CONTAINS HYDROCHLORIC ACID
ERIC CLASS: CL
ENTORY: YES

SECTION VI - REACTIVITY DATA

: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

NS TO AVOID: HEAT, MOISTURE

IBLES: MOST COMMON METALS, WATER, AMINES, METAL OXIDES, ACETIC ANHYDRIDE, PROPIOLACTONE, VINYL ACETATE, MERCURIC SULFATE, CALCIUM PHOSPHIDE, FORMALDEHYDE, ALKALIES, CARBONATES, STRONG BASES, SULFURIC ACID, CHLOROSULFONIC ACID

ITION PRODUCTS: HYDROGEN CHLORIDE, HYDROGEN, CHLORINE

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SECTION VII - SPILL & DISPOSAL PROCEDURES

S TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. VENTILATE AREA. NEUTRALIZE SPILL WITH SODA ASH OR LIME. WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER: REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

. BAKER NEUTRASORB(R) OR TEAM= "LOW NA+" ACID NEUTRALIZERS ARE RECOMMENDED SPILLS OF THIS PRODUCT.

OSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

HAZARDOUS WASTE NUMBER= D002 (CORROSIVE WASTE)

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

TILATION=	USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.
PIRATORY PROTECTION=	RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 100 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH ACID CARTRIDGE IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.
/SKIN PROTECTION=	SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, NEOPRENE GLOVES ARE RECOMMENDED.

SECTION IX - STORAGE AND HANDLING PRECAUTIONS

-T-DATA= STORAGE COLOR CODE: WHITE (CORROSIVE)

RAGE REQUIREMENTS
KEEP CONTAINER TIGHTLY CLOSED. STORE IN CORROSION-PROOF AREA. ISOLATE FROM INCOMPATIBLE MATERIALS. DO NOT STORE NEAR OXIDIZING MATERIALS.

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SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

D.O.T.)

SHIPPING NAME: HYDROCHLORIC ACID
CLASS: CORROSIVE MATERIAL (LIQUID)
UN1789 REPORTABLE QUANTITY: 5000 LBS.
CORROSIVE
REGULATORY REFERENCES: 49CFR 172.101; 173.263

TIONAL (I.M.D.G.)

SHIPPING NAME: HYDROCHLORIC ACID, SOLUTION
CLASS: 8 I.M.O. PAGE: 8174
UN1789 MARINE POLLUTANTS: NO PACKAGING GROUP: II
CORROSIVE
REGULATORY REFERENCES: 49CFR 172.102; PART 176; IMO

I.A.T.A.)

SHIPPING NAME: HYDROCHLORIC ACID, SOLUTION
CLASS: 8
UN1789 PACKAGING GROUP: II
CORROSIVE
REGULATORY REFERENCES: 49CFR 172.101; 173.6; PART 175; ICAO/IATA

ITEMS HARMONIZATION NUMBER: 2806100000

N.APPLICABLE OR NOT AVAILABLE
N.ESTABLISHED

RMATION IN THIS MATERIAL SAFETY DATA SHEET MEETS THE
ENTS OF THE UNITED STATES OCCUPATIONAL SAFETY AND HEALTH ACT AND
INC PROMULGATED THEREUNDER (29 CFR 1910.1200 ET. SEQ.) AND THE
WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM. THIS DOCUMENT
ED ONLY AS A GUIDE TO THE APPROPRIATE PRECAUTIONARY HANDLING OF
RIAL BY A PERSON TRAINED IN, OR SUPERVISED BY A PERSON TRAINED
ICAL HANDLING. THE USER IS RESPONSIBLE FOR DETERMINING THE
INS AND DANGERS OF THIS CHEMICAL FOR HIS OR HER PARTICULAR
ION. DEPENDING ON USAGE, PROTECTIVE CLOTHING INCLUDING EYE AND
ROS AND RESPIRATORS MUST BE USED TO AVOID CONTACT WITH MATERIAL
HING CHEMICAL VAPORS/FUMES.
TO THIS PRODUCT MAY HAVE SERIOUS ADVERSE HEALTH EFFECTS. THIS
MAY INTERACT WITH OTHER SUBSTANCES. SINCE THE POTENTIAL USES

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SO VARIED, BAKER CANNOT WARN OF ALL OF THE POTENTIAL DANGERS OF USE INTERACTION WITH OTHER CHEMICALS OR MATERIALS. BAKER WARRANTS THAT CHEMICAL MEETS THE SPECIFICATIONS SET FORTH ON THE LABEL. ER DISCLAIMS ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED WITH REGARD THE PRODUCT SUPPLIED HEREUNDER, ITS MERCHANTABILITY OR ITS FITNESS A PARTICULAR PURPOSE.
USER SHOULD RECOGNIZE THAT THIS PRODUCT CAN CAUSE SEVERE INJURY AND DEATH, ESPECIALLY IF IMPROPERLY HANDLED OR THE KNOWN DANGERS OF USE NOT HEEDED. READ ALL PRECAUTIONARY INFORMATION. AS NEW DOCUMENTED ERAL SAFETY INFORMATION BECOMES AVAILABLE, BAKER WILL PERIODICALLY ISE THIS MATERIAL SAFETY DATA SHEET. IF YOU HAVE ANY QUESTIONS. ASE CALL CUSTOMER SERVICE (1-800-JTBAKER) FOR ASSISTANCE.

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