DRAFT
SITE MANAGEMENT WORK PLAN
118-130 SWALM STREET
SITE # 1-30-043P

WORK ASSIGNMENT NO. D004444-20

Prepared for:

New York State Department of Environmental Conservation
Albany, New York

Prepared by:

MACTEC Engineering and Consulting, P.C.
Portland, Maine

MACTEC: 3612072097

MARCH 2008

DRAFT
SITE MANAGEMENT WORK PLAN
118-130 SWALM STREET
SITE # 1-30-043P

WORK ASSIGNMENT NO. D004444-20

Prepared for:

New York State Department of Environmental Conservation
Albany, New York

Prepared by:

MACTEC Engineering and Consulting, P.C.
Portland, Maine

MACTEC: 3612072097

MARCH 2008

This document was prepared for the sole use of the New York State Department of Environmental Conservation, the only intended beneficiary of our work. No other party shall rely on the information contained herein without prior written consent of MACTEC Engineering and Consulting, P.C.

Submitted by:	Approved by:
______________________	______________________
Jayme Connolly	John W. Peterson
Project Manager	Principal Professional

TABLE OF CONTENTS

LIST OF FIGURES

Figure

LIST OF TABLES

Table

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

ASP	Analytical Services Protocols
bgs	below ground surface
°F	degrees Fahrenheit
HASP	Health and Safety Plan
HSA	hollow stem auger
LMS	Lawler, Matusky and Skelly Engineers
MACTEC	MACTEC Engineering and Consulting, P.C.
msl	mean sea level
NCIA	New Cassel Industrial Area
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
OM&M	Operations, Maintenance and Monitoring
PID	photoionization detector
ppb	parts per billion
QAPjP	Quality Assurance Project Plan
QAPP	Quality Assurance Program Plan
ROD	Record of Decision
Site	118-130 Swalm Street site
SMWP	Site Management Work Plan
UGA	Upper Glacial Aquifer
VOC	volatile organic compound
WA	work assignment

1.0 INTRODUCTION

This Site Management Work Plan (SMWP) has been prepared by MACTEC Engineering and Consulting, P.C. (MACTEC) in response to Work Assignment (WA) No. D004444-20 from the New York State Department of Environmental Conservation (NYSDEC) for the 118-130 Swalm Street site (Site), in North Hempstead, New York (see Figure 1.1). The Site is listed as a Class 2 Inactive hazardous waste site, Site No. 1-30-043P, in the Registry of Hazardous Waste Sites in New York State (NYS).

WA No. D004444-20 was issued to MACTEC on October 22, 2007 (NYSDEC, 2007a) in response to the Site's Record of Decision (ROD) (NYSDEC, 2004). The selected remedy for the 118-130 Swalm Street site is "No Action with continued groundwater and soil vapor monitoring". This SMWP was prepared in accordance with the Site's Project Management Work Plan (MACTEC, 2008) and includes details regarding the design and implementation of the selected remedy, including a Site-specific Health and Safety Plan (HASP) and a Quality Assurance Project Plan (QAPjP).

This SMWP is organized into four sections as follows:

- Section 1.0 – Introduction;
- Section 2.0 – Site Background and Physical Setting;
- Section 3.0 – Scope of Work; and
- Section 4.0 – References.

2.0 SITE BACKGROUND AND PHYSICAL SETTING

Information presented below has been summarized using historical documents for this Site (NYSDEC, 1998; NYSDEC, 2000; NYSDEC, 2004; and NYSDEC, 2007b).

2.1 SITE LOCATION

The Site is located at 118-130 Swalm Street within the New Cassel Industrial Area (NCIA) in North Hempstead, Nassau County, NY. The property is approximately 1.1 acres and has a chain-linked fence around the northern perimeter. The Site is developed with one single story steel and masonry building with an approximate 28,000 square feet footprint. A former parking lot occupies the northern portion of the Site, which consists of asphalt, weeds and exposed soil. The Site is bounded on the north (Long Island Railroad, Railroad Avenue), east (Rushmore Street), west (Swalm Street) and south by another commercial property.

The NCIA is located in a highly developed area in the Town of North Hempstead, NY. The NCIA is approximately 170 acres in size and is bounded by the Long Island Railroad (north), Frost Street (east), Old Country Road (south) and Grand Boulevard (southwest) (Figure 1.1). As of March 2004, there were eleven Class 2 classified sites within the NCIA.

2.2 SITE HISTORY

The Site was first developed in 1961 with the current single story building and was occupied by a mechanical engraving company and a plastic extrusion company. Historical occupants at the Site have consisted of:

- 1971 to 1974 – All Records Distributor
- 1979 to 1992 – Allomatic Industries and Louis Jordan Labs
- 1985 – Atlas Graphics
- 1994 to unknown – Liqui-Mark Corporation
- Currently vacant

2.3 PREVIOUS INVESTIGATIONS

In 1986, an investigation was conducted of the groundwater quality and it was determined that the NCIA was a major source of volatile organic compound (VOC) contamination in groundwater. Subsequently in 1988, the NYSDEC classified the entire NCIA as a Class 2 site.

Initial investigations in the NCIA conducted in 1993 and 1994 by Lawler, Matusky and Skelly Engineers (LMS) identified several areas that exhibited significant groundwater contamination (NYSDEC, 2000). In 1995 LMS conducted a multi-site preliminary site assessment in the NCIA to further delineate the contaminant plumes, locate the sources of the contaminants and assess the threat of each source to the environment. Based on this report, the NYSDEC removed the NCIA from the Class 2 site list and added five individual Class 2 sites, not including the 118-130 Swalm Street site.

In 1995, two downgradient groundwater samples were collected from 118-130 Swalm Street; both showed concentrations of tetrachloroethene at 1,600 parts per billion (ppb) and 1,800 ppb. The data generated from this investigation was used by the NYSDEC to list the Site on the Registry as a Class 2 site in May of 1997.

A Remedial Investigation was conducted on the Site property between December 1998 and November 2002. VOC contamination was observed in groundwater samples collected at the Site. Based on these results, a ROD was issued in March 2004 (NYSDEC, 2004) selecting a "No Action with continued groundwater and soil vapor monitoring" remedy.

2.4 PHYSICAL SETTING

The sections below describe the Site topography, climate, surface water and groundwater hydrology, and geology.

2.4.1 Topography

The Site is situated within the Town of North Hempstead, Nassau County, New York and is approximately 120 feet above mean sea level (msl) (see Figure 1.1). The Site is approximately six miles south east of Hempstead Harbor on Long Island Sound and nine miles north of Middle Bay and the Atlantic Ocean. The topography in the immediate vicinity of the Site is characterized by a relatively flat grade (NYSDEC, 2004).

2.4.2 Climate

The climate of the area is characterized by moderately warm summers and cold winters. Mean monthly temperatures range from 32 degrees Fahrenheit (°F) in January to 74°F in July. Average semi-annually precipitation is 46 inches (National Climatic Data Center, 1999).

2.4.3 Surface Water Hydrology

The closest down gradient surface water body to the relatively flat topography of the Site is Meadow Brook, situated approximately 2.75 miles southwest of the Site. Due to diversion of local stormwater to Nassau County catch basins in the vicinity of the Site, runoff from the Site to Meadow Brook is not likely.

2.4.4 Groundwater Hydrology

Previous investigations conducted at the Swalm Street Site indicated that groundwater is estimated to be approximately 55 feet below ground surface (bgs) and is interpreted to flow to the southwest (NYSDEC, 2004).

2.4.5 Geology

The Site is generally covered with buildings or paved. Beneath the site, two aquifers exist: the Upper Glacial Aquifer (UGA), which consists of Upper Pleistocene deposits of poorly sorted sand and gravel to approximately 80 feet bgs, and beneath the UGA, the Magothy Formation, which consists of fine sand and clayey sand and some black, grey white, red clay. Gravelly zones are common to the bottom of the Magothy Formation, or at approximately 550 feet msl. Underlying the aquifers is the bedrock surface at a depth of approximately 1,000 feet bgs of Cenozoic era, quaternary system, Pleistocene series (NYSDEC, 2004; FP&M, 1998).

3.0 SCOPE OF WORK

This SMWP has been developed to satisfy the requirements of the Site's ROD (NYSDEC, 2004) and address the selected remedy. The components of the selected remedy include:

- Monitoring Well Installation - Three groundwater monitoring wells will be installed, one upgradient and two downgradient from the Site. The wells will be installed to a depth of approximately 65 feet bgs, using hollow stem auger (HSA) drilling techniques, and screened at the water table.
- Groundwater Sampling - Semiannual sampling will be conducted for a minimum of two years, with sampling events occurring during high (spring) and low (fall) water conditions.
- Soil Vapor Monitoring - Six soil vapor samples will be collected using direct push techniques around the perimeter of the property, with a focus on assessing downgradient conditions. Three direct push soil vapor locations will be sampled at two discrete depth intervals, approximately 8 feet bgs and immediately above the water table (approximately 50 feet bgs).

Figure 3.1 is an aerial photograph of the Site area and illustrates the proposed exploration locations. A summary of the field tasks and methodologies, as well as the sample ids and analytical program is provided in Tables 3.1 and 3.2.

3.1 OPERATIONS, MAINTENANCE AND MONITORING (OM&M) IMPLEMENTATION PLAN

Companion documents to this SMWP that will govern the conduct of the Operations, Maintenance and Monitoring (OM&M) implementation include MACTEC's Program Quality Assurance Program Plan (QAPP) (MACTEC, 2007) and HASP (MACTEC, 2005), stand-alone documents provided in Appendices A and B, respectively. In addition to these program documents, Appendix A contains Site-specific details related to quality assurance and quality control as set forth in the QAPjP and Appendix B provides details related to health and safety for on-Site activities as presented in the Short Form HASP.

Subcontractors chosen to support the OM&M implementation include:

- Columbia Analytical Services – Analytical Services Protocols (ASP) laboratory services to support groundwater analyses;
- Centek Labs – ASP laboratory services to support soil vapor monitoring; and

- GeoLogic NY, Inc. – drilling services to support installation of groundwater monitoring wells and direct push services for collecting soil vapor monitoring samples.

3.1.1 Mobilization

Upon approval of this SMWP, MACTEC will begin mobilization efforts. Mobilization will include obtaining utility clearances for all proposed locations, procurement of subcontractors, and coordination of supplies. The NYSDEC will be responsible for obtaining Site access.

Prior to the commencement of any field activities, a kick-off meeting will be held on-Site with MACTEC and subcontractor personnel to familiarize on-Site workers with the Site's history, health and safety requirements, sampling procedures, decontamination efforts, and investigation derived waste handling.

3.1.2 Groundwater Monitoring Well Installation

To evaluate the presence of VOCs at the water table, three 2-inch overburden monitoring wells (MW-1, MW-2 and MW-3) will be installed (Figure 3.1). The exact locations of the wells may vary based on property access and/or utility clearance.

Each overburden monitoring well boring will be advanced using HSA drilling techniques to the top of the water table. Soil samples will be characterized in 10 foot intervals using 2-foot split spoons. For each 10 foot interval, photoionization detector (PID) headspace readings, sample description and classification using the Unified Soil Classification System, and drilling observations will be recorded on field data records (QAPP Figures 4-4, 4-6, and 4-7; MACTEC, 2007) and as discussed in Subsection 4.5.2.2 of the QAPP (no analytical soil samples will be collected).

The overburden monitoring wells will be constructed of 2-inch inside diameter schedule 40 polyvinyl chloride with ten foot well screens and threaded flush joint risers in accordance with Subsection 4.4.4 of the QAPP (MACTEC, 2007). Monitoring wells will be installed with ten-foot screens set just below the water table. Well screens will have 0.010-inch wide machine slots (unless geologic conditions dictate otherwise) with # 0 sand pack to 2 feet above the screen, a two foot bentonite seal above the sand pack and a bentonite grout backfill to the ground surface. The wells will be completed with a locking cap and a six-inch flush mount steel cover.

3.1.3 Groundwater Monitoring Well Development

Upon completion of monitoring well installations, the newly installed monitoring wells will be developed (no sooner than 24 hours after installation for wells installed with top of screens below the water table) using pump and surge techniques as described in the Section 4.4.4 of the QAPP (MACTEC, 2007). Well depths will be measured to determine if excessive silt has built up at the bottom of the well. If it is determined that there is silt at the bottom, wells will be developed with pump and surge techniques to remove excess sediment. If little to no sediment is present, wells may still be pumped (i.e. with whale pump) to qualitatively evaluate well conductivity/recharge and remove stagnant water. Well development activities will be documented on a Well Development Record (QAPP Figure 4-9; MACTEC, 2007)

3.1.4 Groundwater Sampling

After monitoring wells have been installed and developed, periodic groundwater sampling will be conducted for VOCs. Table 3.2 summarizes the sample ids and analytical program.

The initial sampling event will be no sooner than two weeks following the development of the monitoring wells. Prior to sampling, a synoptic round of water levels will be measured. Monitoring wells will then be sampled using low-flow sampling procedures as described in the Section 4.5.4.3.2 of the QAPP (MACTEC, 2007). Samples will be collected from upgradient to downgradient locations based on the interpreted groundwater flow direction and historic analytical data. Field measurements for pH, temperature, specific conductivity, oxidation reduction potential, dissolved oxygen, and turbidity will be collected through a flow through cell (with the exception of turbidity) from each well during pre-sample purging.

Semiannual (spring and fall) sampling will be conducted for a minimum of two years (four sampling events). Monitoring well sampling activities will be documented using a Low Flow Groundwater Data Record (QAPP Figure 4-16; MACTEC, 2007).

3.1.5 Soil Vapor Sampling

A one-time soil vapor monitoring event will performed. A total of six soil vapor samples will be collected around the outside of the building to evaluate whether residual contamination exists. Soil vapor samples will be collected from each location at two discrete depth intervals (immediately above the water table [approximately 50 feet bgs] and 8 feet bgs) (see Figure 3.1). The exact locations of the soil vapor points may vary based on property access and/or utility clearance.

Soil vapor samples will be collected using direct push technology as described in the Section 4.5.1.3 of the QAPP (MACTEC, 2007). The Geoprobe® rods will be pushed to approximately 50 feet bgs, which is anticipated to be immediately above the water table. Soil vapor collected just above the water table will give an indication of the possible vapor migration from potentially contaminated groundwater. Upon termination of the collection of the soil vapor sample from approximately 50 feet bgs, the geoprobe rods will be pulled back to approximately 8 feet bgs. Samples collected from a depth interval of 8 feet bgs will help to evaluate the potential for soil vapor intrusion to on-Site structure.

Soil vapor samples will be collected using the Geoprobe® PRT system using SUMMA canisters (QAPP Section 4.5.1.3; MACTEC, 2007). Approximately 1 liter of soil vapor, plus the volume of the tubing, will be purged using a personal air monitoring pump before collecting samples. During the soil vapor purge, vapors will be screened with a PID. A helium leak test will be conducted on a subset of the soil vapor samples collected to assess proper sampling technique and representative samples are being collected. Helium tests will be conducted in accordance with the QAPP (Section 4.5.1.3).

Local conditions that may influence interpretation of the results will be documented during sampling:

- The identification of commercial or industrial buildings that may use volatile chemicals during normal operations of the facility;
- Outdoor plot sketches will be drawn as needed that include the Site, area streets, neighboring commercial or industrial facilities (with estimated distance to the Site), outdoor ambient air sample locations (if applicable), and compass orientation (north arrow);
- Local weather conditions (e.g., precipitation, outdoor temperature, barometric pressure, wind speed and direction) should be noted for the past 24 to 48 hours; and
- Pertinent observations, such as odors and readings from field instrumentation.

Soil vapor sampling activities will be documented using a Soil Vapor Sampling Record (QAPP Figure 4-11, MACTEC, 2007). Table 3.2 summarizes the sample ids and analytical program.

3.2 SITE SURVEY

A survey will be performed for the three newly installed wells (no formal survey of the Site and surrounding area is scoped). Horizontal locations will be tied to the NYS Plane Coordinate System using North American Datum of 1983, and measured to an accuracy of 0.1 foot. Vertical elevations of groundwater monitoring wells will be tied to msl, using National Geodetic Vertical Datum of 1988, and measured to an accuracy of 0.01 foot. Locations of the three soil vapor direct push locations will be surveyed using a Trimble Global Positioning Satellite.

3.3 INSTITUTIONAL ENGINEERING CONTROLS

Information presented in the ROD (NYSDEC, 2004) indicates the Site does not present a threat to public health or the environment; therefore no institutional or engineering controls are warranted at this time.

3.4 OM&M REPORTING

Upon completion of the OM&M implementation components and receipt of validated analytical data from the initial groundwater sampling and soil vapor monitoring events, MACTEC will prepare an interim OM&M Report. The interim OM&M Report will summarize activities performed and results obtained from the groundwater and soil vapor monitoring events. Field data records and validated laboratory results will be included as appendices to the interim OM&M Report.

Groundwater analytical results will be compared to the NYS Class GA Groundwater Quality Standards, 6 New York Codes, Rules, and Regulations Part 703, (NYS, 1999). Reported concentrations of individual analytes indicating a contravention of standards or guidelines will be noted in the report.

Two additional interim OM&M Reports will be prepared summarizing the semiannual groundwater monitoring events. Upon completion of the last (fourth) groundwater monitoring event, a final OM&M Report will be prepared and submitted to summarize activities conducted at the Swalm Street

Site as part of this WA. The information provided in the OM&M Reports will aid the NYSDEC in reclassifying the Site, if appropriate.

All OM&M Reports submitted to the NYSDEC will be in portable document format and emailed to the NYSDEC project manager. At the completion of the WA, one paper copy of each interim OM&M Reports will be submitted along with a CD containing all consolidated reports from each period.

4.0 REFERENCES

Fanning, Phillips and Molnar (FP&M), 1998. Focused Remedial Investigation Work Plan for 118-130 Swalm Street, New Cassel, NY. October 1998.

MACTEC Engineering and Consulting, P.C., 2005. Program Health and Safety Plan. Prepared for New York State Department of Environmental Conservation, Albany, New York. 2005.

MACTEC Engineering and Consulting, P.C., 2007. Program Quality Assurance Program Plan. Prepared for the New York State Department of Environmental Conservation, Albany, New York. October 2007

MACTEC Engineering and Consulting, P.C., 2008. "Draft Site Management Project Management Work Plan - 118-130 Swalm Street". Prepared for New York State Department of Environmental Conservation, Albany, New York. January 24, 2008.

National Climactic Data Center (NCDC), 1999. Comparative Climactic Data for the United States through 1998. June 22, 1999.

New York State (NYS), 1999. New York Codes, Rules, and Regulations, Title 6, Part 700-705 Water Quality Regulations Surface Water and Groundwater Classifications and Standards. Amended August 1999.

New York State Department of Environmental Conservation (NYSDEC), 1998. Focused Remedial Investigation Work Plan for 118-130 Swalm Street Avenue, New Cassel, New York. Prepared by Fanning, Phillips & Molnar. October, 1998.

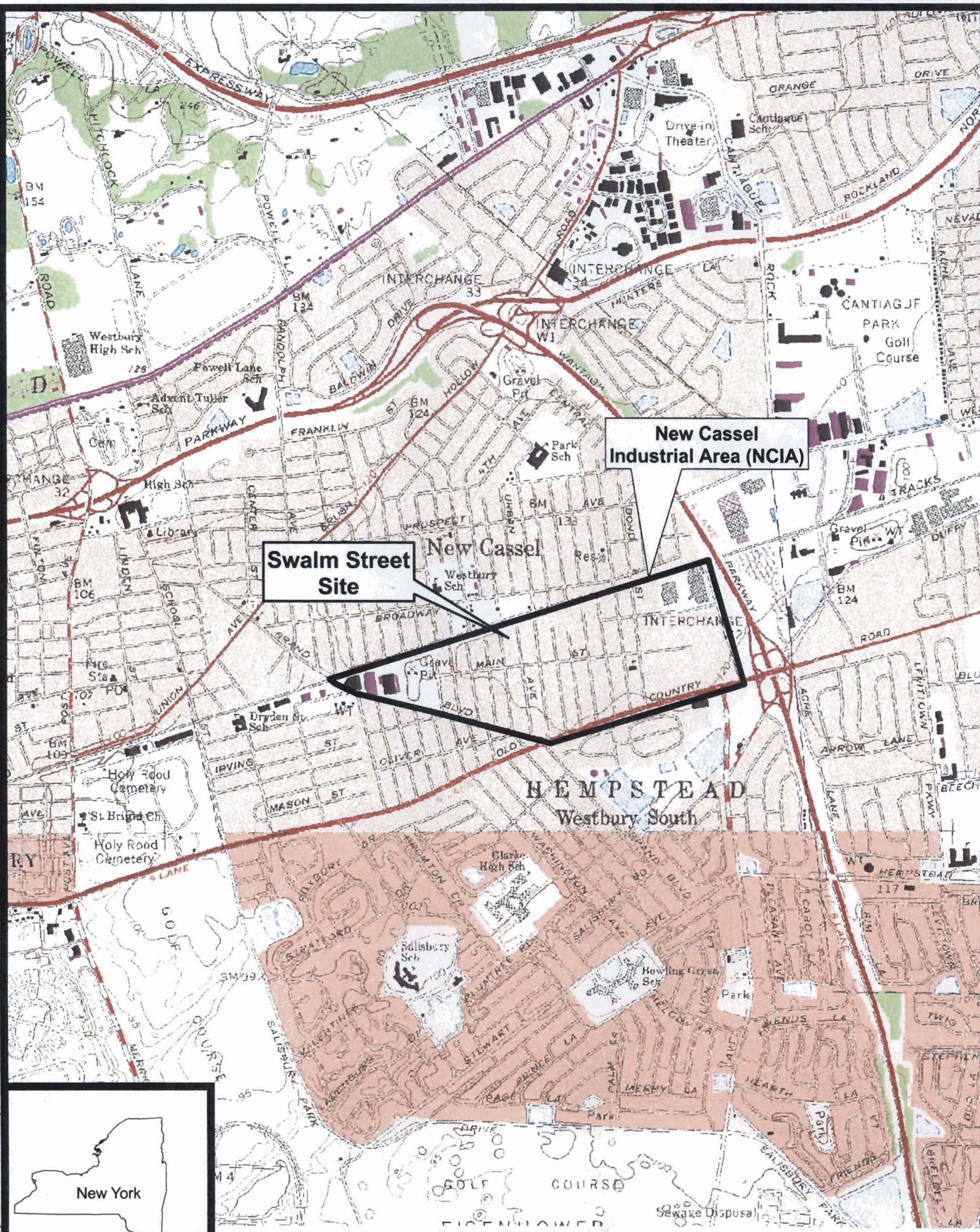
New York State Department of Environmental Conservation (NYSDEC), 2000. Supplemental Focused Remedial Investigation Report for 118-130 Swalm Street, Westbury, New York. Prepared by Fanning, Phillips & Molnar. May, 2000.

New York State Department of Environmental Conservation (NYSDEC), 2004. Division of Remediation. Record of Decision, 118-130 Swalm Street Site, Town of North Hempstead, Nassau County, New York; Site Number 1-30-043P. March 2004.

New York State Department of Environmental Conservation (NYSDEC), 2007a. Work Assignment #D004444-20, 118-130 Swalm Street, Site #1-30-043P - letter dated October 22, 2007.

New York State Department of Environmental Conservation (NYSDEC), 2007b. Standby Contract Work Assignment, 118-130 Swalm Street, Site #1-30-043P – memorandum with Summary of Site Information, Work Assignment Scope of Work, Estimated Budget, Period of Performance, Cost authorization, and Project Schedule October 22, 2007.

FIGURES



0 1,000 2,000 Feet

1:24,000 scale digital topographic map obtained from Cornell University Geospatial Information Repository (CUGIR) at: http://cugir.mannlib.cornell.edu

Prepared/Date: BRP 03/12/08
Checked/Date: BAS 03/12/08

SITE MANAGEMENT WORK PLAN
118-130 SWALM STREET SITE
NORTH HEMPSTEAD, NEW YORK

MACTEC

SITE LOCATION
118-130 SWALM STREET
Project 3612-07-2097
Figure 1.1

Document: P:\Projects\nysdec1\projects\Swalm Street\4.0 Project Deliverables\4.5 Databases\GIS\MapDocuments\Swalm_Proposed_Locations_8x11P.mxd PDF: P:\Projects\nysdec1\projects\Swalm Street\4.0 Project Deliverables\4.2 Work Plans\Draft SMP Work Plan\Figures\Figure3-1.pdf 03/12/2008 10:34 AM brpeters

Nassau County color digital orthoimagery (2000) obtained from New York State GIS Clearinghouse at: http://www.nysgis.state.ny.us

Prepared/Date: BRP 03/12/08
Checked/Date: BAS 03/12/08

SITE MANAGEMENT WORK PLAN 118-130 SWALM STREET SITE NORTH HEMPSTEAD, NEW YORK	MACTEC	PROPOSED EXPLORATION LOCATIONS Project 3612-07-2097 Figure 3.1

TABLES

Table 3.1: Field Tasks and Methodology

LOCATION ID	DESCRIPTION AND METHODOLOGY	RATIONALE	ANALYTICAL
DP-1 through DP-6	Advance three (3) direct push borings down-gradient from the Site building. Collect six (6) soil vapor samples (2 samples from each boring) from approximate depths of 8 feet and 50 feet below ground surface.	Characterize soil vapor conditions at the Site; evaluate potential for residual VOCs in Site soil.	TCL VOCs using USEPA Method TO-15.
MW-1, MW-2 and MW-3	Install three monitoring wells at the Site (one upgradient and two downgradient). Collect semiannual groundwater samples from newly installed wells using low flow sample techniques.	Evaluate groundwater conditions upgradient and downgradient of the Site.	TLC VOCs using USEPA Method 8260B.

Prepared/Date: BAS 03/10/2008
Checked/Date: JPC 03/18/2008

Notes:
TCL VOCs = Target Compound List Volatile Organic Compounds

Table 3.2: Proposed Sample Identification and Analyses

						Water Samples	Soil Vapor Samples
Site Type	**Media**	**Site ID**	**Sample ID**	**MS/MSD**	**DUP**	**VOCs (8260)**	**VOCs (TO-15)**
Groundwater Monitoring Well Sampling							
Monitoring Well	Groundwater	MW-1	130043P-MW1-GW__	1		1	
Monitoring Well	Groundwater	MW-2	130043P-MW2-GW__			1	
Monitoring Well	Groundwater	MW-3	130043P-MW3-GW__		1	1	
Geoprobe Soil Vapor Sampling							
Soil Vapor	Air	DP-01	130043P-DP1-SV__				1
Soil Vapor	Air	DP-02	130043P-DP2-SV__		1		1
Soil Vapor	Air	DP-03	130043P-DP3-SV__				1
Soil Vapor	Air	DP-04	130043P-DP4-SV__				1
Soil Vapor	Air	DP-05	130043P-DP5-SV__				1
Soil Vapor	Air	DP-06	130043P-DP6-SV__				1
TOTAL SAMPLES				**1**	**2**	**3**	**6**

Notes:
Sample ID = 14-digit sample identification as outlined in the QAPjP. The 13 and 14 digit locations represent the sample depth below ground surface (__ = determined in field)
MS/MSD = matrix spike and matrix spike duplicate sample
DUP = duplicate sample
VOCs Target Compound List Volatile Organic Compounds
Field QC blanks collected per QAPP (Section 9.0)

Prepared by: BAS
Checked by: JPC

APPENDIX A

QUALITY ASSURANCE PROJECT PLAN (QAPjP)
and
QUALITY ASSURANCE PROGRAM PLAN (QAPP) (on CD-ROM)

APPENDIX A

QUALITY ASSURANCE PROJECT PLAN

118-130 SWALM STREET SITE

This Quality Assurance Project Plan (QAPjP) identifies sections of the QAPP (MACTEC, 2007) that apply to the activities described in the Site Management Work Plan, describes variances to those procedures, and specifies the analytical methods used for laboratory analysis of environmental samples.

General Procedures. The general procedures used to conduct the OM&M at the Swalm Street site will be taken from the following sections of the QAPP:

Section 2.0	Program Organization and Responsibilities
Section 9.0	Internal Quality Control
Section 11.0	Preventive Maintenance
Section 12.0	Data Assessment
Section 13.0	Corrective Action
Section 14.0	Reports to Management

Sampling Procedures. The following sampling techniques and procedures set forth in the QAPP will be used at the site:

QA/QC Procedures	Section 3.0
Decontamination	Subsection 4.3
Sample Handling	Subsections 4.5 and 5.0
Exploratory Drilling	Subsection 4.4.3
Low Flow Groundwater Sampling	Subsection 4.5.4.3
General Soil Vapor Sampling Methodology	Subsection 4.5.1.3
Global Positioning Surveys	Subsection 4.8.2
Field Instrument Calibration	Section 6.0

Variances. The variances to the QAPP procedures are listed below.

- IDW procedures for disposal of purge water - well water purged prior to groundwater sampling will be considered contaminated and placed in USDOT-approved 55-gallon containers if visual and olfactory signs of contamination are noted. If no visual and olfactory signs of contamination are noted, water will be considered non-hazardous and will be allowed to infiltrate into the ground surface at the sampling location.
- IDW procedures for disposal of drill soil cuttings – soil cuttings will be screened for VOCs with a PID. Soils with visual evidence of contamination or with PID readings greater than 5 ppm will be containerized in USDOT approved 55-gallon containers for off-site disposal. Soils with sustained PID readings of less than or equal to 5 ppm will be considered non-contaminated and will be used as backfill for the borings at the approximate interval from which they were extracted. Remaining uncontaminated soils will be spread evenly on the ground surface in unpaved areas, as agreed upon with the property owner and the NYSDEC.

Data Quality Objectives. Analytical DQOs for the Swalm Street site sampling activities are summarized in Table A-1. NYSDEC Analytical Services Protocols (ASP) (NYSDEC, 2005) methods will be used. Results will be evaluated by preparing a Data Usability Summary Report (DUSR) (NYSDEC, 2002).

Sample Identification. Sample collected for laboratory analysis will identified as follows:

Sample Type	**Nomenclature Sequence**	**Example ID**
Soil Vapor	DEC ID# - DP- ID – SV – Top Depth	130043P-DP1-SV50
Groundwater	DEC ID# - MW- ID – GW – Top Depth	130043P-MW1-GW5

DP = direct push
SV = soil vapor
MW = monitoring well
GW = groundwater

REFERENCES

MACTEC Engineering and Consulting, Inc., 2007. Program Quality Assurance Program Plan. Prepared for the New York State Department of Environmental Conservation, Albany, New York. October 2007.

New York State Department of Environmental Conservation (NYSDEC), 2005. *"Analytical Services Protocols"*; 6/05 Edition; June 2005.

New York State Department of Environmental Conservation (NYSDEC), 2002. Draft DER-10, Technical Guidance for Site Investigation and Remediation. December 2002.

U.S. Environmental Protection Agency (USEPA), 1987. "Data Quality Objectives for Remedial Response Activities"; Office of Emergency and Remedial Response and Office of Waste Programs Enforcement; Washington DC; EPA/540/G-87/003; March 1987.

Table A-1:

Analytical DQO Levels

Parameter	Use	Data Quality Level
PH, Dissolved Oxygen Temperature Specific Conductance Turbidity	Provides physical and chemical data on groundwater samples for use during sampling collection.	Level I
PID screening	Provides qualitative real-time information on air quality in the breathing zone for health and safety decisions, and to identify potentially contaminated groundwater, soil, and soil gas.	Level I
TCL VOCs	Provides analytical information to compare to standards and guidance values.	<u>Level III</u> 8260B (water) TO-15 (soil vapor)

Notes:

TCL = target compound list

VOCs = volatile organic compounds

APPENDIX B

MACTEC SHORT FORM HASP
and
PROGRAM HEALTH AND SAFETY PLAN (on CD-ROM)

MACTEC, Inc.

MACTEC Short Form HASP

Site: 118-130 Swalm Street Site (Swalm Street) Job Number: 3612072097
Street Address: 118-130 Swalm Street, North Hempstead, New York
Proposed Date(s) of Investigation: June 1, 2008
Prepared by: Brandon Shaw Date: 03/06/2008
*Approved by: Cindy Sundquist Date: 03/14/2008
Site Description: The Swalm Street is located in the area known as NCIA, which has known chlorinated groundwater contamination. In 1988, the NYSDEC's subcontrators conducted many subsurface investigations to delineate the containment plume in groundwater. As of March 2004, eleven Sites located in the NCIA were listed as Class 2 Sites. The Site building has been industrially occupied since 1961.
Proposed Activity(s): Overburdened Well Installation, Low-Flow Groundwater Sampling and Soil Vapor Sampling.
*Approval also serves as certification of a Hazard Assessment as required by 29 CFR 1910.132

Known or Suspected Contaminants (include PELs/TLVs):

Contaminants of Concern	PEL/TLV
SOILS:	
Tetrachloroethylene (570 ppb)	25 ppm
Trichloroethylene (23 ppb)	10 ppm
Toluene (25 ppb)	20 ppm
GROUNDWATER:	
Tetrachloroethylene (1,800 ppb)	25 ppm
Trichloroethylene (100 ppb)	10 ppm
Cis-1,2-dichloroethylene (1.2 ppb)	200 ppm
Vinyl Chloride	1 ppm

JHAs: Check and attach all that apply:

Activity Specific JHAs:

☒	Mobilization/Demobilization and Site Preparation
☒	Field Work - General
☒	Groundwater Monitoring
☒	Environmental Drilling (pre and post work) (MACTEC Oversight)
☐	Soil Sampling
☒	Geoprobe
☐	Excavations and Backfilling
☒	Decontamination
☐	Stream/Wetlands Work
☐	Clearing Brush and Trees
☐	Chain Saw
☒	Handling of Gas Cylinders

Activity Specific JHAs:

☐	Insect Stings and Bites
☐	Gasoline
☒	Working with Preservatives (Acids)
☐	Pore Water Sampling
☒	Well Development
☐	Power Tool Use - Electrical
☒	Groundwater Level Monitoring
☐	Indoor Air Sampling
☐	Sump Sampling
☐	
☐	
☐	

Chemicals Brought to the Site:
List all chemicals brought to the site (e.g., preservatives, decontamination solutions, gasoline, etc.). Attach MSDS

Chemicals	**MSDS Attached?**
HYDROCHLORIC ACID, NITRIC ACID, SULFRIC ACID, SODIUM HYDROXIDE	☒

Chemicals will be kept in their original containers. If transferred to another container, aside from days use by one individual, the new container will be labeled with the name of the chemical and the hazard warnings.

HAZARD IDENTIFICATION SUMMARY

Complete the checklist for summarizing the hazards identified in the JHAs

Standard Hazards			
☒ Falling Objects	☒ Slips and trips	☒ Pinch points	☒ Rotating equipment
☒ Falls	☒ Power equipment/tools	☐ Elevated work surfaces	☐ ______________
Eye Hazards			
☒ Particulates	☒ Liquid splashes	☐ Welding Arc	☐ ______________
Hearing Hazards			
☐ None	☒ Impact noise	☐ High frequency noise	☒ High ambient noise
Respiratory Hazards			
☐ None	☒ Dust/aerosols/ particulates	☒ Organic Vapors	☐ Acid Gases
☐ Oxygen deficient	☐ Metals	☐ Asbestos	☐ ______________
Chemical Hazards			
☐ None	☒ Organic solvents	☐ Reactive metals	☐ PCBs
☒ Acids / bases	☐ Oxidizers	☒ Volatiles/Semi-volatiles	☐ ______________
Environmental Hazards			
☐ None	☒ Temperature extremes ☒ Cold ☒ Heat	☒ Wet location	☐ Bio hazards (snakes, insects, spiders, poisonous plants, etc.)
☐ Explosive vapors	☐ Confined space	☐ Engulfment Hazard	☐ ______________
Electrical Hazards			
☐ None	☐ Energized equipment or circuits	☐ Overhead utilities ☒ Underground utilities	☐ Wet location
Fire Hazards			
☒ None	☐ Cutting, welding, or grinding generated sparks or heat sources	☐ Flammable materials present	☐ Oxygen enriched location
Ergonomic Hazards			
☒ Lifting	☒ Bending	☒ Twisting	☒ Pulling/tugging
Computer Use in the: ☐ Office ☐ Field	☐ Repetitive motion	☒ Carrying	☐ ______________
Radiological Hazards			
☒ None	☐ Alpha	☐ Beta	☐ Gamma/X-rays
☐ Neutron	☐ Radon	☐ Non-Ionizing	☐
Other Hazards			
☒ None Known			

PPE and Monitoring Instruments

Initial Level of PPE *			
☒ Level D	☐ Modified Level D	☐ Level C	* Cannot use Short Form HASP for Level B or A work
Standard PPE			
☒ Hard Hat	☒ Safety boots	☒ Safety glasses	☐ Chemical Resistant Boots
☒ High visibility vest	☐ Other:__________		
Eye and Face Protection			
☐ Face shield	☐ Vented goggles	☐ Unvented goggles	☐ Indirect vented goggles
Hearing Protection			
☒ Ear plugs	☒ Ear Muffs	☐ Ear plugs and muffs	☐ Other __________
Respiratory Protection			
☒ None	☐ Dust mask	☐ Full Face APR ☐ Half Face APR	Cartridge Type: N/A Change Cartridges: N/A
Protective Clothing			
☐ White uncoated Tyvek®	☐ Poly-coated Tyvek®	☐ Saranex®	☐ Work uniform
☐ Boot covers	☐ Reflective vest	☐ Chap or Snake Legs	☐ Other __________
Hand Protection			
☐ None	☒ Cotton gloves	☒ Leather gloves	☐ Glove liners
☒ Outer Gloves List Type Nitrile	☐ Inner Gloves List Type_____	☐ Cut-resistant gloves	☐ Other __________
Monitoring Instruments Required			
☐ LEL/O2 Meter	☒ PID ☒ 10-10.6 eV Lamp ☐ 11.7 eV Lamp	☐ FID	☐ Hydrogen Sulfide/Carbon Monoxide
☒ Dräger Pump (or equivalent) List Tubes Vinyl Chloride	☐ Dust Meter ☐ Respirable dust ☐ Total dust	☐ Other __________	

Air Monitoring Action Levels:

PID/FID Reading [1]	Detector Tube [1]	Dust Meter [1]	Action	Level of PPE
At Background	< 0.5ppm Vinyl Chloride or staining	No visible dust (below 2.5 mg/m^3)	Work as usual	Level D
Above Background			Monitor Breathing Zone with Vinyl Chloride Dräger Tube	
>4 ppm	< 0.5ppm Vinyl Chloride or staining	No visible dust (below 2.5 mg/m^3)	Cease work, re-evaluate situation. Contact Division EH&S Manager.	Level C
	N/A	>Visual dust present - 2.5 mg/m^3	Move upwind. Implement dust control measures. If dust persists, cease work and consult H&S Officer.	Level D
	> 0.5 ppm VC	N/A	Back off - cease work and consult H&S Officer.	

[1] Sustained readings measured in the breathing zone
[2] Readings at measured at the source (borehole, well, etc.)

PPE Selection Guidelines

When selecting the appropriate PPE for the job, consider the following:

- **Safety glasses** – general eye protection – source of hazard, typically coming from straight on, required at most sites
- **Tinted Safety Glasses** – same as above, but when working in direct sunlight. May need two both tinted and untinted if working in both sunlight and shade/overcast skys.
- **Safety goggles** – needed for splash hazard, more severe eye exposures coming from all directions. Non-vented or indirect venting for chemical splash, non-vented for hazardous gases or very fine dust, vented for larger particulates coming from all directions.
- **Face shield** – needed to protect face from cuts, burns, chemicals (corrosives or chemicals with skin notation), etc.
- **Safety boots** – needed if danger of items being dropped on foot that could injure foot
- **Hard hat** – danger from items falling on head – any overhead work, tools, equipment, etc that is above the head and could fall on head of item fails, or falls off work platform. Typically required at most sites as a general PPE
- **Thin, chemical protective inner gloves** (e.g., thin Nitrile, PVC – do not use latex – many people are allergic to latex) –needed to protect hands from incidental contact with low risk contamination at very low concentrations (ppb or low ppm concentrations in groundwater or soil) or used in combination with outer gloves as a last defense against contamination. Need to specify type
- **Outer gloves** – thicker gloves (e.g., Nitrile, Butyl, Viton, etc.) – used when potential for high concentrations of contaminants (e.g., floating product, percent ranges of contaminant, opening drums, handling pure undiluted chemicals, etc.). Need to specify type.
- **Leather gloves, leather palm, and cotton** – good in protecting hands against cuts – no protection from chemicals. May be used in combination with chemical protective gloves.
- **Boot Covers** – when there is contamination in surface soils or waking surface in general. When safety boots need protection from contact with contaminants.
- **White (uncoated) Tyveks** – protect clothing from getting dirty, good for protection against solid, non-volatile chemicals (e.g., asbestos, metals) – no chemical protection.
- **Polycoated Tyveks** – least protective of chemical protective clothing. Used when some risk of contamination getting on skin or clothing. Usually, lower ppm ranges of contaminants.
- **Saranex** – Greater protection against contamination than Polycoated Tyveks. Used to protect against PCBs or higher concentrations of contaminants in the soil or groundwater.

- **Other Chemical protective clothing** – if significant risk of dermal exposure, contact H&S to determine best kind.
- **Long sleeved shirts, long pants** – if working in areas with poison ivy/oak/sumac, poisonous insects, etc. and no chemicals exposure. May want to use uncoated Tyveks for work in areas where poisonous plants are know to be to protect clothing.
- **Cartridge Respirator (Level C PPE)** – Need to calculate change schedule (contact Division EH&S Manager for this) to determine length of use. To be able to use cartridge respirators, need to know contaminants, estimate levels to be encountered in the breathing zone, need to ensure that cartridge will be effective against COCs, and need to be able to monitor for COCs using PID, FID, Dräger tubes, etc. If can't do any of these, then Level B PPE is probably going to be needed.
- **High Visibility Vest** – needed for any road work (with in 15 feet of a road) or when working on a site with vehicular traffic or working around heavy equipment. Needed if work tasks would take employee concentration away from movement of vehicles and workers would have to rely on the other driver's ability to see the employee in order not to hit them. This includes heavy equipment as well as cars and trucks, on public roads or the jobsite. Not needed if wearing Polycoated Tyveks – as they are already high visibility.
- **Reflective Vest** – see above, but for use at night.
- **Hearing Protection** – needed if working at noise levels above 85 dBA on a time weighted average. If noise measurements are not available, use around noisy equipment, or in general, if you have to raise your voice to be heard when talking to someone standing two feet away.
- **Protective Chaps** – required when using a machete or chain saw or any other cut hazard to legs.

Work Zones:

The work zones will be defined relative to the location of the work activity. The Exclusion Zone is considered the area within a 10-foot diameter of the sampling location. The Contamination Reduction Zone is considered to be the area with in a 20-foot diameter of the sampling location. The decontamination zone being located upwind of the work area. Work zones will be maintained through the use of:

______ Warning Tape
__X__ Visual Observations

Site Communication:

__X__ Verbal
__X__ Two-way radio
__X__ Cellular telephone
______ Hand signals

- Hand gripping throat .... Out of air, can't breathe
- Grip partner's wrist or both hands around waist .... Leave area immediately
- Hands on top of head .... Need assistance
- Thumbs up .... OK, I am all right, I understand
- Thumbs down .... No, negative

__X__ Horn

EMERGENCY CONTACTS

NAME	TELEPHONE NUMBERS	DATE OF PRE-EMERGENCY NOTIFICATION (if applicable)
Fire Department:	911	

Primary Hospital: Nassau University Medical Center	516-72-0123		
Alternate Hospital: New Island Hospital	516-572-6229		
Police Department:	911		
Site Health And Safety Officer: Jerry Rawcliff	Office: 207-775-5401	Home:	
Client Contact: NYSDEC Joseph Jones	Office: 518-402-9621	Pager:	
Project Manager: Jayme Connolly	Office: 207-775-5401	Home:	
Division EH&S Manager: Cindy Sundquist	Office: 207-828-3309 (w) 207-650-7593(c)	Home: 207-892-4402	
OTHER: Ambulance	911		
Health Resources	800-350-4511		

Emergency Equipment:

The following emergency response equipment is required for this project and shall be readily available:

X Field First Aid Kit
X Fire Extinguisher (ABC type) – May be the Drillers
___ Eyewash (Note: 15 minutes of free-flowing fresh water)
___ Other: ___

EMERGENCY PROCEDURES

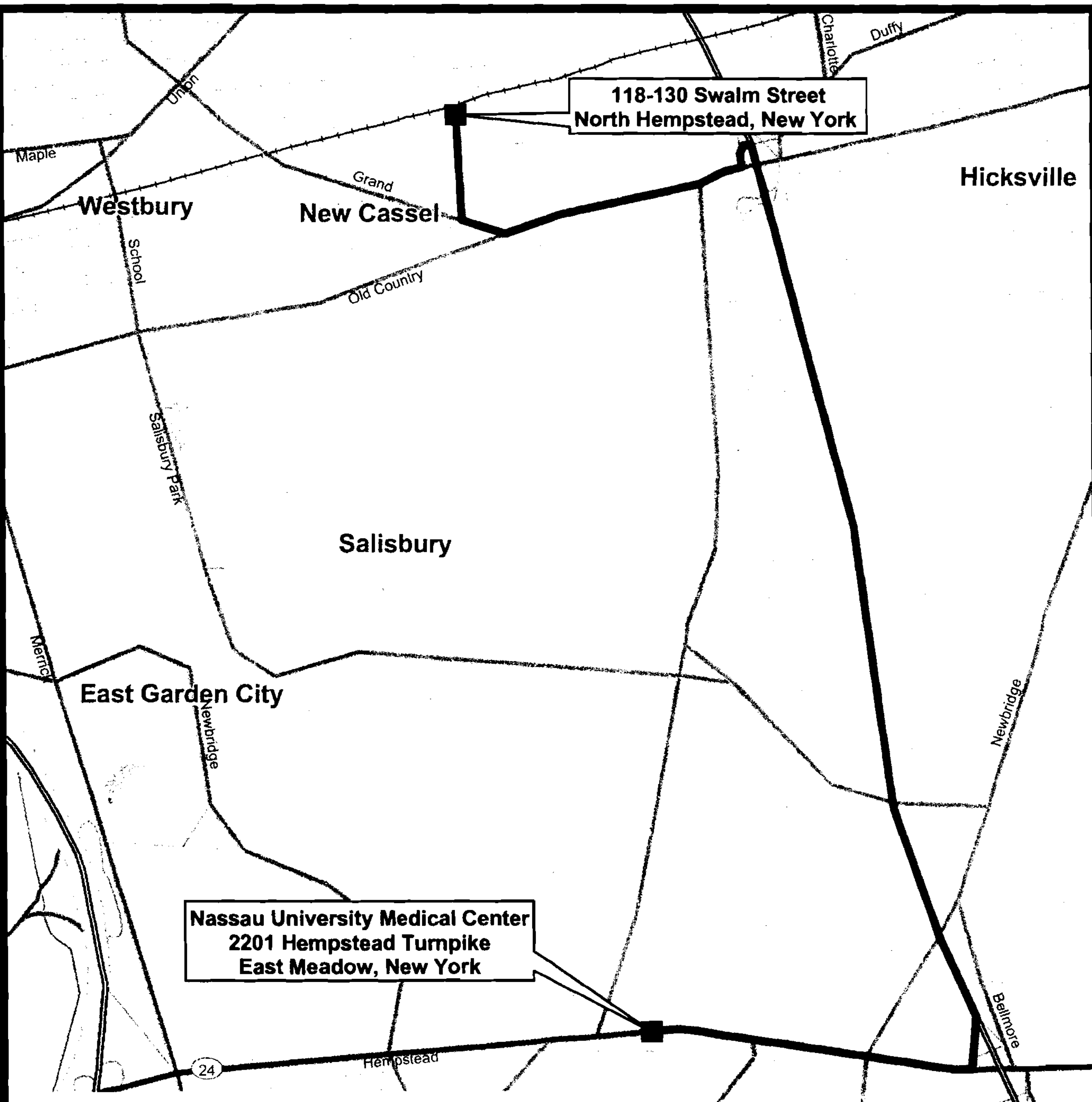
- The HSO (or alternate) should be immediately notified via the on-site communication system. The HSO assumes control of the emergency response.
- The HSO notifies the Project Manager and client contact of the emergency. The HSO shall then contact the Division ES&H Manager who will then contact the Corporate EH&S Manager.
- If applicable, the HSO shall notify off-site emergency responders (e.g. fire department, hospital, police department, etc.) and shall inform the response team as to the nature and location of the emergency on-site.
- If applicable, the HSO evacuates the site. Site workers should move to the predetermined evacuation point (See Site Map).
- For small fires, flames should be extinguished using the fire extinguisher. Large fires should be handled by the local fire department.
- In an unknown situation or if responding to toxic gas emergencies, appropriate PPE, including SCBAs (if available), should be donned. If appropriate PPE is unavailable, site workers should evacuate and call in emergency personnel.
- If chemicals are accidentally spilled or splashed into eyes or on skin, use eyewash and wash affected area. Site worker should shower as soon as possible after incident.
- If a worker is injured, first aid shall be administered by certified first aid provider.

- If the emergency involves toxic gases, workers will back off and reassess. Prior to re-entering the work zone, the area must be determined to be safe. Entry will be using Level B PPE and utilize appropriate monitoring equipment to verify that the site is safe.
- An injured worker shall be decontaminated appropriately.
- After the response, the SHSO shall follow-up with the required company reporting procedures, including the completing the MACTEC Incident Analysis Report.

Site Specific Emergency Procedures are as follows:

Refer to project HASP for MACTEC Program information such as Required Training, Medical monitoring, Investigative Derived Waste disposal and Decontamination procedures.

Decontamination and Investigative Derived Waste shall be handled as documented in the work plan.



Driving distance: 4.3 miles Driving time: 5 minutes			
1	Go South on Swalm Ave toward Main St	0.3 miles	< 1 minute
2	Turn left on Grand Blvd	0.1 miles	< 1 minute
3	Bear left on Old Country Rd	0.6 miles	1 minute
4	Turn left onto ramp and go South on STHY 908 (Wantagh State Pky)	2.3 miles	2 minutes
5	Bear right onto ramp and go West on STHY 24 (Hempstead Tpke)	0.9 miles	1 minute
6	Arrive at Nassau University Medical Center (2201 Hempstead Turnpike, East Meadow, New York 11554), on the right		

N

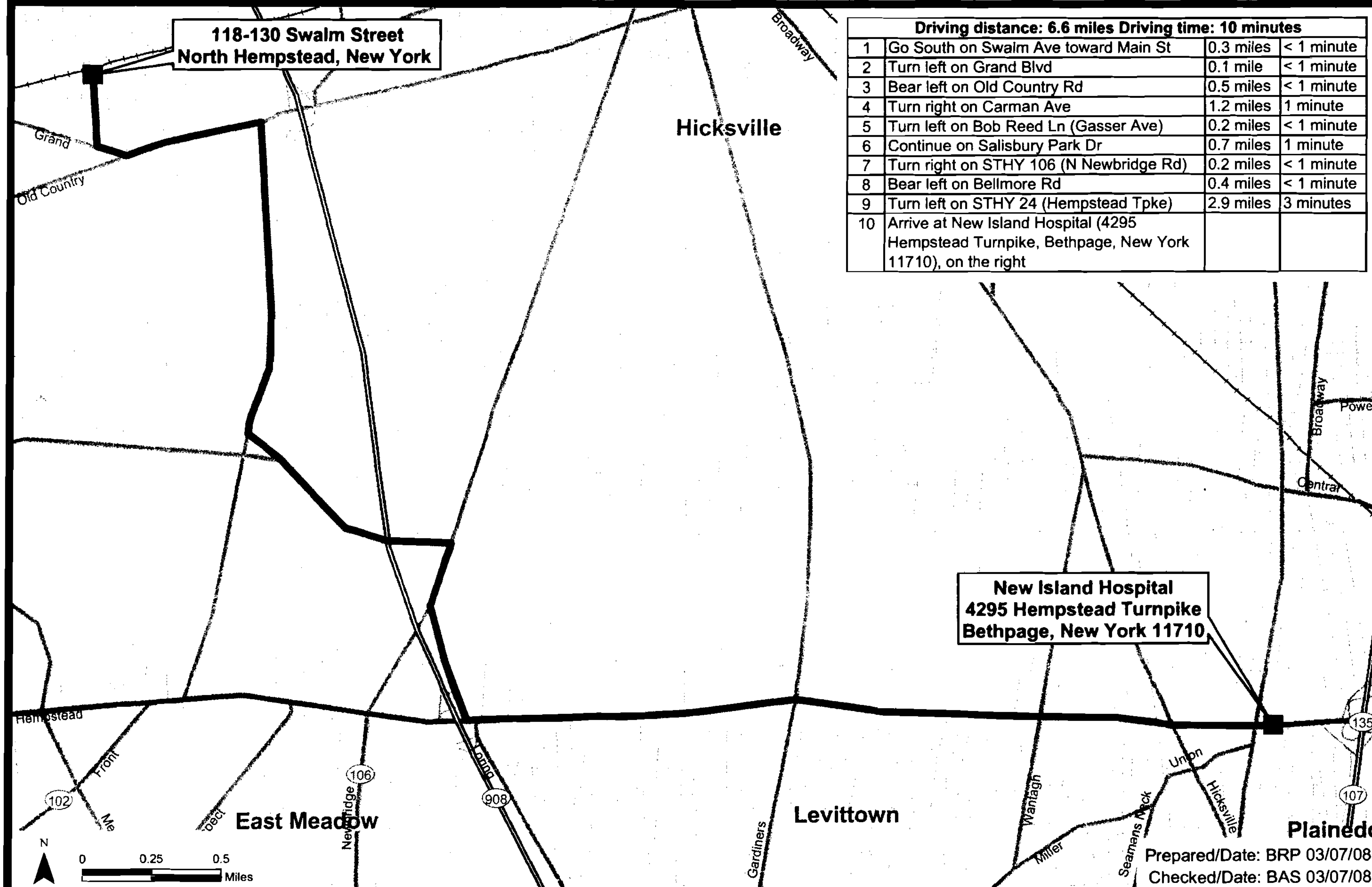
0 1,000 2,000 Feet

Prepared/Date: BRP 03/07/08
Checked/Date: BAS 03/07/08

SITE MANAGEMENT WORK PLAN
118-130 SWALM STREET SITE
NORTH HEMPSTEAD, NEW YORK

MACTEC

PRIMARY HOSPITAL ROUTE
NASSAU UNIVERSTIY MEDICAL CTR
Project 3612-07-2097
Figure C-1



Driving distance: 6.6 miles Driving time: 10 minutes			
1	Go South on Swalm Ave toward Main St	0.3 miles	< 1 minute
2	Turn left on Grand Blvd	0.1 mile	< 1 minute
3	Bear left on Old Country Rd	0.5 miles	< 1 minute
4	Turn right on Carman Ave	1.2 miles	1 minute
5	Turn left on Bob Reed Ln (Gasser Ave)	0.2 miles	< 1 minute
6	Continue on Salisbury Park Dr	0.7 miles	1 minute
7	Turn right on STHY 106 (N Newbridge Rd)	0.2 miles	< 1 minute
8	Bear left on Bellmore Rd	0.4 miles	< 1 minute
9	Turn left on STHY 24 (Hempstead Tpke)	2.9 miles	3 minutes
10	Arrive at New Island Hospital (4295 Hempstead Turnpike, Bethpage, New York 11710), on the right		

SITE MANAGEMENT WORK PLAN
118-130 SWALM STREET SITE
NORTH HEMPSTEAD, NEW YORK

MACTEC

SECONDARY HOSPITAL ROUTE
New Island Hospital
Project 3612-07-2097
Figure C-2

Key Work Steps	Hazards/Potential Hazards	Safe Practices
2. Operating vehicles – general	2A) Collisions, unsafe driving conditions	2A) Drive Defensively! ▪ Seat belts must be used at all times when operating any vehicle on company business. ▪ Drive at safe speed for road conditions ▪ Maintain adequate following distance ▪ Pull over and stop if you have to look at a map ▪ Try to park so that you don't have to back up to leave. ▪ If backing in required, walk around vehicle to identify any hazards (especially low level hazards that may be difficult to see when in the vehicle) that might be present. Use a spotter if necessary
3. Driving to the jobsite	3A) Dusty, winding, narrow roads	3A) Dusty, winding, narrow roads ▪ Drive confidently and defensively at all times. ▪ Go slow around corners, occasionally clearing the windshield.
	3B) Rocky or one-lane roads	3B) Rocky or one-lane roads ▪ Stay clear of gullies and trenches, drive slowly over rocks. ▪ Yield right-of-way to oncoming vehicles---find a safe place to pull over.
	3C) Stormy weather, near confused tourists	3C) Stormy weather, near confused tourists ▪ Inquire about conditions before leaving the office. ▪ Be aware of oncoming storms. ▪ Drive to avoid accident situations created by the mistakes of others.
	3D) When angry or irritated	3D) When angry or irritated ▪ Attitude adjustment; change the subject or work out the problem before driving the vehicle. Let someone else drive.
	3E) Turning around on narrow roads	3E) Turning around on narrow roads ▪ Safely turn out with as much room as possible. ▪ Know what is ahead and behind the vehicle. ▪ Use a backer if available.
	3F) Sick or medicated	3F) Sick or medicated ▪ Let others on the crew know you do not feel well. ▪ Let someone else drive.
	3G) On wet or slimy roads	3G) On wet or slimy roads ▪ Drive slow and safe, wear seatbelts.
	3H) Animals on road	3H) Animals on road ▪ Drive slowly, watch for other animals nearby. ▪ Be alert for animals darting out of wooded areas
4. Gain permission to enter site	4A) Hostile landowner, livestock, pets	4A) Hostile landowner, livestock, pets ▪ Talk to land owner, be courteous and diplomatic ▪ Ensure all animals have been secured away from work area
5. Mobilization/ Demobilization of Equipment and Supplies	5A) Struck by Heavy Equipment/Vehicles	5A) Struck by heavy equipment ▪ Be aware of heavy equipment operations. ▪ Keep out of the swing radius of heavy equipment. ▪ Ground personnel in the vicinity of heavy equipment operations will be within the view of the operator at all times ▪ Employees shall wear a high visibility vest or T-shirt (reflective vest required if working at night). ▪ Ground personnel will be aware of the counterweight swing and maintain an adequate buffer zone. ▪ Ground personnel will not stand directly behind heavy equipment when it is in operation.

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	5B) Struck by Equipment/Supplies	5B) Struck by Equipment/Supplies ▪ Workers will maintain proper space around their work area, if someone enters it, stop work. ▪ When entering another worker's work space, give a verbal warning so they know you are there.
	5C) Overexertion Unloading/Loading Supplies	5C) Overexertion Unloading/Loading Supplies ▪ Train workers on proper body mechanics, do not bend or twist at the waist while exerting force or lifting. ▪ Tightly secure all loads to the truck bed to avoid load shifting while in transit.
	5D) Caught in/on/between	5D) Caught in/on/between ▪ Do not place yourself between two vehicles or between a vehicle and a fixed object.
	5E) Slip/Trip/Fall	5E) 1E). Slip/Trip/Fall ▪ Mark all holes and low spots in area with banner tape. Instruct personnel to avoid these areas. ▪ Drivers will maintain 3 point contact when mounting/dismounting vehicles/equipment. ▪ Drivers will check surface before stepping, not jumping down.
	5F) Vehicle Incident	5F) Vehicle accident ▪ Employees should follow MACTEC vehicle operation policy and be aware of all stationary and mobile vehicles.
6. Site Preparation	6A) Slip/Trip/Fall	6A) Slip/Trip/Fall ▪ Mark all holes and low spots in area with banner tape. Instruct personnel to avoid these areas
	6B) Overexertion	6B) Overexertion ▪ Workers will be trained in the proper method of lifting items. ▪ Do not bend and twist at the waist while lifting or exerting force.
	6C) Struck by Equipment/Supplies	6C) Struck by Equipment/Supplies ▪ Workers will maintain proper space around their work area, if someone enters it, stop work. ▪ When entering another worker's work space, give a verbal warning so they know you are there.
7. Driving back from the jobsite	8A) See hazards listed under item #3	8A) See safe work practices under item #3

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	3C) Chemical/Toxicological Hazards	3C) Chemical/Toxicological Hazards ▪ See HASP for appropriate level of PPE ▪ Use monitoring equipment, as outlined in HASP, to monitor breathing zone ▪ Read MSDSs for all chemicals brought to the site ▪ Be familiar with hazards associated with site contaminants. ▪ Ensure that all containers are properly labelled ▪ Decon thoroughly prior to consumption of food, beverage or tobacco.
	3D) Damage to eyes	3D) Protect eyes: ▪ Watch where you walk, ecpecially around trees and brush with limbs sticking out. ▪ Exercise caution when clearing limbs from tree trunks. Advise wearing eye protection. ▪ Ultraviolet light from the sun can be damaging to the eyes; look for sunglasses that specify significant protection from UV-A and UV-B radiation. If safety glasses require, use one's with tinted lenses
	3E) Bee and wasp stings	3E) See JHA for Insect Stings and Bites
	3F) Ticks and infected mosquitos	3F) See JHA for Insect Stings and Bites
	3G) Wild Animals	3G) Wild Animals ▪ Avoid phyisical contact with wild animals ▪ Do not threaten and/or conrner animals ▪ Make noise to get the animal to retreat. ▪ Stay in or return to vehicle/equipment if in danger
	3H) Contact with poisonous plants or the oil from those plants:	3H) Contact with poisonous plants or the oil from those plants: ▪ Look for signs of poisonous plants and avoid. ▪ Ensure all field workers can identify the plants. Mark identified poisonous plants with spray paint if working at a fixed location. ▪ Do not allow plant to touch any part of your body/clothing. ▪ Wear PPE as described in the HASP and wear Tyveks, gloves and boot covers if contact with plant is likely ▪ Always wash gloves before removing them. ▪ Discard PPE in accordance with the HASP. ▪ Use commercially available products such as Ivy Block or Ivy Wash as appropriate. ▪ See the JHA for Poisonous Plants
		 POISON IVY (Rhus toxicondendron L.) POISON OAK (Rhus diversiloba) POISON SUMAC (Rhus toxicondendron ver[illegible]
	3I) Back Injuries	3I) Back Injuries ▪ Site personnel will be instructed on proper lifting techniques. ▪ Mechanical devices should be used to reduce manual handling of materials. ▪ Split heavy loads in to smaller loads ▪ Team lifting should be utilized if mechanical devices are not available. ▪ Make sure that path is clear prior to lift.

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	3J) Shoveling	3J) Shoveling ▪ Select the proper shovel for the task. A long handled, flat bladed shovel is recommend for loose material ▪ Inspect the handle for splinters and/or cracks ▪ Ensure that the blade is securely attached to the handle ▪ Never be more than 15 inches from the material you are shoveling ▪ Stand with your feet about hip width for balance and keep the shovel close to your body. ▪ Bend from the knees (not the back) and tighten your stomach muscles as you lift. ▪ Avoid twisting movements. If you need to move the snow to one side reposition your feet to face the direction the snow will be going. ▪ Avoid lifting large shoveling too much at once. When lifting heavy material, pick up less to reduce the weight lifted. ▪ Pace yourself to avoid getting out of breath and becoming fatigued too soon. ▪ Be alert for signs of stress such as pain, numbness, burning and tingling. Stop immediately if you feel any of these symptoms.
	3K) Slips/Trips/Falls	3K) Slips/Trips/Falls ▪ Maintain work areas safe and orderly; unloading areas should be on even terrain; mark or repair possible tripping hazards. ▪ Site SHSO inspect the entire work area to identify and mark hazards. ▪ Maintain three points of contact when climbing ladders or onto/off of equipment
	3L) Overhead Hazards	3L) Overhead Hazards ▪ Personnel will be required to wear hard hats that meet ANSI Standard Z89.1. ▪ All ground personnel will stay clear of suspended loads. ▪ All equipment will be provided with guards, canopies or grills to protect the operator from falling or flying objects. ▪ All overhead hazards will be identified prior to commencing work operations.
	3M) Dropped Objects	3M) Dropped Objects ▪ Steel toe boots meeting ANSI Standard Z41 will be worn.
	3N) Noise	3N) Noise ▪ Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs); all equipment will be equipped with manufacturer's required mufflers. Hearing protection shall be worn by all personnel working in or near heavy equipment.
	3O) Eye Injuries	3O) Eye Injuries ▪ Safety glasses meeting ANSI Standard Z87 will be worn.

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	3P) Heavy Equipment (overhead hazards, spills, struck by or against)	3P) Heavy Equipment ▪ All operators will be trained and qualified to operate equipment ▪ Equipment will have seat belts. ▪ Operators will wear seat belts when operating equipment. ▪ Do not operate equipment on grades that exceed manufacturer's recommendations. ▪ Equipment will have guards, canopies or grills to protect from flying objects. ▪ Ground personnel will stay clear of all suspended loads. ▪ Personel are prohibited from riding on the buckets, or elsewhere on the equipment except for designated seats with proper seat belts or lifts specifically designed to carry workers. ▪ Ground personnel will wear high visibility vests ▪ Spill and absorbent materials will be readily available. ▪ Drip pans, polyethylene sheeting or other means will be used for secondary containment. ▪ Ground personnel will stay out of the swing radius of excavators. ▪ Eye contact with operators will be made before approaching equipment. ▪ Operator will acknowledge eye contact by removing his hands from the controls. ▪ Equipment will not be approached on blind sides. ▪ All equipment will be equipped with backup alarms and use spotters when significant physical movement of equipment occurs on-site, (i.e., other than in place excavation or truck loading). ▪ Inspect rigging prior to each use.
	3Q) Struck by vehicle/equipment	3Q) Struck by vehicle/equipment ▪ Be aware of heavy equipment operations. ▪ Keep out of the swing radius of heavy equipment. ▪ Ground personnel in the vicinity of vehicles or heavy equipment operations will be within the view of the operator at all times. ▪ Ground personnel will be aware of the counterweight swing and maintain an adequate buffer zone. ▪ Ground personnel will not stand directly behind heavy equipment when it is in operation. ▪ Drivers will keep workers on foot in their vision at all times, if you lose sight of someone, Stop! ▪ Spotters will be used when backing up trucks and heavy equipment and when moving equipment. ▪ High visibility vests will be worn when workers are exposed to vehicular traffic at the site or on public roads.
	3R) Struck/cut by tools	3R) Struck/cut by tools ▪ Cut resistant work gloves will be worn when dealing with sharp objects. ▪ All hand and power tools will be maintained in safe condition. ▪ Do not drop or throw tools. Tools shall be placed on the ground or worksurface or handed to another employee in a safe manner. ▪ Guards will be kept in place while using hand and power tools.
	3S) Caught in/on/between	3S) Caught in/on/between ▪ Workers will not position themselves between equipment and a stationary object. ▪ Workers will not wear long hair down (place in pony-tail and tuck into shirt) or jewelry if working with tools/machinery.

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	3T) Contact with Electricity/Lightning	3T) Contact with Electricity/Lighting ▪ All electrical tools and equipment will be equipped with GFCI. ▪ Electrical extension cords will be of the "Hard" or "Extra Hard" service type. ▪ All extension cords shall have a three-blade grounding plug. ▪ Personnel shall not use extension cords with damaged outer covers, exposed inner wires, or splices. ▪ Electrical cords shall not be laid across roads where vehicular traffic may damage the cord without appropriate guarding. ▪ All electrical work will be conducted by a licensed electrician. ▪ All equipment will be locked out and tagged out and rendered in a zero energy state prior to commencing any operation that may exposed workers to electrical, mechanical, hydraulic, etc. hazards. ▪ All utilities will be marked prior to excavation activities. ▪ All equipment will stay a minimum of 10 feet from overhead energized electrical lines (50 kV). This distance will increase by 4 inches for each 10 kV above 50 kV. Rule of Thumb: Stay 10 feet away from all overhead powerlines known to be 50 kV or less and 35 feet from all others.) ▪ The SHSO shall halt outdoor site operations whenever lightning is visible, outdoor work will not resume until 30 minutes after the last sighting of lightning.
	3U) Equipment failure	3U) Equipment failure ▪ All equipment will be inspected before use. If any safety problems are noted, the equipment should be tagged and removed from service until repaired or replaced.
	3V) Hand & power tool usage.	3V) Hand & power tool usage ▪ Daily inspections will be performed. ▪ Ensure guards are in place and are in good condition. ▪ Remove broken or damaged tools from service. ▪ Use the tool for its intended purpose. ▪ Use in accordance with manufacturers instructions. ▪ No tampering with electrical equipment is allowed (e.g., splicing cords, cutting the grounding prong off plug, etc.) ▪ See JHA for Power Tool Use - Electrical and Power Tool Use - Gasoline
	3W) Fire Protection	3W) Fire Protection ▪ Ensure that adequate number and type of fire extinguishers are present at the site ▪ Inspect fire extinguishers on a monthly basis – document ▪ All employees who are expected to use fire exinguishers will have received training on an annual basis. ▪ Obey no-smoking policy ▪ Open fires are prohibited ▪ Maintain good housekeeping. Keep rubbish and combustibles to a minimum. ▪ Keep flammable liquids in small containers with lids closed or a safety can. ▪ When dispensing flammable liquids, do in well vented area and bond and ground containers.
	3X) Confined Space Entry	3X) Confined Space Entry ▪ See JHA for Confined Space Entry

Key Work Steps	Hazards/Potential Hazards	Safe Practices

4. Environmental health considerations	4A) Heat Stress	4A) Take precautions to prevent heat stress
		▪ Remain constantly aware of the four basic factors that determine the degree of heat stress (air temperature, humidity, air movement, and heat radiation) relative to the surrounding work environmental heat load.
		▪ Know the signs and symptoms of heat exhaustion, heat cramps, and heat stroke. Heat stroke is a true medical emergency requiring immediate emergency response action.
		NOTE: The severity of the effects of a given environmental heat stress is decreased by reducing the work load, increasing the frequency and/or duration of rest periods, and by introducing measures which will protect employees from hot environments.
		▪ Maintain adequate water intake by drinking water periodically in small amounts throughout the day (flavoring water with citrus flavors or extracts enhances palatability).
		▪ Allow approximately 2 weeks with progressive degrees of heat exposure and physical exertion for substantial acclimatization.
		▪ Acclimatization is necessary regardless of an employee's physical condition (the better one's physical condition, the quicker the acclimatization). Tailor the work schedule to fit the climate, the physical condition of employees, and mission requirements.
		  ▪ A reduction of work load markedly decreases total heat stress.
		  ▪ Lessen work load and/or duration of physical exertion the first days of heat exposure to allow gradual acclimatization.
		▪ Alternate work and rest periods. More severe conditions may require longer rest periods and electrolyte fluid replacement.

	4B) Wet Bulb Globe Temperature (WBGT) Index	4B) WBGT ▪ Curtail or suspend physical work when conditions are extremely severe (see attached Heat Stress Index). ▪ Compute a Wet Bulb Globe Temperature Index to determine the level of physical activity (take WBGT index measurements in a location that is similar or closely approximates the environment to which employees will be exposed).
		WBGT THRESHOLD VALUES FOR INSTITUTING PREVENTIVE MEASURES
		80-90 degrees F: Fatigue possible with prolonged exposure and physical activity. 90-105 degrees F: Heat exhaustion and heat stroke possible with prolonged exposure and physical activity. 105-130 degrees F: Heat exhaustion and heat stroke are likely with prolonged heat exposure and physical activity.
	4C) Cold Extremes	4C) Take precautions to prevent cold stress injuries ▪ Cover all exposed skin and be aware of frostbite. While cold air will not freeze the tissues of the lungs, slow down and use a mask or scarf to minimize the effect of cold air on air passages. ▪ Dress in layers with wicking garments (those that carry moisture away from the body – e.g., cotton) and a weatherproof slicker. A wool outer garment is recommended. ▪ Take layers off as you heat up; put them on as you cool down. ▪ Wear head protection that provides adequate insulation and protects the ears. ▪ Maintain your energy level. Avoid exhaustion and over-exertion which causes sweating, dampens clothing, and accelerates loss of body heat and increases the potential for hypothermia. ▪ Acclimate to the cold climate to minimize discomfort. ▪ Maintain adequate water/fluid intake to avoid dehydration.
	4D) Wind	4D) Effects of the wind ▪ Wind chill greatly affects heat loss (see attached Wind Chill Index). ▪ Avoid marking in old, defective timber, especially hardwoods, during periods of high winds due to snag hazards.

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	4E) Thunderstorms	4E) Thunderstorms ▪ Monitor weather channels to determine if electrical storms are forcased. ▪ Plan ahead and identify safe locations to be in the event of a storm. (e.g., sturdy building, vehicle, etc.) ▪ Suspend all field work at the first sound of thurnder. You should be in a safe place when the time between the lightning and thunder is less than 30 seconds. ▪ Only return to work 30 minutes after the after the last strike or sound of thunder

MACTEC

Job Hazard Analysis - HASP Format

Job Title: Swalm Street, North Hempstead; NY Drilling – Pre-ground Clearance Activities **Date of Analysis:** 6/1/2008

Minimum Recommended PPE*: Steel Toed, Slip Resistant Boots; Safety Glasses; Face Shield (if danger to face due to flying particles); Leather and/or Nitrile Gloves, Snake Chaps (if required); High visibility vest; Hard Hat; Hearing Protection; Insulated Gloves (if hand digging to identify underground electrical lines)

*See HASP for all required PPE

Key Work Steps	Hazards/Potential Hazards	Safe Practices
1. All Pre-Ground Disturbance Clearance Activities including Site Inspection, Subsurface Features Mark-out, Removal of Surface Cover and Ground Clearance	1A) Slips/Trips/Falls	1A) Slips/Trips/Falls ▪ Keep work area free of excess material and debris ▪ Remove all trip hazards by keeping materials/objects organized and out of walkways ▪ Keep work surfaces dry when possible ▪ Wear appropriate PPE (see HASP) including non-slip rubber boots if working on wet or slick surfaces ▪ Install rough work surface covers where possible ▪ Stay aware of footing and do not run
	1B) Heat/Cold Stress	1B) Heat/Cold Stress ▪ Take breaks if feeling faint or overexerted ▪ Consume adequate food/beverages (water, sports drinks) ▪ If possible, adjust work schedule to avoid temperature extremes
	1C) Biological Hazards: Insects, Snakes, Wildlife, Vegetation	1C) Biological Hazards: Insects, Snakes, Wildlife, Vegetation ▪ See JHA – Insect Bites and Stings ▪ Inspect work areas when arrive at site to identify hazard(s) ▪ Use insect repellant if observe mosquitoes/gnats ▪ Survey site for presence of biological hazards and maintain safe distance ▪ Wear appropriate PPE including leather gloves, long sleeves and pants, and snake chaps as warranted by site conditions
	1D) Traffic (including pedestrian)	1D) Traffic (including pedestrian) ▪ Notify attendant or site owner/manager of work activities and location ▪ Use cones, signs, flags or other traffic control devices as outlined in the Traffic Control Plan ▪ Set up exclusion zone surrounding work area using cones, signs, flags or other traffic control devices ▪ Wear appropriate PPE including high visibility clothing such as reflective vest ▪ Inspect area behind vehicle prior to backing and use spotter
	1E) Fire/Explosion	1E) Fire/Explosion ▪ Post No Smoking signs around work area ▪ Establish designated smoking area away from work area ▪ Ensure type ABC, 20-lb, fully charged fire extinguisher on-site and within inspection period ▪ As site conditions/activities warrant, establish Hot Work Permit including air monitoring using direct-reading, real-time instruments such as LEL/O meter (see HASP) ▪ Stop work if hazardous conditions (explosive atmosphere) are identified
2. Ambient Air Monitoring	2A) Vapors	2A) Vapors ▪ Approach area where vapors are suspected from upwind direction and stay upwind/crosswind of from potential sources of vapors (use flagging or similar device to indicate wind direction) ▪ See HASP for monitoring requirements and action limits
	2B) Ineffective Air Monitoring	2B) Ineffective Air Monitoring ▪ Ensure personnel using have been trained on instrument use ▪ Calibrate instrument prior to use

MACTEC

Job Hazard Analysis - HASP Format

Job Title: Swalm Street, North Hempstead; NY Drilling – Pre-ground Clearance Activities **Date of Analysis:** 6/1/2008

Key Work Steps	Hazards/Potential Hazards	Safe Practices
3. Breaking-Up and Removing Asphalt/ Concrete Cover by Saw Cutting or with Heavy Equipment	3A) Heavy Equipment Movement	3A) Heavy Equipment Movement ▪ Heavy equipment should be equipped with back-up alarm or use horn when backing ▪ Do not allow personnel to stand within the swing radius of equipment booms/arms when equipment is in operation ▪ Stay clear of operating equipment and heavy equipment when moving ▪ When approaching heavy equipment, approach should be made from the front ensuring eye contact is made with operator
	3B) Suspended Loads	3B) Suspended Loads ▪ Do not walk under suspended loads ▪ Wear appropriate PPE including hard hat
	3C) Ignition Sources	3C) Ignition Sources ▪ Ensure electrical equipment properly grounded ▪ Apply water as necessary to address surface sparking potential ▪ Equip heavy equipment with non-sparking bucket/blade
	3D) High Noise Levels	3D) High Noise Levels ▪ Hearing protection required when working around operating equipment if levels are suspected to be >85 dBA (if have to yell to person at a dist of 3 ft to be heard, likely exceeding 85 dBA).
	3E) Airborne Particulates and Debris	3E) Airborne Particulates and Debris ▪ Use water as necessary to control dust in area ▪ Wear appropriate PPE including face shield or safety glasses with side shields, dust mask, leather gloves and long sleeves
	3F) Heavy Material Lifting	3F) Heavy Material Lifting ▪ Use heavy equipment to lift ▪ Do not lift or move heavy materials (greater than 50 lbs) without adequate assistance ▪ Bend and lift with legs and arms, keeping back straight ▪ Wear appropriate PPE including leather gloves, long sleeves and pants, and steel-toed boots
	3G) Impact to Subsurface Lines	3G) Impact to Subsurface Lines ▪ Ensure all underground features have been identified in area per Subsurface Clearance Protocol (SCP) prior to start of activities
	3H) Equipment Rollover	3H) Equipment Rollover ▪ If soil appears unstable, the soil should be assessed by a qualified professional engineer to ensure safe conditions with implementation of design control measures prior to start of work
	3I) Heavy Equipment Movement	3I) Heavy Equipment Movement ▪ Heavy equipment should be equipped with back-up alarm ▪ When approaching heavy equipment, approach should be made from the front ensuring eye contact is made with operator
	3J) Physical Injury from Managing Equipment	3J) Physical Injury from Managing Equipment ▪ Take breaks if feeling faint or overexerted
	3K) Ignition Sources	3K) Ignition Sources ▪ Ensure equipment properly bonded and grounded ▪ Use sufficient hose so that equipment does not have to be located in critical zone ▪ Apply water as necessary to address sparking potential if equipment comes in contact with rocks/buried objects ▪ Equip heavy equipment with non-sparking bucket/blade

MACTEC

Job Hazard Analysis - HASP Format

Job Title: Swalm Street, North Hempstead; NY Drilling – Pre-ground Clearance Activities **Date of Analysis:** 6/1/2008

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	3L) High Noise Levels	3L) High Noise Levels ▪ Hearing protection required when working around operating equipment if levels are suspected to be >85 dBA (if have to yell to person at a dist of 3 ft to be heard, likely exceeding 85 dBA).
	3M) Airborne Debris	3M) Airborne Debris ▪ Wear appropriate PPE including leather gloves, long sleeves and pants, and face shield or safety glasses with side shields (see HASP)
	3N) Vapors and Airborne Particulates	3N) Vapors and Airborne Particulates ▪ Monitor air concentrations using direct-reading, real-time instruments such as OVM and Dräger tubes (See HASP for monitoring equipment and action limits) ▪ Stop work if hazardous conditions (explosive atmosphere, O2 deficient atmosphere) identified until precautions are taken (See HASP) ▪ Wear appropriate PPE including dust masks and respirators (See HASP) ▪ Stay upwind (use flagging or similar device to indicate wind direction)
	3O) Impact to Underground Lines/Tanks	3O) Impact to Underground Lines/Tanks ▪ Ensure underground features in area have been identified to extent possible per SCP (line locators, drawing review,) ▪ Wear insulating gloves or stand on insulating mat when advancing hand tools
	3P) Open Excavation	3P) Open Excavation ▪ Personnel should stay at least two feet away from edge ▪ Install orange construction fence or temporary chain link fence around excavated area if to be left unattended
4. Solid Waste Management/ Disposal	4A) Vapors and Airborne Particulates	4A) Vapors and Airborne Particulates ▪ Monitor air concentrations using direct-reading, real-time instruments such as OVM and Dräger tubes (See HASP for required monitoring instruments and action limits) ▪ Stop work if hazardous conditions (explosive atmosphere, O2 deficient atmosphere) identified until precautions are taken (See HASP) ▪ Wear appropriate PPE including safety glasses with side shields, dust masks and respirators (See HASP) ▪ Stay upwind (use flagging or similar device to indicate wind direction)
	4B) Contaminated Materials and Container Pinch Points	4B) Contaminated Materials and Container Pinch Points ▪ Wear appropriate PPE including nitrile and leather gloves (See HASP) ▪ Position hands/fingers to avoid pinching/smashing/crushing when closing drum rings
	4C) Heavy Materials and Container Lifting/Moving	4C) Heavy Materials and Container Lifting/Moving ▪ Do not lift or move heavy containers without assistance ▪ Use proper bending/lifting techniques by lifting with arms and legs and not with back ▪ If possible, use powered lift truck, drum cart, or other mechanical means to move containers ▪ Take breaks if feeling faint or overexerted ▪ Spot drums in storage area prior to filling ▪ Wear appropriate PPE including leather gloves and steel-toed boots (See HASP)

Job Hazard Analysis Form

JHA No.: JHA -_______-_____-____-____

Job Title: Decontamination **Date of Analysis:** 5/1/07

Job Location: 118-130 Swalm Street, North Hempstead, NY **Team Leader:** Jayme Connolly

Applicable ES&H Procedures:
2.9.A - Hazardous Waste Operations and Emergency Response Program
2.9.C - Respiratory Protection Program
2.9.D - Personal Protective Equipment Program
2.9.E - Hazard Communication Program
2.5.1 - Heavy Equipment
2.9.16 - Thermal Stress
2.9.21 - Power and Hand Tools

Other Referenced JHAs:

Key Work Steps	Hazards/Potential Hazards	Safe Practices
1. Establish Decontamination Station	1A) Materials Handling	1A) Materials Handling ▪ Use proper lifting techniques ▪ Use mechanical aids, if available, to move heavy items.
2. Decontamination / Steam cleaning.	2A) Struck by steam/hot water/pressure washing	2A) Struck by steam/hot water ▪ Workers not directly engaged in steam cleaning operations must stay clear. ▪ Workers using steam cleaning equipment must be trained on operation and safety devices/procedures using the owners/operators manual. ▪ Use face shield **and** safety glasses or goggles, if steam cleaning. ▪ Stay out of the splash/steam radius. ▪ Pressure washer must have dead man switch. ▪ Do not direct steam at anyone. ▪ Do not hold objects with your feet or hands. ▪ Ensure that direction of spray minimizes spread of contaminants of concern. ▪ Use shielding as necessary.
	2B) Exposure to contaminants	2B) Exposure to contaminants ▪ Conduct air monitoring (see HASP). ▪ Wear proper PPE. ▪ See MSDSs for hazards associated with the decon solutions used (if other than water alone us used).
	2C) Slips/Trips/Falls	2C) Slips/Trips/Falls ▪ Be cautious as ground/plastic can become slippery ▪ Use boots or boot covers with good traction
3. Vehicle Decontamination	3A) Vehicle traffic in and out of the CRZ	3A) Large Vehicle Traffic ▪ Always wear a hard hat, steel toe boots, and a high visibility vest (unless Tyveks are used and are high visibility). ▪ Vehicle drivers are not to exit the vehicle in the CRZ. ▪ Identify an individual to communicate with vehicle drivers and maintain order ▪ Trucks will be lined with plastic and kept out of direct contact with any contaminated materials during loading. Wear PPE when removing plastic lining from truck beds. ▪ If not in the vehicle, obtain eye contact with the driver, so he is aware of your presence and location in the CRZ.

Key Work Steps	Hazards/Potential Hazards	Safe Practices
		▪ If you are driving the vehicle, be aware of personnel in the CRZ and maintain communication with the identified personnel.
	3B) Exposure to contaminants	3B) Exposure to contaminants ▪ Use safety glasses or goggles, Polycoated Tyvek (if level of contamination poses dermal hazard or to keep work clothes dry), high visibility vest (if high visibility Tyveks are not used) hard hats, steel toe boots, and gloves while cleaning contaminated materials. ▪ Do not doff PPE until decontamination of the vehicle is complete and a decontamination certificate has been issued by the HSO. ▪ Conduct air monitoring (see HASP). ▪ See MSDSs for hazards associated with the decon solutions (if other than water alone is used).
	3C) Slips/Trips/Falls	3C) Slips/Trips/Falls ▪ Be cautious as ground/plastic can become slippery ▪ Use boots or boot covers with good traction
4. Equipment and Sample Decontamination	4A) Chemical exposure when handling contaminated sample jars and equipment	4A) Chemical exposure ▪ Wear PPE. ▪ Refer to MSDS for specific hazards associated with decon solutions ▪ Monitor breathing zone for contaminants ▪ Monitor breathing zone for decon solutions (e.g., methanol, hexane, etc.) if appropriate (see HASP)
	4B) Materials Handling related injuries	4B) Materials Handling related injuries ▪ Use proper lifting techniques when lifting heavy equipment ▪ Use two person lift for heavy coolers

5. Personal Decontamination	5A) Exposure to contaminants	5A) Exposure to contaminants
		▪ Avoid bringing contaminated materials via shoes and clothing into the CRZ by examining such prior to exiting the EZ.
		▪ Removal of PPE will be performed by the following tasks in the listed order:
		  ▪ Gross boot wash and rinse and removal
		  ▪ Outer glove removal
		  ▪ Suit removal
		  ▪ Respirator removal (if worn).
		  ▪ Inner glove removal
		▪ Contaminated PPE is to be placed in the appropriate, provided receptacles.
		▪ Respirators will be removed and decontaminated at a specified location within the CRZ by a designated technician, then placed in storage bag.
		▪ Employees will wash hands, face, and any other exposed areas with soap and water.
		▪ Portable eyewash stations and showers will be available should employees come into direct contact with contaminated materials.
		▪ See MSDSs for hazards associated with the decontamination solutions used.
		▪ Decon solutions will be disposed of according to the work plan.

Job Safety Analysis Training Guide	Job Title: WWT Operator		October 17, 2006
Department: WWT	Section: 2.0 Groundwater level monitoring/ Troll Data	Supervisor: R. O'Brien	Analysis by: J. Caryl, R. O'Brien
			Reviewed by:
Required and / or recommended Personal Protective Equipment: Level D PPE			Approved by:

Sequence of basic job steps	Potential accidents or hazards	Recommended safe job procedure
Locate well to be monitored (1-33)	Slip / trips / falls	Be aware of surroundings
Remove well cover bolts from well being monitored	Wrench slips off of bolt heads	Be sure that both the wrench and bolts are in good condition
Remove well cover	Pinch point	Wear canvas gloves to protect hands
Remove well cap	Pinch point	Wear canvas gloves; hold onto well cap securely to avoid hand slipping off of cap.
Insert gauge	Back strain	Bend with knees
Observe gauge depth at side of well casing	Back strain	Bend with knees
Remove gauge		
Clean gauge with alcohol and rinse with distilled water as outlined in SOP	Rubbing alcohol drying out skin on hands.	Wear nitrile protective gloves when cleaning gauge
Replace well cap	Pinch point	Wear canvas gloves; hold onto well cap securely to avoid hand slipping off of cap.
Replace well cover	Pinch point	Wear canvas gloves to protect hands
Replace well cover bolts	Wrench slips off of bolt heads	Be sure that both the wrench and bolts are in good condition

MACTEC

Job Hazard Analysis Form

JHA No.: JHA -_______-_____-____-___

Job Title: Groundwater Sampling **Date of Analysis:** 8/20/07

Job Location: 118-130 Swalm Street, North Hempstead, NY **Team Leader/Project Manager:** Jayme Connolly

Applicable ES&H Procedures:
2.9.A - Hazardous Waste Operations and Emergency Response Program
2.9.C - Respiratory Protection Program
2.9.D - Personal Protective Equipment Program
2.9.19 - Electrical Safety
2.14.1 - Flammable and Combustible Liquids
2.14.5 - Collection of Field Samples

Other Referenced JHAs:
- Mobilization/Demobilization and Site Preparation
- Field Work General
- Insect Stings and Bites
- Gasoline
- Working with Preservatives

Key Work Steps	Hazards/Potential Hazards	Safe Practices
1. Mobilization	1A) See JHA Mobilization/Demobilization/Site Preparation	1A) See JHA Mobilization/Demobilization/Site Preparation
2. General Site Hazards	2A) See JHA Field Work - General	2A) See JHA Field Work - General
	2B) Chemical exposure	2B) Chemical Exposure ▪ Read HASP and determine air monitoring and PPE needs.
3. Calibrate monitoring equipment	3A) Exposure to calibration gases	3A) Exposure to calibration gases ▪ Review equipment manuals ▪ Calibrate in a clean, well ventilated area
4. Opening the well cap, taking water level readings	4A) Contact with poisonous plants or the oil from poisonous plants	4A) Contact with poisonous plants or the oil from those plants: ▪ Look for signs of poisonous plants and avoid. ▪ Ensure all field workers can identify the plants. Mark identified poisonous plants with spray paint if working at a fixed location. ▪ Wear PPE as described in the HASP. ▪ Do not touch any part of your body/clothing. ▪ Always wash gloves before removing them. ▪ Discard PPE in accordance with the HASP. ▪ Use commercially available products such as Ivy Block or Ivy Wash as appropriate.

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	4B) Contact with biting insects (i.e., spiders, bees, etc.) which may have constructed a nest in the well cap/well.	4B) Contact with stinging/biting insects ▪ Discuss the types of insects expected at the Site and be able to identify them. ▪ Look for signs of insects in and around the well. ▪ Wear Level of PPE as described in the HASP. At a minimum, follow guidelines in the JHA "Insects Stings and Bites." ▪ If necessary, wear protective netting over your head/face. ▪ Avoid contact with the insects if possible. ▪ Inform your supervisor and the Site Health and Safety Supervisor if you have any allergies to insects and insect bites. Make sure you have identification of your allergies with you at all times and appropriate response kits if applicable. ▪ Get medical help immediately if you are bitten by a black widow or brown recluse, or if you have a severe reaction to any spider bite or bee sting.
	4C) Exposure to hazardous Inhalation and contact with hazardous substances (VOC contaminated groundwater/ soil); liquid splash; flammable atmospheres.	4C) Exposure to hazardous substances ▪ Wear PPE as identified in HASP. ▪ Review hazardous properties of site contaminants with workers before sampling operations begin ▪ Immediately monitor breathing zone after opening well to determine exposure and verify that level of PPE is adequate – see Action Levels in HASP ▪ Monitor headspace in well. After the initial headspace reading (if required by the Work Plan), allow the well to vent for several minutes before obtaining water level and before sampling. ▪ When decontaminating equipment wear additional eye/face protection over the safety glasses such as a face shield.
	4D) Back strain due to lifting bailers or pumps and from moving equipment to well locations	4D) Back strain ▪ Use mechanical aids when possible, if mechanical aids are not available, use two person lifts for heavy items. ▪ Use proper lifting techniques
	4E) Foot injuries from dropped equipment	4E) Foot Injuries ▪ Be aware when moving objects, ensure you have a good grip when lifting and carrying objects. ▪ Do not carry more than you can handle safely ▪ Wear Steel toed boots
5. Collecting water samples	5A) Fire/Explosion/Contamination hazard from refueling generators	5A) Fire/Explosion/Contamination hazard from refueling generators ▪ Turn the generator off and let it cool down before refueling ▪ Segregate fuel and other hydrocarbons from samples to minimize contamination potential ▪ Transport fuels in approved safety containers. The use of containers other than those specifically designed to carry fuel is prohibited ▪ See JHA for Gasoline use

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	5B) Electrocution	5B) Electrocution ▪ A ground fault circuit interrupter (GFCI) device must protect all AC electrical circuits. ▪ Use only correctly grounded equipment. Never use three-pronged cords which have had the third prong broken off. ▪ Make sure that the electrical cords from generators and power tools are not allowed to be in contact with water ▪ Do not stand in wet areas while operating power equipment ▪ Always make sure all electrically-powered sampling equipment is in good repair. Report any problems so the equipment can be repaired or replaced. ▪ When unplugging a cord, pull on the plug rather than the cord. ▪ Never do repairs on electrical equipment unless you are both authorized and qualified to do so.
	5C) Exposure to contaminants	5C) Exposure to Contaminants ▪ Stand up wind when sampling ▪ Monitor breathing zone with appropriate monitoring equipment (see HASP) ▪ Wear chemical resistant PPE as identified in HASP ▪ See section 4C) under Safe Practices above
	5D) Infectious water born diseases	5D) Infectious water born diseases ▪ Wear chemical resistant gloves and other PPE – as identified in HASP ▪ Prevent water from contacting skin ▪ Wash exposed skin with soap and water ASAP after sampling event ▪ Ensure that all equipment is adequately decontaminated using a 10% bleach solution
	5E) Exposure to water preservatives	5E) Exposure to water preservatives ▪ Work in a well ventilated area, upwind of samples ▪ Wear chemical resistant PPE as identified in HASP ▪ When preserving samples always add acid to water, avoid the opposite. ▪ See JHA Working with Preservatives

MACTEC

Job Hazard Analysis - HASP Format

Job Title: Environmental Drilling/Boring and Associated Soil Sampling **Date of Analysis:** 6/1/2008

Minimum Recommended PPE*: Steel Toed, Slip Resistant Boots; Safety Glasses; Face Shield (if danger to face due to flying particles); Leather and/or Nitrile Gloves, Snake Chaps (if required); High visibility vest; Hard Hat; Hearing Protection; Insulated Gloves (if hand digging to identify underground electrical lines)

*See HASP for all required PPE

Key Work Steps	Hazards/Potential Hazards	Safe Practices
1. All Drilling/Boring Activities	2A) Slips, Trips, Falls	1A) Slips, Trips, Falls ▪ Keep work area free of excess material and debris ▪ Remove all trip hazards by keeping materials/objects organized and out of walkways ▪ Keep work surfaces dry when possible ▪ Wear appropriate PPE (See HASP) including non-slip rubber boots if working on wet or slick surfaces ▪ Install rough work surface covers where possible ▪ Stay aware of footing and do not run
	2B) Heat/Cold Stress	1B) Heat/Cold Stress ▪ Take breaks if feeling faint or overexerted ▪ Consume adequate food/beverages (water, sports drinks) ▪ If possible, adjust work schedule to avoid temperature extremes
	2C) Biological Hazards: Insects, Snakes, Wildlife, Vegetation	1C) Biological Hazards: Insects, Snakes, Wildlife, Vegetation ▪ Inspect work areas when arrive at site to identify hazard(s) ▪ Use insect repellant if observe mosquitoes/gnats ▪ Open enclosures slowly ▪ Survey site for presence of biological hazards and maintain safe distance ▪ Wear appropriate PPE including leather gloves, long sleeves and pants, and snake chaps as warranted by site conditions (See HASP)
	2D) Traffic (including pedestrian)	1D) Traffic (including pedestrian) ▪ Notify attendant or site owner/manager of work activities and location ▪ Use cones, signs, flags or other traffic control devices as outlined in the ▪ Traffic Control Plan ▪ Set up exclusion zone surrounding work area using cones, signs, flags or other traffic control devices ▪ Wear appropriate PPE including high visibility clothing such as reflective vest (See HASP) ▪ Inspect area behind vehicle prior to backing and use spotter
	2E) Fire/ Explosion	1E) Fire/ Explosion ▪ Post No Smoking signs around work area ▪ Establish designated smoking area away from work area ▪ Ensure type ABC, 20-lb, fully charged fire extinguisher on-site and within inspection period ▪ As site conditions/activities warrant, establish Hot Work Permit including air monitoring using direct-reading, real-time instruments such as LEL/ O2 meter (See HASP for required monitoring instruments and action limits) ▪ Stop work if hazardous conditions (explosive atmosphere) are identified
2. Ambient Air Monitoring	2A) Vapors	2A) Vapors ▪ Approach area where vapors are suspected from upwind direction and stay upwind/crosswind of from potential sources of vapors (use flagging or similar device to indicate wind direction)
	2B) Ineffective Air Monitoring	2B) Ineffective Air Monitoring ▪ Ensure personnel using have been trained on instrument use ▪ Calibrate instrument prior to use

MACTEC

Job Hazard Analysis - HASP Format

Job Title: Environmental Drilling/Boring and Associated Soil Sampling **Date of Analysis:** 6/1/2008

Key Work Steps	Hazards/Potential Hazards	Safe Practices
3. Concrete Coring	3A) Ignition Sources	3A) Ignition Sources ▪ Ensure electrical equipment properly grounded ▪ Apply water as necessary to address surface sparking potential
	3B) High Noise Levels	3B) High Noise Levels ▪ Hearing protection required when working around operating equipment if levels are suspected to be >85 dBA (if have to yell to person at a dist of 3 ft to be heard, likely exceeding 85 dBA).
	3C) Airborne Particulates and Debris	3C) Airborne Particulates and Debris ▪ Use water as necessary to control dust in area ▪ Wear appropriate PPE including face shield or safety glasses with side shields, dust mask, leather gloves and long sleeves (See HASP)
	3D) Sharp Rough Materials	3D) Sharp Rough Materials ▪ Wear appropriate PPE including leather gloves, long sleeves and pants, and steel-toed boots (See HASP)
	3E) Impact to Subsurface Lines	3E) Impact to Subsurface Lines ▪ Ensure all underground features have been identified in area per SCP prior to start of activities
4. Drill Rig Set-Up	4A) Contact with Electric Lines and Other Overhead Obstacles	4A) Contact with Electric Lines and Other Overhead Obstacles ▪ Position rig to avoid overhead utility lines by distance defined by voltage and local regulations ▪ Use a spotter when raising mast to confirm clearance of overhead lines and other obstructions
	4B) Rig Movement	4B) Rig Movement ▪ Heavy equipment should be equipped with back-up alarm or use horn when backing - use spotter when available ▪ Stay clear of operating equipment and rig when moving
	4C) Heavy Equipment Lifting/ Carrying	4C) Heavy Equipment Lifting/ Carrying ▪ Use at least 2 people to lift and carry sections, use mechanical lift devices whenever possible, bend and lift with legs and arms, not back
	4D) Sharp or Elevated Equipment	4D) Sharp or Elevated Equipment ▪ Wear appropriate PPE including steel-toed safety boots, leather gloves and hard hat (See HASP) ▪ Establish communication system between workers involved in moving/attaching sections
5. Ground Disturbance: Auger/Boring Advancement	5A) Faulty or Inappropriate Equipment	5A) Faulty or Inappropriate Equipment ▪ Qualified driller must inspect drill rig prior to use, if faulty or inappropriate, do not proceed until repaired or replaced ▪ Inspect all hand tools prior to use, if faulty or inappropriate, do not proceed until repaired or replaced. Tag out all defective tools
	5B) Moving Equipment	5B) Moving Equipment ▪ Clear area of obstructions and communicate with all workers involved that drilling is beginning ▪ Do not exceed manufacturer's recommended speed, force, torque, or other specifications. and penetrate the ground slowly with hands on the controls for at least the first foot of soil to minimize chance of auger kick-out ▪ Stay clear of rotating auger ▪ Use long-handled shovel to clear away cuttings when auger has stopped ▪ Do not wear loose clothing ▪ Wear appropriate PPE including leather gloves and steel-toed boots (See HASP)

MACTEC

Job Hazard Analysis - HASP Format

Job Title: Environmental Drilling/Boring and Associated Soil Sampling **Date of Analysis:** 6/1/2008

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	5C) Suspended Loads	5C) Suspended Loads ▪ Do not walk under suspended loads ▪ When possible, remove overhead hazards promptly ▪ Wear appropriate PPE including hard hat and steel-toed boots (See HASP)
	5D) High Noise Levels	5D) High Noise Levels ▪ Use hearing protection if within 20 feet of active drill rig
	5E) Ground Disturbance: Auger/Boring Advancement Vapors and Airborne	5E) Ground Disturbance: Auger/Boring Advancement Vapors and Airborne ▪ Monitor air concentrations using direct-reading, real-time instruments such as OVM and Dräger tubes (See HASP for required monitoring instruments and action limits)
	5F) Particulates	5F) Particulates ▪ Stop work if hazardous conditions (explosive atmosphere, O2 deficient atmosphere) identified until precautions are taken (See HASP for required monitoring instruments and action limits) ▪ Wear appropriate PPE including face shield or safety glasses with side shields, dust masks or respirators, long sleeves and pants (See HASP) ▪ Stay upwind (use flagging or similar device to indicate wind direction)
	5G) Impact to Subsurface Lines/Tanks	5G) Impact to Subsurface Lines/Tanks ▪ Only drill in areas where underground features have been identified and cleared per Subsurface Clearance Protocol (SCP) if hole has to be moved, clear new location first ▪ Wear appropriate PPE including insulating gloves or stand on an insulating mat when in contact with drill rig ▪ Ensure first aid responders are trained to deal with electric shock and flash burns
6. Ground Intrusion: Split Spoon	6A) Faulty Equipment	6A) Faulty Equipment ▪ Inspect rope/cable/rod for wear, fraying, oils and moisture prior to use, do not use if faulty until repaired or replaced. ▪ Inspect cathead for rust and rope grooves prior to use, do not use if faulty until repaired or replaced ▪ Report any defects to your supervisor
	6B) Moving Equipment	6B) Moving Equipment ▪ Do not wrap rope around any part of the hand or body ▪ Maintain distance of at least 18-inches from in-running points on running/reciprocating equipment ▪ Eliminate excess rope ▪ Do not wear loose clothing ▪ Wear appropriate PPE including leather gloves (See HASP)
7. Soil Sampling	6C) Contaminated Materials	6C) Contaminated Materials ▪ Wear appropriate PPE including Nitrile gloves (See HASP)
	6D) Sharp Sampling Tools	6D) Sharp Sampling Tools ▪ Use correct tools for opening sleeves ▪ When opening sleeve, cut away from body ▪ Place soil core on sturdy surface prior to cutting
	6E) Vapors	6E) Vapors ▪ Wear appropriate PPE including respirator if conditions warrant
	6F) Sample Cross Contamination	6F) Sample Cross Contamination ▪ Decontaminate or dispose of sampling equipment between sampling locations ▪ Double-check sample labels to ensure accuracy and adhesion to containers

MACTEC

Job Hazard Analysis - HASP Format

Job Title: Environmental Drilling/Boring and Associated Soil Sampling **Date of Analysis:** 6/1/2008

Key Work Steps	Hazards/Potential Hazards	Safe Practices
8. Solid/Liquid Waste Management/ Disposal	6G) Vapors and Airborne Particulates	6G) Vapors and Airborne Particulates ▪ Monitor air concentrations using direct-reading, real-time instruments such as OVM and Dräger tubes (See HASP for required monitoring instruments and action limits) ▪ Stop work if hazardous conditions (explosive atmosphere, O2 deficient atmosphere) identified until precautions are taken ▪ Wear appropriate PPE including safety glasses with side shields, dust masks and respirators (See HASP) ▪ Stay upwind (use flagging or similar device to indicate wind direction)
	6H) Contaminated Materials and Container Pinch Points	6H) Contaminated Materials and Container Pinch Points ▪ Wear appropriate PPE including Nitrile and leather gloves (See HASP) ▪ Position hands/fingers to avoid pinching/smashing/crushing when closing drum rings
	6I) Heavy Materials and Containers Lifting/ Moving	6I) Heavy Materials and Containers Lifting/ Moving ▪ Do not lift or move heavy containers without assistance ▪ Use proper bending/lifting techniques by lifting with arms and legs and not with back ▪ If possible, use powered lift truck, drum cart, or other mechanical means Take breaks if feeling faint or overexerted ▪ Spot drums in storage area prior to filling ▪ Wear appropriate PPE including leather gloves and steel-toed boots

MACTEC

Job Hazard Analysis - HASP Format

Job Title: Handling Compressed Gas Cylinders **Date of Analysis:** 9/14/06

Minimum Recommended PPE*: Steel toed boots

*See HASP for all required PPE

Key Work Steps	Hazards/Potential Hazards	Safe Practices
1. Moving full gas cylinder to work area or to vehicle.	1A) Projectile hazard (if cylinder falls and neck shears off)	1A) Projectile Hazard ▪ Use cylinder cart to transport gas cylinders. ▪ Cylinders are to be secured to the cart ▪ Move gas cylinders only with the protective cap in place. ▪ Move gas cylinders in an upright position ▪ Do not allow cylinders to drop or strike against each other or against hard objects.
	1B) Back or muscle strain	1B) Back or muscle strain ▪ Avoid lifting cylinder. ▪ Use materials handling aid (e.g., cart, dolly, etc.) whenever possible ▪ If cylinder must be lifted, use proper lifting techniques (lift with legs, not back, don't reach or use a twisting motion). ▪ Obtain assistance in lifting large cylinders
	1C) Foot injury	1C) Foot injury ▪ Wear steel toed boots
2. Transporting a gas cylinder in a vehicle.	2A) Asphyxiation and/or chemical exposure	2A) Asphyxiation and/or chemical exposure ▪ All gases can create an asphyxiation hazard. Some may also be toxic and/or flammable ▪ Ensure cylinder is NOT leaking (use soapy water to check), valve is tightly closed, regulator removed and cap is secured to cylinder. ▪ Gas cylinders should NOT be transported in the passenger compartment of a vehicle. Cylinders should be transported in a pickup bed, or trailer. ▪ Do not transport with incompatibles
	2B) Fire hazard	2B) Fire hazard ▪ Do not leave cylinders in vehicles -- especially in extreme temperatures. ▪ Secure in vehicles – away from flammable/combustible materials and ignition sources. ▪ Ensure cylinder is NOT leaking (use soapy water to check), valve is tightly closed, regulator removed and cap is secured to cylinder.
	2C) Projectile hazard	2C) Projectile hazard ▪ Secure cylinders tightly to vehicle. ▪ Do not allow cylinders to roll around loosely in vehicle
3. Securing a gas cylinder in the field	3A) Back or muscle strain.	3A) Back or muscle strain. ▪ Use mechanical aid (e.g., cart) to move large cylinder, if possible. ▪ If lifting and manual handling is unavoidable, use proper lifting techniques. Protect your back from strain and twisting. ▪ Use two people to handle large cylinders
	3B) Projectile hazard	3B) Projectile hazard ▪ Ensure tanks are secured tightly to wall of trailer, to a cart, or to a tree, post or other sturdy object, in an upright position. ▪ Do not lay cylinder on it's side.
	3C) Fire hazard	3C) Fire hazard ▪ Store flammable gases away from combustible materials (wood, paper, dried grasses, etc.) ▪ Store away from ignition sources

MACTEC

Job Hazard Analysis - HASP Format

Job Title: Handling Compressed Gas Cylinders **Date of Analysis:** 9/14/06

	3D) Chemical exposure	3D) Chemical exposure ▪ Ensure label on cylinder is legible ▪ Ensure valves are tightly closed when not in use ▪ Store away from incompatibles ▪ Review MSDS ▪ Wear PPE as identified in HASP.
4. Using gas cylinders	4A) Projectile hazard.	4A) Projectile hazard ▪ Ensure cylinder is secured tightly before removing protective cap.
	4B) Cylinder may fall when changing cylinders.	4B) Cylinder may fall when changing cylinders. ▪ Ensure BOTH cylinders are secured tightly to the wall or the transport cart.
	4C) Leaking Cylinders	4C) Leaking Cylinders ▪ Move all leaking cylinders outdoors, into a well ventilated area

	4D) High pressure gas release	4D) High pressure gas release
		▪ Use proper procedures to open and close a cylinder with a regulator attached:
		  ▪ Open cylinder valves slowly and do not open valves all the way.
		  ▪ Open so nozzle is facing away from person
		  ▪ Open valves only by hand unless the cylinder is specifically designed to be opened with a hand tool (keep hand tool with cylinder)

5. Returning "empty" gas cylinder to vendor	5A) High pressure gas	5A) High pressure gas ▪ Replace protective cap on the empty gas cylinder before transporting to vendor.
	5B) Moving a heavy object	5B) Moving a heavy object ▪ Use proper lifting techniques. Protect your back from strain and twisting. ▪ Get aid when lifting heavy cylinders ▪ Use a cart, if possible, to transport cylindeds

MACTEC

Job Hazard Analysis - HASP Format

Job Title: Well Development **Date of Analysis:** 8/11/06

Minimum Recommended PPE*:

*See HASP for all required PPE

Key Work Steps	Hazards/Potential Hazards	Safe Practices
1. Going to site, work preparation	1A) Mobilization / Demobilization and Site Preparation	1A) See JHA for Mobilization Demobilization and Site Preparation ▪ See HASP for required PPE and air monitoring equipment needs
2. Working at the site	2A) General Field Work – Walking and working in the field, environmental conditions, communication	2A) See JHA for General Field Work
3. Surge and Bail well	3A) Lifting/Twisting/Tugging	3A) Lifting/Twisting/Tugging ▪ Use proper lifting techniques when lifting equipment ▪ Use mechanical aids if available ▪ Use 2 person lift for heavy items
	3B) Slips/Trips/Falls	3B) Slips/Trips/Falls ▪ Ground can become wet/muddy, created by spilled water ▪ Place all purged water in drums or carboys for removal ▪ Wear good slip resistant footwear
	3C) Entanglement – Mechanical Surge	3C) Entanglement – Mechanical Surge ▪ Be aware of cords/wiring/hose location at all times. ▪ Secure all loose clothing and long hair
	3D) Exposure to Contaminated Groundwater	3D) Exposure to Contaminated Groundwater ▪ After the initial headspace reading (if required by the Work Plan), allow the well to vent for several minutes before bailing well ▪ Wear PPE as identified in HASP. ▪ Review hazardous properties of site contaminants with workers before sampling operations begin ▪ Monitor breathing zone air in accordance with HASP to determine levels of contaminants present. ▪ Wear face shield if splash hazard exists.
	3E) Poisonous Plants and Insects	3E) Poisonous Plants and Insects ▪ Look for signs of poisonous plants and avoid. ▪ Ensure all field workers can identify the plants. Mark identified poisonous plants with spray paint if working at a fixed location. ▪ Wear PPE as described in the HASP. ▪ Do not touch any part of your body/clothing. ▪ Always wash gloves before removing them. ▪ Discard PPE in accordance with the HASP. ▪ Use commercially available products such as Ivy Block or Ivy Wash as appropriate.
	3F) Contact with biting insects (i.e., spiders, bees, etc.) which may have constructed a nest in the well cap/well.	3F) Contact with biting insects ▪ Discuss the types of insects expected at the Site and be able to identify them. ▪ Look for signs of insects in and around the well. ▪ Wear Level of PPE as described in the HASP. At a minimum, follow guidelines in the JHA "Insects Stings and Bites." ▪ If necessary, wear protective netting over your head/face. ▪ Avoid contact with the insects if possible. ▪ Inform your supervisor and the Site Health and Safety Supervisor if you have any allergies to insects and insect bites. Make sure you have identification of your allergies with you at all times and appropriate response kits if applicable. ▪ Get medical help immediately if you are bitten by a black widow or brown recluse, or if you have a severe reaction to any spider bite or bee sting.

MACTEC

Job Hazard Analysis - HASP Format

Job Title: Well Development **Date of Analysis:** 8/11/06

Key Work Steps	Hazards/Potential Hazards	Safe Practices
4. Pump well	4A) Lifting/Twisting/Tugging	4A) Lifting/Twisting/Tugging ▪ Use proper lifting techniques when lifting equipment ▪ Use mechanical aids if available ▪ Use 2 person lift for heavy items
	4B) Using Generator/Electrical Equipment	4B) Using Generator/Electrical Equipment ▪ A ground fault circuit interrupter (GFCI) device must protect all AC electrical circuits. ▪ Use only correctly grounded equipment. Never use three-pronged cords which have had the third prong broken off. ▪ Make sure that the electrical cords from generators and power tools are not allowed to be in contact with water ▪ Do not stand in wet areas while operating power equipment ▪ Always make sure all electrically-powered equipment is in good repair. Report any problems so the equipment can be repaired or replaced. ▪ When unplugging a cord, pull on the plug rather than the cord. ▪ Never do repairs on electrical equipment unless you are both authorized and qualified to do so.
	4C) Entanglement	4C) Entanglement ▪ Be aware of cords/wiring/hose location at all times. ▪ Secure all loose clothing and long hair
	4D) Exposure to Contaminated Groundwater	4D) Exposure to Contaminated Groundwater ▪ After the initial headspace reading (if required by the Work Plan), allow the well to vent for several minutes before bailing well ▪ Wear PPE as identified in HASP. ▪ Review hazardous properties of site contaminants with workers before sampling operations begin ▪ Monitor breathing zone air in accordance with HASP to determine levels of contaminants present. ▪ Wear face shield if splash hazard exists.
	4E) Cuts to hands	4E) Cuts ▪ Be alert for sharp edges. Wear cut resistant gloves as appropriate
	4F) Poisonous Plants and Insects	4F) Poisonous Plants and Insects ▪ Look for signs of poisonous plants and avoid. ▪ Ensure all field workers can identify the plants. Mark identified poisonous plants with spray paint if working at a fixed location. ▪ Wear PPE as described in the HASP. ▪ Do not touch any part of your body/clothing. ▪ Always wash gloves before removing them. ▪ Discard PPE in accordance with the HASP. ▪ Use commercially available products such as Ivy Block or Ivy Wash as appropriate.

MACTEC

Job Hazard Analysis - HASP Format

Job Title: Well Development **Date of Analysis:** 8/11/06

Key Work Steps	Hazards/Potential Hazards	Safe Practices
	4G) Contact with biting insects (i.e., spiders, bees, etc.) which may have constructed a nest in the well cap/well.	4G) Contact with biting insects ▪ Discuss the types of insects expected at the Site and be able to identify them. ▪ Look for signs of insects in and around the well. ▪ Wear Level of PPE as described in the HASP. At a minimum, follow guidelines in the JHA "Insects Stings and Bites." ▪ If necessary, wear protective netting over your head/face. ▪ Avoid contact with the insects if possible. ▪ Inform your supervisor and the Site Health and Safety Supervisor if you have any allergies to insects and insect bites. Make sure you have identification of your allergies with you at all times and appropriate response kits if applicable. ▪ Get medical help immediately if you are bitten by a black widow or brown recluse, or if you have a severe reaction to any spider bite or bee sting.
5. Dispose of developmental water	5A) Lifting, Carrying (5 gal carboys or heavy equipment)	5A) Lifting, Carrying ▪ Use proper lifting techniques when lifting equipment ▪ Use mechanical aids if available ▪ Use 2 person lift for heavy items
	5B) Slips/Trips/Falls	5B) Slips/Trips/Falls ▪ Ground can become wet/muddy, created by spilled water ▪ Place all purged water in drums or carboys for removal ▪ Wear good slip resistant footwear
	5C) Exposure to Contaminated Groundwater	5C) Exposure to Contaminated Groundwater ▪ After the initial headspace reading (if required by the Work Plan), allow the well to vent for several minutes before bailing well ▪ Wear PPE as identified in HASP. ▪ Review hazardous properties of site contaminants with workers before sampling operations begin ▪ Monitor breathing zone air in accordance with HASP to determine levels of contaminants present. ▪ Wear face shield if splash hazard exists.
	5D) Walking through woods	5D) Walking through woods ▪ Protect head agains falling objects. ▪ Wear your hardhat for protection from falling limbs and pinecones, and from tools and equipment carried by other crewmembers. ▪ Stay out of the woods during extremely high winds. ▪ Watch your footing as stepping over rocks, roots, uneven terrain, etc.

QUALITY ASSURANCE PROGRAM PLAN

NYSDEC SUPERFUND STANDBY CONTRACT
CONTRACT NUMBERS D004434 AND D004444

Submitted to:

New York State Department of Environmental Conservation
Albany, New York

Submitted by:

MACTEC Engineering and Consulting, P.C.
Portland, Maine

October 2007
Version 1

APPROVED FOR
MACTEC Engineering and Consulting, Inc.:

William J. Weber, P.E.
Program Manager

Christian Ricardi, NRCC-EAC
Quality Assurance Manager

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (CONTINUED)

LIST OF TABLES

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
ARF	analytical request form
ASP	Analytical Services Protocols
AVS:SEM	acid volatile sulfide: simultaneously extractable metals
CADD	computer aided design
cc	cubic centimeter
CLP	Contract Laboratory Program
COC	chain-of-custody
CS	Contract Specialist
DO	dissolved oxygen
DQO	data quality objective
DUSR	data usability summary reports
EDD	electronic data deliverable
ELAP	Environmental Laboratory Approval Program
EM	electromagnetic
FDR	field data record
FOL	Field Operations Leader
ft	foot/feet
GPR	ground penetrating radar

GLOSSARY OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

GPS	global positioning system
HASP	Health and Safety Plan
HDPE	high density polyethylene
Hg	mercury
HSA	hollow-stem auger
ID	inside diameter
ILM	Multi-Media, Multi-Concentration Inorganic Analysis
ISIS	Integrated Site Information System
K	hydraulic conductivity
LCS	laboratory control samples
LNAPL	light non-aqueous phase liquid
MACTEC	MACTEC Engineering and Consulting, P.C.
MEDD	Multimedia Electronic Data Deliverable
MGP	maximum allowable gauge pressure
ml	milliliter
MS/MSD	matrix spike/matrix spike duplicate
NAPL	non-aqueous phase liquid
NTUs	nephelometric turbidity units
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation

GLOSSARY OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

NYSDOH	New York State Department of Health
OLC	Organic, Low Concentration
OLM	Multi-Media, Multi-Concentration Organics Analysis
ORP	oxidation-reduction potential
oz	ounce
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyl
PID	photoionization detector
PM	Project Manager
POTW	publicly-owned treatment works
PPE	personal protective equipment
PS	Procurement Specialist
psi	pounds per square inch
PVC	polyvinyl chloride
QA	Quality Assurance
QAM	Quality Assurance Manager
QAPjP	site-specific Quality Assurance Project Plan
QAPP	Quality Assurance Program Plan
QAO	Quality Assurance Officer
QC	Quality Control
QRB	Quality Review Board
RCRA	Resource Conservation and Recovery Act

GLOSSARY OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

RPD	Relative Percent Difference
RQD	rock quality data
SOP	Standard Operating Procedures
SOW	Statement of Work
SVOC	semivolatile organic compound
TAGM	Technical and Administrative Guidance Memo
TAL	Target Analyte List
TC	Terrain Conductivity
TCL	Target Compound List
TED	Technical Environmental Database
TOGS	Technical and Operational Guidance Series
µg/L	micrograms per liter
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1.0 PROGRAM DESCRIPTION

1.1 PURPOSE

The purpose of this Quality Assurance Program Plan (QAPP) is to define responsibilities and authorities for data quality, and to prescribe requirements for assuring that the field exploration activities under taken by MACTEC Engineering and Consulting, P.C. (MACTEC) for the New York State Department of Environmental Conservation (NYSDEC) are planned and executed in a manner consistent with established program-wide quality assurance (QA) objectives and the State Superfund Standby Contract.

The QAPP provides guidance and specifications to ensure that:

- samples are obtained under controlled conditions using appropriate and documented procedures;
- samples are identified uniquely and controlled through sample tracking systems and chain-of-custody (COC) protocols;
- field determinations and laboratory analytical results are of known quality and are valid and consistent through using approved methods, preventive maintenance, calibrations, analytical protocols, quality control (QC) measurements, reviews, audits, and correcting out-of-control situations;
- calculations and evaluations are accurate, appropriate, and consistent throughout the project;
- data are validated and their use in calculations is documented; and
- records are retained as documentary evidence of the quality of samples, applied processes, equipment, and results.

1.2 SCOPE

This document has been prepared in support all work assignments issued under NYSDEC Contract No. D004434 and D004444. The requirements of this QAPP apply to all MACTEC and subcontractor activities undertaken, unless otherwise stipulated in the site-specific Work Plan or Quality Assurance Project Plan (QAPjP).

The organizational responsibilities and interactions outlined in Section 2 of this document extend to quality-related controls and activities. The content and format of the QAPP is based on:

- *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans - QAMS-005/80* prepared by the United States Environmental Protection Agency (USEPA) (USEPA, 1980) and
- NYSDEC Technical and Administrative Guidance Memos (TAGMs) including:
    - Phase II Investigation Generic Work Plan; TAGM HWR-88-4007 (NYSDEC, 1988).
    - Phase II Investigation Oversight Guidance; TAGM HWR-90-4008 (NYSDEC, 1990a).
    - Phase II Investigation Oversight Note Taking; TAGM HWR-90-4019 (NYSDEC, 1990b).

The QAPP consists of 14 sections, as described in QAMS 005/80, and is organized as follows:

Section 2	Program Organization and roles of the MACTEC project team
Section 3	QA objectives
Section 4	Sampling procedures
Section 5	Sample custody
Section 6	Calibration procedures
Section 7	Analytical procedures

Section 8	Data reduction, validation, and reporting
Section 9	Internal QC
Section 10	Audits
Section 11	Preventive maintenance
Section 12	Data assessment
Section 13	Corrective action
Section 14	Reports to management

The figures and tables are located at the end of each section they are first referenced in.

1.3 CONTRACT SUMMARY

MACTEC has been retained by NYSDEC to conduct field investigation and remedial activities at various inactive hazardous waste sites in New York State (NYS). Under the contract, work assignments are issued that may require the performance of some, or all, of the following services:

- Preliminary Site Assessment
- Remedial Investigation/Feasibility Study
- Remedial Design
- Remedial Construction Management
- QA/QC Activities
- Site Response Activities
- Operation and Maintenance
- Citizen Participation Activities
- Health and Safety Plan (HASP) Review

Particular sections of the QAPP will apply to the above work elements. Specific QAPP requirements that apply to a given work assignment will be identified in the site-specific QAPjP to be developed for each unique site.

2.0 PROGRAM ORGANIZATION AND RESPONSIBILITIES

2.1 ORGANIZATION

MACTEC operates using a multi-disciplinary team-based system. Under this system, personnel representing both engineering and scientific disciplines are assigned to teams and groups organized by similar client focus. The administrative personnel for the NYSDEC contract are members of the State Programs team, which is managed under the Government Operations group. Tasks leaders and key technical staff assigned to NYSDEC work assignments are generally either members of the State Programs team or the Government Operations group. However, additional resources are available from throughout the entire MACTEC organization. Individuals with specialized skills assigned to other teams, groups, or offices within MACTEC may join a NYSDEC project team as needed.

This portion of the QAPP addresses MACTEC's NYSDEC Program organization and specifically outlines QC coordination and responsibilities. Those individuals assigned to a project or task are responsible for conducting project work by using the resources assigned to the project management organization. In this way, resources through MACTEC are available to each project, but responsibility for initiating services and for ensuring acceptable results remains within the project organization. This responsibility carries with it the authority to initiate, modify, and stop activities, as appropriate. It is the Quality Review Board's (QRB) role to assist the Project Manager (PM), Task Leaders, and Site Managers in meeting project goals while providing an independent evaluation of product quality.

Figure 2-1 illustrates the overall program organization and principal lines of communication and authority.

2.2 SPECIFIC RESPONSIBILITIES

The responsibilities of the MACTEC project positions and support organizations are summarized below.

Corporate Officer. The Corporate Officer is William J. Weber, P.E., of MACTEC. Mr. Weber is responsible for establishing a contract for the services to be performed, for committing the corporate resources necessary to conduct the program work activities, and for supplying corporate-level input for problem resolution.

Program Manager. The NYS Superfund Standby Contract Program Manager is William J. Weber, P.E. The Program Manager has overall responsibility to organize and set operating procedures with NYSDEC.

Project Manager. The PM, named in the site-specific QAPjP or Work Plan, is responsible for day-to-day technical administration of the project and will be the primary technical contact for NYSDEC on most jobs. The PM will be responsible for:

- initiating project activities;
- identifying project staff, equipment, and other resource requirements;
- interfacing with NYSDEC on all cost, contractual, personnel, and other administrative matters;
- monitoring task activities, and adjusting efforts on resources, as required, to help assure that existing budgets, schedules, and work programs are maintained;
- providing regular briefings on the status of the project and preparation of monthly reports showing both technical progress and cost status;
- providing assurance that project technical and financial records are kept according to the requirements of NYSDEC and MACTEC; and
- implementing subcontracting as required

Task Leaders and Site Managers. The Task Leaders and Site Managers are responsible for:

- the appropriateness, adequacy, and timeliness of the technical and engineering services provided;
- developing the technical approach and level of effort required to address each of task/subtask;
- the day-to-day conduct of the work, including the integration of the input of supporting disciplines and subcontractors (i.e., drilling or laboratory subcontractors);
- ongoing QC during performance of the work; and
- the technical integrity as well as the clarity and usefulness of all project work products.

Task Leaders and Site Managers will be identified in the site-specific Work Plan or QAPjP

Quality Review Board. A key component in the review process is the designation of a QRB for each project. The function of this group of senior technical and/or management personnel is to provide guidance on the technical aspects of the project. This is accomplished through periodic reviews of the services designed to incorporate the accumulated experience and corporate policy of the firm and to meet the objectives of the program as established by NYSDEC. The QRB provides input to project deliverables by conducting technical reviews while work is in progress. The QRB serves as a resource for the Quality Assurance Manager (QAM) in evaluating the magnitude of identified QC problems and supporting the development of appropriate corrective action.

Three QRB members have been identified and are listed on Figure 2-1. For most work assignments, individuals from this group will be selected to serve as part of the project-specific QRB. If special technical issues are identified on a site- or project-specific basis, additional senior technical staff maybe assigned to the project-specific QRB to provide the appropriate technical guidance and review.

Quality Assurance Officer. The Quality Assurance Officer (QAO), Christian Ricardi, has responsibility for establishing, overseeing, and auditing specific procedures for documenting and controlling analytical and field data quality. Many of the procedures will be implemented by other individuals. The QAO works with the PM, Task Leaders, and Site Managers to verify that established MACTEC and NYSDEC protocols are followed.

Responsibilities of the QAO include:

- monitoring the QA and QC activities of the laboratory for conformance with approved policies, procedures, and sound practices, and authorize improvements as necessary;
- informing the PM, Task Leaders, Site Managers, and/or subcontract laboratory management of nonconformance to the approved QC program;
- assuring that records, logs, standard procedures, project plans, and analytical results are complete and maintained in a retrievable fashion;
- distributing copies of standard procedures and project plans to all appropriate personnel involved in the project; and
- assuring that sampling is conducted in a manner consistent with the QC plan.

The QAO will delegate implementation of analytical QC functions as appropriate to the Laboratory Analytical Task Manager. The QAO will monitor the proper application of the program through review of all reports on a routine basis.

Procurement Specialist. The Procurement Specialist (PS), Peggy Franklin, aids and assists the PM, Task Leaders, and Site Managers with procuring subcontractors and subcontract terms and conditions issues.

Contract Specialist. The Contract Specialist (CS), Theresa Casavant, aids and assists the PM, Task Leaders, and Site Managers with compliance with contract terms and conditions, including cost allowability, invoicing, monitoring budgets, maintaining employee NSPE-grade lists, administering subcontracts, and meeting minority/women-owned business enterprise goals.

2.3 PERSONNEL QUALIFICATIONS AND TRAINING

Assignment of technical staff is completed by MACTEC with regard to appropriate qualifications in the technical areas relevant to the project and any associated QC techniques. This involves an assessment of individual qualifications and a resolution of training needs prior to the commencement of data generation/manipulation activities. Training typically consists of one or more of the following activities:

- general briefings covering all aspects of QA program and project plans;
- specific briefings on individual QAPjPs;
- specific briefings on individual QA and QC procedures or activities;
- required reading of pertinent QA-related documents; and
- participation in USEPA-approved and other training courses.

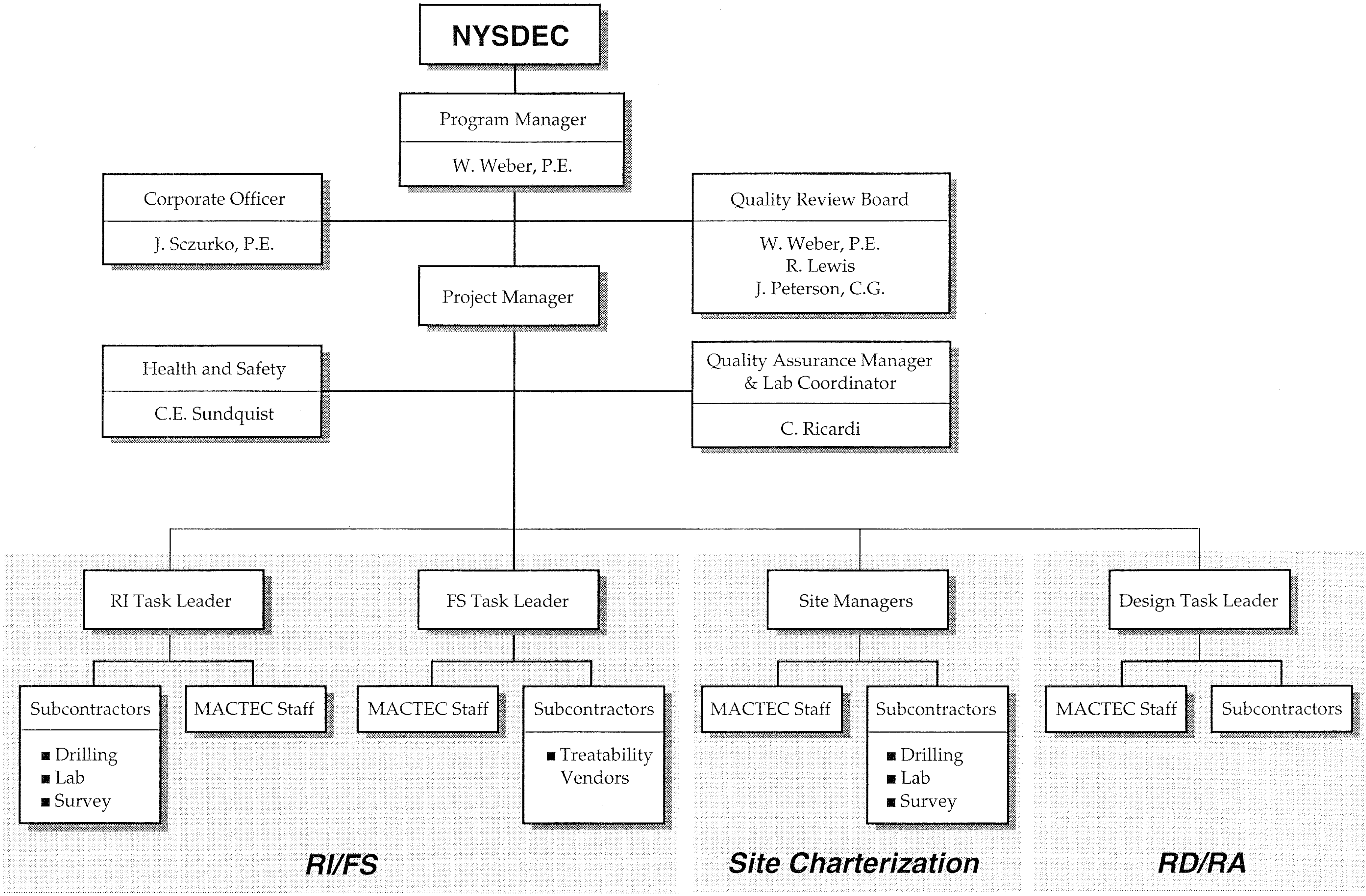
MACTEC personnel involved with hazardous waste site investigations are required to attend an approved 40-hour health and safety course prior to working on hazardous waste sites. In addition, personnel are required to attend annual 8-hour, refresher health and safety training courses designed to review: (1) health and safety requirements and principles; (2) sampling procedures; (3) documentation procedures; (4) operational procedures; and (5) safety equipment use and function.

MACTEC will staff projects with capable, trained personnel. MACTEC typically uses a cross-section of junior-, middle-, and senior-level personnel to implement field sampling and investigation programs. By using this cross-section, personnel are placed in a position of responsibility to which they can respond.

2.4 SUPPORT SERVICES

To conduct certain Work Assignment, MACTEC will retain subcontractors (selected considering price and technical qualifications) to perform specialized services, including sample analysis, drilling, surveying, and engineering consulting services. Before MACTEC enters into a subcontract relationship, MACTEC evaluates the potential subcontractor. Such evaluations may include visiting the subcontractors' business unit and conducting facility audits. MACTEC may conduct pre-bid meetings to explain potential tasks, site conditions that may be encountered, and the importance of each task to the project. MACTEC evaluates proposals both technically and financially, and then recommends selection to the NYSDEC.

Contract documents are thoroughly discussed with the subcontractor, and are complete and detailed, including scopes of work, payment terms and conditions, penalties for poor performance, and applicable prime contract flow down clauses. Before awarding any work, MACTEC will confirm the subcontractors' ability to accomplish the work on the required schedule. As work is to be awarded, and as it continues, MACTEC will confirm schedules and commitments. MACTEC requires periodic subcontractor progress reports (e.g., drillers' daily quantity sheets and documentation of internal technical reviews). Subcontractors must contact MACTEC if they anticipate difficulty in adhering to scope, schedule, or budget. For technical issues, the subcontractor's primary point of contact within MACTEC is the PM; for subcontract terms and conditions issues, it is the PS; and for payment issues, it is the CS. The procedural steps MACTEC follows to effect subcontractor corrective action are listed in Table 2-1.



MACTEC
511 Congress Street
Portland, ME 04101

FIGURE 2-1
ORGANIZATION CHART
NYSDEC QUALITY ASSURANCE PROGRAM PLAN

TABLE 2-1
SUBCONTRACTOR CORRECTIVE ACTION STEPS

NYSDEC QUALITY ASSURANCE PROGRAM PLAN

1.	MACTEC visits subcontractors' facilities prior to initiating subcontract relationship
2.	CS and procurement staff develop, negotiate, and issue clear and concise subcontract agreement protecting the NYSDEC's and MACTEC's interests
3.	CS and procurement staff communicate to the subcontractor assigned roles and responsibilities of the MACTEC project team
4.	CS and PM maintain regular contact regarding subcontractor's technical performance and any deviations from scope and schedule
5.	CS and PM review subcontractor invoices for conformance to contract terms and conditions
6.	CS and PM attempt to resolve any issues with subcontractor's authorized representative
7.	CS and PM require subcontractor progress reports describing scope, schedule, and budget conformance
8.	CS and PM solicit Program Manager and other senior MACTEC staff advice on non-routine issues
9.	CS and Program Manager involve subcontractors' senior management in unresolved issues
10.	CS and PM invoke applicable financial penalties
11.	CS and Program Manager consider subcontract termination if subcontract allows and performance problems are well-documented and unresolvable
12.	Refuse further subcontract associations

Notes:

CS = Contract Specialist
MACTEC = MACTEC Engineering and Consulting
NYSDEC = New York State Department of Environmental Conservation
PM = Project Manager

3.0 QUALITY ASSURANCE OBJECTIVES

3.1 PROGRAM DATA QUALITY OBJECTIVES

This QAPP covers all work complete by MACTEC under the State Superfund Standby Contract and is applicable to site investigation activities that are completed in the State of New York. Site investigation activities will be completed in accordance with NYSDEC regulations and guidelines. Regulations and guidelines provided by the United States Environmental Protection Agency (USEPA) may also be applied. When planning and implementing site-specific investigations the MACTEC project team will incorporate requirements and procedures described in the following documents into their planning documents and technical evaluations of site conditions:

Draft DER-10 “Technical Guidance for Site Investigation and Remediation”; New York Department of Environmental Conservation; Division of Environmental Remediation; December 2002.

6 NYCRR PART 375 “Environmental Remediation Program”; New York Department of Environmental Conservation; Division of Environmental Remediation; October 2006.

Title 6, Part 371 “Identification and Listing of Hazardous Wastes”; New York Codes, Rules, and Regulations; September 2006.

Title 6, Part 700-705 “Water Quality Regulations Surface Water and Groundwater Classifications and Standards”; New York Codes, Rules, and Regulations; August 1999.

“Division Technical and Administrative Guidance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels”; New York Department of Environmental Conservation; Division of Hazardous Waste Remediation; January 1994.

Technical and Operational Guidance Series (TOGs) 1.1.1. "Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations"; New York Department of Environmental Conservation; Division of Water; June 1998.

USEPA 542-S-02-001 "Ground-Water Sampling Guidelines for Superfund and Resource Conservation and Recovery Act (RCRA) project Managers"; United State Environmental Protection Agency (USEPA); Office of Solid Waste and Emergency Response; May 2002.

"Analytical Services Protocols (ASP)"; New York Department of Environmental Conservation; June 2000; revised July 2005.

"Guidance for Evaluating Soil Vapor Intrusion in the State of New York"; New York State Department of Health (NYSDOH); October 2006.

"Draft Procedures for Collection and Preparation of Aquatic Biota for Contaminant Analysis"; New York State Department of Environmental Protection; Division of Fish, Wildlife, and Marine Resources; Bureau of Habitat; October 2002.

3.2 IDENTIFICATION OF PROJECT DATA QUALITY OBJECTIVES

Project Data Quality Objectives (DQOs) will be established during the development of project Work Plans to specify the quality of data and project specific goals for each particular data collection activity. The DQO will be established to ensure that data collected can support project-specific decisions. The DQOs are the starting point in the design of the investigation. DQOs are based on the concept that the intended use of the data determines the quality and type of the data required. DQOs are established based on site conditions, project objectives, and available measurement systems. The DQO process matches sampling and analytical capabilities to the data targeted for specific uses and ensures that the quality of the data does not underestimate project requirements.

During the development of project-specific Work Plans, the guidance documents identified in Section 3.1 will be used to establish sampling and analytical testing goals. The MACTEC project team will evaluated site historical information and data, and recommend a plan for each site. Each Work Plan will include detailed descriptions of the following information:

- Project description and site investigation objectives
- Planned explorations and sampling procedures
- Summaries of proposed samples for all media at the site
- Summary of analytical procedures
- Data quality goals for each sampling task
- Applicable standards for groundwater, surface water, sediment, and soils

3.3 ANALYTICAL DATA QUALITY LEVELS

During the development of project-specific Work Plans the analytical program for field samples will be established. The plan will specify analytical methods, analyte detection limits, data reporting requirements, and data review and reporting procedures.

In 1987 the USEPA identified five general levels of analytical data quality as being potentially applicable to field investigations conducted at potential hazardous waste sites under the Comprehensive Environmental Response, Compensation, and Liability Act (USEPA, 1987). In 1993 USEPA revised their DQO guidelines to include specific types of project planning information and to establish project goals (USEPA, 1993). The data quality levels were not included in this DQO document and analytical data quality was described as definitive data (off-site laboratory) and on-site screening data with definitive confirmation. For the purposes of this QAPP, the data quality levels described in the 1987 guidance will be used to reference general types of chemical testing data that will be collected. Data quality components from the 1993 guideline will be incorporated into the data level descriptions. These levels are summarized as follows:

Level I - Field Screening. This level is characterized by the use of portable instrumentation that can provide real time data to assist in the optimization of sampling point locations and for health and safety monitoring. Data can be generated indicating the presence or absence of certain contaminants, especially volatiles, at sampling locations. These measurements may include hand held photoionization detector (PID) for volatile organic compounds (VOC) monitoring, and instruments used for measuring temperature, pH, specific conductance, dissolved oxygen (DO), and turbidity during water sampling. Calibration and data recording procedures for the field testing instruments are described in Section 6.

Level II - Field Analysis. This level is characterized by the use of portable analytical instruments of field test kits that can be used on-site or in mobile laboratories stationed near a site. A detailed description of field analytical procedures will be included in each site-specific Work Plan. Depending on the project field analysis objectives, types of contaminants, sample matrix, and analytical procedure either qualitative or quantitative data will be obtained. The data quality goal will be specified. For sampling tasks requiring quantitative results, split samples for off-site laboratory analysis will be collected to evaluate the accuracy of the field analytical data. The split sample process and data comparison goals will be identified in the Work Plans.

Level III - Laboratory Analysis. Subcontract laboratory-generated data obtained using USEPA or NYSDEC-approved procedures. Laboratory services will be completed in accordance with the NYSDEC ASP. Analytical methods may include a MACTEC subcontracted lab using USEPA Contract laboratory Program (CLP) Statement of Work (SOW) methods, USEPA SW-846 (USEPA, 1996), USEPA drinking water (500 series) methods and waste water methods (600 series) [40 CFR Part 136], Methods for the Chemical Analysis of Waters and Wastes (USEPA, 1983), Standard Method (APHA, 1998), American Society for Testing and Materials (ASTM) procedures, or other approved testing procedures. Analyses will be completed by a laboratory that has CLP certification with the NYSDOH Environmental Laboratory Approval Program (ELAP). For Level III work a NYSDEC Data Usability Summary Report is generated as described in Section 8.

Level IV – Laboratory Analysis using CLP Routine Analytical Services. These data represent laboratory analytical results developed using a CLP contract and supported by a rigorous QA program, supporting documentation, and data validation procedures. These data are typically used for definitive site characterization, risk assessment, engineering alternative selection and design in support of enforcement/litigation activities. Level IV data can include Target Compound List (TCL) VOCs, semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), and Target Analyte List (TAL) inorganics.

Level V - Non-standard Methods. This level is used for the analysis of non-standard sample matrices (i.e., biota, waste, etc.). The level also applies when non-conventional parameters, method-specific detection limits, or modification of existing methods are required. None standard methods will be identified and described in the project Work Plans.

3.4 PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, COMPARABILITY

To establish the quality goals for analytical data, data quality refers to a degree of uncertainty with respect to precision, accuracy, representativeness, completeness, and comparability. Specific objectives for each of these characteristics are established to develop sampling protocols, and to identify applicable documentation, sample handling procedures and measurement system procedures.

3.4.1 Precision

Precision is defined as the agreement among individual measurements of the same chemical constituent in a sample, obtained under similar conditions. Field precision will be expressed as relative percent difference (RPD) of field duplicates:

$$\frac{(X_1\text{-}X_2)}{X_1 + X_2/2} \text{ x } 100 = \text{RPD}$$

where,

RPD	=	relative percent difference between duplicate results
X1 and X2	=	results of duplicate analyses
$\lvert$X1 - X2$\rvert$	=	absolute difference between duplicates X1 and X2

Field duplicates take into account the level of error introduced by field sampling techniques, field conditions, and analytical variability. The RPD of field duplicates will be calculated by MACTEC in order to evaluate the sample precision.

3.4.2 Accuracy

Accuracy is defined as the degree to which the analytical measurement reflects the true concentration level present. Accuracy will be measured as percent recovery for spiked analyses including laboratory control samples (LCS), surrogates spikes, and matrix spikes.

A spike is a sample to which predetermined quantities of standard solutions of certain target analytes are added prior to sample extraction/digestion and analysis.

Accuracy can also be evaluated using the recovery of surrogate spikes in the organic analyses. These spikes consist of organic compounds which are similar to the analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. These compounds are spiked into all blanks, standards, and samples prior to analysis.

Percent recoveries of the LCS, surrogate, and matrix spikes will be reported by the laboratory for all analytes associated with the samples. Variations from 100 percent recovery may be due to method extraction and analysis efficiency, matrix interferences, laboratory spike handling procedures, or sample heterogeneities between replicates. The percent recovery of the spikes can be calculated from the following equation:

$$\frac{X - B}{T} \times 100 = REC$$

where,

X	=	measured amount in sample after spiking
B	=	background amount in sample
T	=	amount of spike added

Accuracy is difficult to evaluate for the entire data collection activity, especially the sampling component. Field and trip blanks will be used in addition to the matrix and surrogate spiked samples to evaluate data accuracy in the investigations.

3.4.3 Representativeness

Representativeness expresses the degree to which sample data depict existing site conditions. Measurements will be made so that analytical results are representative of the media (e.g., soil, water, and sediments) and conditions being measured, to the extent possible. Representative data are collected by establishing standardized procedures for identification of sample locations and sampling techniques, and the collection of a sufficient number of samples. Sampling protocols are designed to collect representative samples of the media. Sample handling protocols (e.g., storage, transportation, holding time, sample preservation) are selected to protect the representativeness of the collected sample during shipment to the laboratory. Proper documentation will establish that protocols have been followed and sample identification and integrity are assured. Sample collection and handling will be in accordance with the standard procedures contained in Section 4 and Section 5.

QC blanks including laboratory method blanks and field QC blanks are also collected to determine if samples have been contaminated during sample collection or lab analysis. If evidence of sample contamination is found during data review, results for detected of contaminants may be removed from the final data set.

3.4.4 Completeness

The characteristic of completeness is a measure of the amount of valid data obtained compared to the amount that was expected. The completeness of data generated during each sampling task will be evaluated by the MACTEC project team when data review is completed and sample data are considered final. It may be impossible to collect samples that were proposed in the project Work Plans due to problems encountered during the field sampling event. For example, multiple depth soil sample collection from a boring may be specified, but the boring may be terminated for technical reasons prior to reaching the specified depth. Samples may be lost or destroyed during sample handling or shipment to the laboratory. Data may be qualified during the completion of data usability summary reports

(DUSR) or data validation reports described in Section 8. In some cases results may be qualified estimated (J) or rejected (R). Interpretations on missed sample location results, lost samples, and qualified data will be evaluated by the MACTEC project team after each site investigation sampling event. If data are missing from critical locations, or if qualification of data has an unacceptable impact on the usability of results relative to the project DQOs, then a decision may be made with the NYSDEC PMs to recollect samples.

3.4.5 Comparability

The characteristic of comparability reflects: (1) the internal consistency of measurements made at the site, (2) the expression of results in units consistent with other organizations reporting similar data, and (3) the confidence with which one data set can be compared to other similar measurements. The use of subcontract laboratories that have NYSDOH ELAP certification is a QA step designed to ensure that laboratories will produce chemical data that meet standards for testing for work within New York. Use of USEPA and other standard analytical methods used in the environmental testing industry provides another level of QA that results will be comparable to industry standards.

4.0 SAMPLING PROCEDURES

4.1 SAMPLE LABELS AND RECORDS

Sample labels will be prepared, to the extent feasible prior to initiation of work, using a computerized labeling system. Each sample may require several labels for the different containers, depending on the analysis to be performed.

Identification of samples collected during the field investigation will be accomplished with an Integrated Site Information System (ISIS) code indicating sample type, sample identification, depth of sample (if applicable), and designation of duplicate samples. Soil, groundwater, and sediment samples will be labeled using a 14-digit system, as follows:

Digits 1 & 2	<u>Site Code</u> - two letter code to identify the site Example: GS (Guterl Specialty Steel)
Digits 3, 4	<u>Sample Type</u> - two letter code to identify sample media AA - Ambient Air Sample BA - Basement Air Sample BS - Test Boring Soil Sample BW - Screened-auger Groundwater Sample CD - Septic System/Sump Catch Basin Sludge Sample CL - Septic System/Sump Catch Basin Liquid Sample DL - Drum Liquid DS - Drum Solids or Sludge FA - First Floor Air Sample GS - GeoProbe® Soil Sample

GV - Geoprobe® Soil Vapor Sample

GW - GeoProbe® Water Sample

IA - Indoor Air Sample

MW - Monitoring Well Groundwater Sample

PS – Pore Water Sample

PW – Private Well Sample

QD - Source Water Blank

QS - Sampler Blank (i.e., Rinsate Blank)

QT - Trip Blank

RC – Rock Chip

SD - Sediment Sample

SS - Surface Soil Sample and/or Subslab Soil Vapor Sample

SW - Surface Water

TP - Test Pit Soil Sample

TW - Test Pit Water Sample

WT - Waste Sample

Digits 5,6,7 Horizontal Sample Locator - three numbers to identify sample location. Example: 202

Digits 8,9,10 Depth of Sample Below Reference Surface – Example (1): 001 equals 1 foot (ft) in depth; Example (2): 025 equals 25 feet (ft) in depth.

For BS samples, the depth indicated is assumed to be the top of a 2-ft, split-spoon sample. The designation 000 will be used for BS samples collected from 0 to 2 ft below ground surface.

All samples obtained from the ground surface will be designated 000 and from drums will be designated XXX.

Digits 11,12 — Used as sampling event number when more than one round of sampling is required. If only one event is planned, the two letter code will be the year (e.g., 95 for samples obtained in 1995).

Digits 13,14 — XD - duplicate sample

XX - sample

XF - sample collected for field laboratory analysis or a filtered groundwater sample collected for analytical laboratory analysis

MS - Matrix Spike

MD - Matrix Spike Duplicate

Acceptable sample ISIS codes include GSMW10102595XX (a groundwater sample collected from 25 ft in depth), GSQT001XXX94XX (a trip blank), and GSBS30102993XX (a soil boring sample collected from 29 ft in depth).

At the time the sample is obtained a field data record (FDR) sheet and field logbook entries will be completed. The FDRs for specific types of sampling are discussed and illustrated in Subsections 4.4 and 4.5. The sample record documentation will include:

- a plan of the site with the sample location;
- sample label numbers;
- a description of the sample site;
- other physical descriptors of the sample site, if appropriate (e.g., stream width, groundwater depth, etc.);
- photographs of the sample site may be taken showing the sampling equipment and/or unusual conditions (orientation of photograph must be shown on sketch map, and photo number recorded in field notebook); and
- COC documentation (see Section 5).

4.2 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Sample integrity is maintained by using containers and preservation methods that are specific to the media sampled and analytical parameters. Sample containers and preservation methods specified in NYSDEC ASP protocols are summarized in Table 4-1. Any project-specific variation or addition to the sample containers and preservation methods outlined in this table will be specified in the site-specific QAPjP.

4.2.1 Preparation of Sample Containers

Sample containers will be provided by the laboratory and are prepared according to USEPA protocols. Sample containers will meet or exceed the specifications established in S*pecifications and Guidance for Contaminant-Free Sample Containers*, (USEPA, 1992). QC records for the bottles used will be maintained by the laboratory. The procedures used by the vendor providing the laboratory with sample containers are detailed below.

4.2.2 Sample Preservation

Sample preservation for water samples will be completed in accordance with requirements described in the ASP Exhibit I (NYSDEC, 2005). Steps to maintain the in situ characteristics required for analysis may include storage of samples at 4 degrees Celsius, pH adjustment, and chemical fixation. Specific sample and container preservation requirements are summarized in Table 4-1 for the most commonly utilized methods. Holding times specified in the ASP Exhibit I are based on time of sample receipt at the laboratory. Holding times specified on Table 4-1 have been modified to begin at the time of sample collection. If pre-preserved sample containers are provided by the laboratory, extra preservation material should be available in the field in cases where additional material is needed to achieve the necessary pH.

Sample preservation and holding times for soils are based on guidelines provided in the ASP, referenced USEPA methods, or USEPA guidance documents.

Soil samples collected for VOC analysis will be preserved in the field in accordance with USEPA Method 5035 (USEPA, 1996) unless otherwise directed by the NYSDEC PMs.

4.3 DECONTAMINATION PROCEDURES

Equipment to be decontaminated during the project may include: (1) drill rig, GeoProbe®, backhoe, truck, or trailer; (2) tools; (3) monitoring equipment; and (4) sample collection equipment.

All decontamination will be done by personnel in protective gear appropriate for the level of decontamination as determined in the site-specific HASP. The site-specific Work Plan will designate where equipment decontamination will be performed on site (e.g., at a central decontamination station at an established site or at individual exploration locations).

4.3.1 Large Equipment

MACTEC anticipates that large equipment such as drill rigs, GeoProbes®, backhoes, trucks, and trailers may potentially be contaminated during field activities. Large equipment requiring decontamination will be cleaned with a portable, high-pressure steam cleaner. Personnel performing this activity will use the same level of health and safety personal protection required for invasive exploration activities plus splash protection.

4.3.2 Tools and Sampling Equipment

Contaminated tools and sampling equipment will be dropped into a plastic pail, tub or other container. The tools will be brushed off, rinsed, and transferred into a second pail to be carried to further decontamination stations where they will be washed with a Liquinox ®, or equivalent soap and water solution, rinsed with clean potable water, and finally rinsed with deionized water. Tools such as wrenches, split-spoons, etc., may be decontaminated between exploration locations with a high-pressure steam cleaner instead of washing. Sampling equipment, such as bailers, will be wrapped in aluminum foil after cleaning to prevent contamination before next use.

4.3.3 Monitoring Equipment

When monitoring equipment is being used under conditions where it may become contaminated, the equipment will be protected as much as possible from contamination by draping, masking or otherwise covering as much of the instrument as possible with plastic without hindering the operation of the unit. For example, the PID can be placed in a clear plastic bag which allows reading of the scale and operation of the knobs. The sensor on the PID can be partially wrapped, keeping the sensor tip and discharge port clear.

Any contaminated equipment will be taken from the drop area and the protective coverings removed and disposed of in the appropriate containers. Any direct or obvious contamination will be brushed or wiped with a disposable paper wipe. The units will then be wiped off with damp disposable wipes and dried. The units will be checked, standardized, and recharged, as necessary, for the next day's operation. They will then be prepared with new protective coverings.

4.3.4 Sample Handling/Shipping Areas

Sample containers will be wiped clean at the sample site, taken to the decontamination area to be further cleaned, as necessary, and transferred to a clean carrier. The samples will be checked off against the COC record. The samples will then be stored on ice in a secure area prior to shipment.

Sample handling areas will be cleaned/wiped down daily using disposable wipes. Disposable wipes will not be used on any equipment that comes in contact with samples. For final cleanup, all equipment will be disassembled and decontaminated. Any equipment which cannot be satisfactorily decontaminated will be disposed (e.g., glassware, covers for surfaces).

The management of disposal of liquid and solid wastes generated during decontamination is presented in Subsection 4.9.

4.4 FIELD INVESTIGATION TECHNIQUES AND PROCEDURES

Prior to any subsurface investigation activities, MACTEC or the contracted subcontractor will work closely with the NYSDEC, the Site property owner, the neighboring property owners, and utility companies to obtain access to the exploration locations and clear utility lines.

4.4.1 Geophysical Methods

Geophysical methods are remote-sensing techniques that provide information about subsurface conditions. Geophysical surveys can be used to identify buried objects or features such as utility lines/pipes, former disposal trenches or pits, buried debris and/or waste material. This information is used to plan locations of explorations including test pits, borings, and monitoring wells. Geophysical techniques commonly used as part of field investigations include (but not limited to) ground penetrating radar (GPR), magnetometry, and terrain conductivity (TC). Using more than one individual survey technique in a given area provides for correlation of anomalous features and lends for a more comprehensive interpretation. The principles, instrumentation, methodology, and techniques of data evaluation of GPR, magnetometry, and TC are presented in the following subsections.

4.4.1.1 Ground Penetrating Radar

GPR uses high frequency radio waves to investigate the presence of subsurface objects and structures by measuring reflections from any interface where there is a significant change in the dielectric constant. Typical applications for GPR include delineating the boundaries of buried waste materials and perimeters of abandoned landfills; finding steel reinforcement bars and voids in concrete structures; recording the depth of geological interfaces, bedrock, and coal seams; locating and mapping buried utilities; profiling lake bottoms; and determining glacial ice stratification and thickness.

Principles. Energy is radiated downward into the subsurface from an antenna that is pulled slowly across the ground at speeds varying from about 0.25 to 5 miles per hour, depending on the amount of detail desired and the nature of the target. The radio wave energy is reflected from surfaces where there is a contrast in the electrical properties of subsurface materials. These surfaces may be naturally occurring geologic horizons (e.g., soil layers, changes in moisture content, voids and fractures in bedrock) or manmade (e.g., buried utilities, tanks, drums). The reflected energy is processed and displayed on a continuous strip chart recording of distance versus time (i.e., where time can be thought of as proportional to depth).

The time required for the electromagnetic (EM) pulse to traverse the path down to and back from the reflecting medium is measured in nanoseconds (one nanosecond = $1x10^{-9}$ seconds). The two-way travel time is proportional to the depth of burial of the reflecting medium and is dependent on the dielectric properties of the medium through which the EM pulse travels. The dielectric properties of a medium are related to the moisture content and composition of a material. Figure 4-1 depicts the relationship between a single EM pulse generated by the controller and the resulting strip chart recording that would result from many such EM pulses.

The depth of penetration of a GPR system is highly site-specific, and depends on (1) the soil types at the site, (2) moisture conditions, and (3) the frequency of the antenna (i.e., lower frequencies penetrate deeper resulting in less resolution).

Instrumentation. The radar system consists of a control unit, an antenna assembly (i.e., transmitter/receiver), and a recording device for analog field recordings. A digital recording unit may also be present for further data processing after field activities are completed. The antenna transmits EM pulses of short duration into the ground. The pulses are reflected from geologic or manmade surfaces and are picked up by the receiver, which transmits the signals to the control unit for processing and display. Shallow objects appear near the top of the strip chart recording (i.e., less time elapsed between the outgoing pulse and the return of reflected energy), whereas deeper objects appear farther down the recording (i.e., more time elapsed). MACTEC generally uses a GSSI (Geophysical Survey Systems, Inc., North Salem, N.H.) SIR System III unit.

Methodology. GPR surveys are usually performed by establishing a grid of parallel lines across a site and towing the radar antenna along each of these survey lines, usually in the same direction. The spacing and orientation of the grid lines depends on the orientation, if any, of the target features and the required resolution, factors that will be specified in the site-specific Work Plan. For determination of geologic features or to detect large targets, surveys are typically performed with line spacing ranging from 5 to 20 ft, or greater.

The position of the antenna along the survey lines is annotated by vertical marks (i.e., "tick marks") placed on the instrument output by a device controlled by the operator. The tick marks correspond with distance along a cloth measuring tape, pin flags, or other physical markers at the site.

Data Evaluation. The propagation velocity of the EM pulse depends upon the relative dielectric permittivity of the material through which the pulse travels. The relative dielectric permittivity is a measure of the degree to which a medium can resist the flow of the EM pulse -- the higher the relative permittivity, the lower the resistance to flow, and vice versa. For most earth materials and rocks, the relative dielectric permittivity does not exceed 10 and is always greater than unity, the value for a vacuum. Table 4-2 gives typical permittivity values for commonly encountered materials. The dielectric permittivity is related to the propagation velocity by the formula:

$$e_r = (c/V_m)^2$$

where,

c	=	propagation velocity in free space ($3x10^8$ meters per second or approximately 1 ft per nanosecond)
V_m	=	the propagation velocity through a material.

It follows that

$$(e_r)^{½} = c/V_m \text{ or } 1/V_m = (e_r)^2/c$$

Since c is approximately equal to 1 ft/ns, then $1/V_m$ is approximately equal to $(e_r)^{½}$.

Final results are values of nanoseconds per ft (one-way travel time). These formulas give a method for estimating the propagation velocity for a medium; therefore, the depth to a reflecting horizon if the soil conditions are known. If soil conditions are unknown or their properties cannot be estimated accurately enough, a reflector of known depth can often be used to calibrate the GPR recordings to site conditions.

4.4.1.2 Magnetometry.

Magnetometry uses local variations in the earth's magnetic field to locate buried ferromagnetic objects such as drums, tanks, pipes, and cables. Typically a single 55-gallon drum can be detected at depths of up to 15 ft and large drum deposits or large tanks can be detected at depths of 65 ft or more assuming minimal magnetic interference in the vicinity of the target(s). Calculations of the mass or size of detected objects generally yield only approximate results.

Magnetic surveys are impractical in areas where metal pipes, fences, railroad tracks, metal buildings, and other ferrous metal artifacts are abundant. Proper selection of equipment and survey techniques can alleviate some of these problems.

Principles. All materials subjected to a magnetic field, including the magnetic field of the earth, will develop an induced magnetization, the intensity of which is proportional to the applied magnetic field and the magnetic susceptibility of the material. Ferromagnetic materials, such as iron or steel, have high magnetic susceptibilities.

Induced magnetization in an object produces a local magnetic field which either reinforces (i.e., positive magnetic susceptibility) or reduces (i.e., negative magnetic susceptibility) the external applied field. The variations in an otherwise uniform magnetic field caused by the presence of an object are called magnetic anomalies. Observations of such anomalies can be used to infer the presence of such objects.

In magnetometry, one measures local variations in the earth's magnetic field along a traverse or across an area on the surface. Because the intensity of the earth's magnetic field depends in part on the magnetic susceptibility of subsurface materials, a knowledge of variations in field intensity provides an indication of variations in the distribution of materials with different magnetic susceptibilities. In particular, magnetometry can detect the anomalies caused by buried ferromagnetic objects and other natural features which may be of interest in hydrogeologic site investigations.

Instrumentation. Magnetometer surveys will be conducted using a proton precession magnetometer with vertical gradiometer capability. A vertical gradiometer has a dual sensor mounted on a vertically oriented staff which simultaneously measures the total field at each sensor. The gradient is the difference between the values recorded at the upper and lower sensors divided by the distance between them, typically one-half of one meter. In a proton precession magnetometer, a strong magnetic field is applied to a proton-rich fluid (e.g., kerosene) which realigns the protons. The field is then turned off and the frequency of the signal generated by the protons as they realign themselves with the earth's magnetic field is dependent upon, and thus a measure of, the strength of the field at that point.

Methodology. Magnetic measurements are generally made along a grid pattern or in a series of parallel lines across the survey area. The spacing of the grid or lines depends on the size and depth of the objects sought and will be specified in the site-specific Work Plan. Because of the phenomena of temporal magnetic drift, a magnetic survey usually includes establishing a base station at which magnetic measurements are made at regular intervals. These measurements may later be used to correct all total field survey data for temporal differences due to drift and also act as a QA/QC check on the function of the instrument. Theoretically, it is not necessary to correct vertical gradient measurements for temporal drift because any variation affects the two sensors equally.

In the field, the operator should avoid any sources of high magnetic gradients such as power lines, buildings, and any large iron or steel objects. The operator should also avoid carrying any unnecessary metal articles.

Data evaluation. Field data are recorded in the instrument as a series of data blocks which can be transferred to a computer for processing and evaluation. Each data block contains the total field values for each sensor, the "X" and "Y" coordinates for the measurement are input by the user, the date and time, and several parameters that permit an evaluation of data quality. The total field values are recorded in gammas. The intensity of the earth's magnetic field is approximately 60,000 gammas at the poles and 30,000 gammas at the equator.

For typical manmade iron or steel objects, one may quantify the approximate depth of burial and the amount of metal that produces an observed magnetic anomaly. The intensity or size of the anomaly (I) can be expressed as:

$$I = M/r^n$$

where,

M	=	magnetic moment of the source
r	=	depth to the source and,
n	=	is a measure of the rate of decay with distance, n = 3 for a dipole source and 2 for a monopole source.

Assuming a dipole source, the weight of a metal object in pounds, can be expressed as:

$$(Ir^3)/M$$

where,

M	=	magnetic moment per pound of iron, varying from approximately 175 to 1,750
r	=	depth in ft below the sensor
I	=	anomaly amplitude in gammas.

4.4.1.3 Terrain Conductivity.

TC surveys use measurements of the electrical conductivity of a hydrogeologic section to (1) characterize the conductivity of subsurface materials, (2) delineate the extent of contaminant plumes with high concentrations of dissolved electrolytes, and (3) map large concentrations of buried wastes with a degree of saturation, containerization, or inherent electrical properties distinct from the surrounding soil matrix.

Principles. The instrumentation consists of a transmitter and receiver. When a measurement is made, the transmitter is energized by an alternating current that produces a magnetic field, designated as the primary field, H_p. This artificial magnetic field induces small electric currents to flow in the earth which, in turn, produce a secondary magnetic field, H_s, which is made up of two components, quadrature and in-phase components.

The secondary magnetic field is related to the transmitter/receiver separation and to the operating frequency of the transmitter, both of which are selected by the operator. The ratio of the quadrature phase of the secondary field to the primary field (H_s/H_p) is linearly proportional to the TC under most conditions. This ratio is measured by the receiver and converted into conductivity values in units of milliohms per meter.

Field measurements may be recorded on a digital data logger, which is capable of recording simultaneously both the quadrature phase and in-phase components of the induced magnetic field. The quadrature phase component gives the ground conductivity value in milliohms per meter. The in-phase component is more sensitive to metallic objects and hence is useful for looking for buried tanks and drums. Data from the in-phase component may be thought of as being equivalent to a metal detector survey.

Instrumentation. Three instruments are available for EM surveying: an EM-31 or EM 34-3, EM-61, all manufactured by Geonics, Ltd., of Mississauga, Ontario. These instruments are rapid-reconnaissance exploration tools used to assess the conductivity values for soil, rock, and waste materials.

The most commonly used instrument, the Geonics EM-31, is a single-piece model operable by one person, with a fixed coil spacing of 12 ft. This provides an effective sampling depth of up to 18 ft. The Geonics EM 34-3 is a dual coil model, operable by two people, with variable coil spacings of 33, 66, and 321 ft. This provides for an effective sampling depth of up to nearly 200 ft. Each instrument can be used in either the horizontal dipole or vertical dipole mode. Selection of the operational dipole mode depends on the depth of sampling desired and the desired sensitivity of the instrument to materials at various depths, relative to the transmitter-receiver coil separation. The EM-61 is a time domain metal detector which detects both ferrous and non-ferrous materials.

Methodology. TC surveys are generally conducted on a grid system of parallel lines across the site area. Measurements are taken at grid points. The spacing of the lines depends on the resolution required and will be specified in the site-specific Work Plan. At each grid point the meter reading is recorded and the apparatus is moved to the next site grid location.

For the dual coil method (Model EM-34), the selected inter-coil spacing must be achieved prior to recording the data. In addition, the two coils must be coplanar. In the horizontal dipole mode, the coils are oriented vertically, where as in the vertical dipole mode, the coils are oriented horizontally.

Data Evaluation. Although it is difficult to define the thickness and "true" conductivity of individual subsurface layers, the instrument measures very precisely the "apparent" conductivity of a volume of underlying earth materials. The apparent conductivity value is made up of the sum of the contributions from each layer that is "sampled" by the transmitter-receiver array. The volume, therefore the depth, of earth materials sampled increases with increasing separation between the transmitter and receiver.

A comparison of the relative responses for vertical and horizontal dipoles is illustrated in Figure 4-2. The vertical axis describes the relative contribution to the secondary magnetic field, arising from a thin layer at a given depth, z. The horizontal axis shows how this response varies as a function of the ratio (z/s), where "z" is the depth of the thin layer described previously and "s" is the transmitter/receiver separation.

As illustrated in Figure 4-2, in the vertical dipole mode, the contribution to the secondary magnetic field from near-surface materials is very small but reaches a maximum at a depth "z" of approximately

0.4. The contribution is significant, although diminished, at a depth of 1.5. This depth represents the effective depth of exploration in the vertical dipole mode.

In the horizontal dipole mode, the contribution to the secondary magnetic field arising from near-surface materials is a maximum and decreases with increased depth. The contribution is also significant at a depth of about 0.75s. This depth represents the effective depth of exploration in the horizontal dipole mode.

4.4.2 Test Pits

Test pits or trenches are designed to allow exploration of subsurface contamination and the nature of near-surface soils. The locations of test pits will be planned in advance and rationale presented in the site-specific Work Plan, with provisions for the field geologist to modify plans in response to unanticipated site conditions. Test pitting will be conducted at the levels of personal protection specified in the site-specific HASP.

Test pits will be excavated using a backhoe. The field geologist will record the following information on the Test Pit Record (see Figure 4-3) and in the field logbook:

- site name and location;
- names of contractor, backhoe operator, and sampler;
- date and time of excavation;
- depth, width, length, and orientation of trench;
- sample number, depth, and type for all samples;
- approximate water level, after stabilization;
- soil description;
- results of any field screening;
- list of any photographs taken;

- date and type of backfill; and
- any other pertinent observations (staining, odor, etc.).

Test pit samples will be collected from the middle of the backhoe bucket, without requiring the field geologist to enter the excavation. Samples will be collected using the following procedures:

1. Excavate to the dimensions required by the field geologist.
2. Test pit excavation may be terminated due to groundwater seepage into the excavation or encountering obstructions, utility lines, or waste containers. Depending on the conditions encountered, it may be possible to continue excavating more slowly and carefully, rather than to terminate the exploration.
3. The backhoe operator will remove the material from the test pit, under the direction of the field geologist, and deposit excavated soil on plastic sheets in order to minimize contamination of surface soils.
4. When the bucket is brought to the surface, the contents will be screened for VOCs with a PID and examined for visible signs of contamination.
5. Samples will be obtained from the middle of the bucket and placed in the appropriate jars using a clean stainless steel trowel or spatula. Samples may also be collected from the test pit walls by using an extendable hand tool.
6. Excavated soils will be back-filled into the excavation and tapped down into place with the backhoe bucket.

Sample containers will be checked for complete and accurate labeling and COC procedures will be initiated.

The test-pitting subcontractor will decontaminate his backhoe bucket between excavations following the procedures described in Subsection 4.3.1.

4.4.3 Exploratory Drilling

A geologist will be present during the drilling of borings and installation of monitoring wells. The geologist will maintain drilling logs and collect appropriate samples. Soil borings will be described on the soil boring log (Figure 4.4) and bedrock coring will be described on the Rock Coring Log form (Figure 4.5). Soils will be described using the Unified Soil Classification System (USCS) (Figure 4.6). A qualified drilling subcontractor will supply the necessary type and number of drilling rigs capable of performing drilling techniques appropriate for the existing subsurface conditions. The boring methods employed at a given site are selected based on known subsurface conditions. MACTEC has prepared detailed drilling specifications that govern the drilling subcontractor's effort. These specifications are modified and issued on a site-specific basis to reflect the needs of each project.

4.4.3.1 Auger Borings

One of the most commonly used drilling methods use of hollow-stem augers (HSA), utilizing coupled lengths of continuous flight augers to bring cuttings upward as the auger string is rotated and advanced into the ground. MACTEC routinely specifies 4.25-inch inside diameter (ID) HSA drilling at sites where overburden is composed of sand or silt, and cobbles, boulders, or rubble are not expected to be encountered. The hollow-stem allows for collection ahead of the augers using a split-spoon sampler or other device, and is large enough for installation of 2-inch ID monitoring wells inside the annular space of the casing. Auger sections are usually 5 ft in length and are attached directly to each other with bolts or with bolted collars. During drilling, the open end of the auger can be blocked as it advances to prevent soil from entering the hollow stem. No drilling fluids are used under normal circumstances. More commonly, the soil is allowed to pack into the open end a few inches. After the auger is advanced to the desired sampling level, the sampling tool is inserted through the hollow stem and driven. Techniques for subsurface soil sampling are presented in Subsection 4.5.1.1.

The advantages of the HSA technique include:

- simplicity of procedure;
- low risk of personnel exposure;
- can be used to obtain soil samples from a wide range of subsurface conditions;
- drilling fluids are generally not required; and
- availability of equipment.

The disadvantages of the HSA technique are:

- difficulty in penetrating excessively cobbled or bouldered soils; and
- difficulty in sampling granular soil below the water table since, without drill fluids, there is no practical means to maintain hydrostatic equilibrium in the borehole. When the plug is withdrawn, water and sediment from outside the augers may enter the borehole, potentially causing contamination and difficulty in sampling undisturbed soil below the bottom of the augers.

4.4.3.2 Drive and Wash Drilling Method.

This method, which will be approved prior to use by the NYSDEC PM, involves advancing casing, as required, and washing-out the soil to the bottom of the casing with a chopping bit to the desired sampling depth. The casing can be advanced by either spinning or hammering (pounding) the casing with a 300-pound hammer. The borehole may be stabilized with the casing, water, or drilling mud, and open samplers, such as the split-or solid-spoon type are driven into the undisturbed soil at the bottom of the borehole.

Drive and wash is most commonly used in soils which do not contain large cobbles and boulders, or cemented horizons. The wash boring method involves the introduction of drilling water and/or drilling mud to the borehole. The use of these materials and this method is not preferred in environmental investigations since the introduction of drilling fluids can alter the chemical composition of the groundwater adjacent to the borehole, and may have an adverse effect on groundwater quality analyses on groundwater samples from monitoring wells installed in the completed borehole. If it is necessary to use this technique to advance a borehole, the field geologist should determine the source and quality of the drilling water to be used in the boring process. The field geologist should not authorize the use of on-site or nearby groundwater or surface water bodies as the source of the drilling water, unless the proposed source has been sampled and analyzed for the full suite of contaminants considered likely to be present in the groundwater beneath the site. In all cases where drilling water or drilling mud are used to advance a borehole, the field geologist should consider obtaining a sample of the drilling fluid for potential analysis, at the discretion of the PM and QAM.

Records of each exploration shall be made on the Test Boring Log (Figure 4-4) and in a field logbook.

4.4.3.3 Cased Borings

In washed casing methods (driven or spun), the boring is advanced by first driving or spinning the casing (i.e., smooth sided, threaded, flush joint pipe) into the soil to the desired depth and then clearing out to a maximum depth of three inches below the bottom of the casing using a rollerbit and rod through which water is pumped as the bit is advanced. Where driven casing is used, the lead casing is equipped with a bit called the drive shoe. Spun casing uses a spin shoe. MACTEC commonly specifies 4-inch ID washed casing in tight, heavy soils such as clay, soil containing cobbles, boulders, or rubble through which augers could not be advanced, or in borings that are planned to be advanced through the overburden into bedrock.

Driven casing is advanced using the blows of a 300-pound hammer falling 24-inches. Hammer blows are recorded for each 12 inches of penetration. In cohesive soils, the inner bit may be advanced further than 3-inches ahead of the casing, and then the casing advanced. During washing of the casing and advance of the roller bit and rod, water will not be recirculated, to prevent cross-contamination unless specified in the site-specific Work Plan. Management and disposal of the wash water and soil cuttings will be in accordance with Subsection 4.9 or specified in the site-specific Work Plan. As washed borings are advanced, special care shall be taken to note and record the depth where drilling fluid is lost if this occurs, the depth of an apparent change in soil type, consistency, or color, as can be detected practically while advancing the boring, or other details about the progress of the boring.

The advantages of this drilling technique are:

- simplicity of procedure;
- low risk of personnel exposure;
- can be used to obtain soil samples from a wide range of subsurface conditions;
- can be used to obtain samples from depths greater than 100 ft; and
- availability of equipment.

The disadvantages of cased borings arise from the need to use a drilling fluid. When sampling pervious soils, drilling fluids can permeate ahead of the casing. This can result in contamination of the underlying pervious soils if drilling fluids are recirculated.

4.4.3.4 Rotary Technique.

This method is a variation of the wash boring technique, utilizing a rotary drill bit, rather than a chopping bit. It is employed primarily in advancing and cleaning the borehole to the required sampling depth, and is used in conjunction with air, water, or mud to bring the cuttings to the ground surface. This is the method generally preferred for exploratory test borings in the geo-technical consulting industry. This method is commonly used in environmental investigations when test borings are expected to encounter dense tills and coarse granular deposits (such as gravels), or are expected to terminate at depths exceeding thirty ft below the ground surface.

The primary disadvantage of this technique for environmental investigations is the introduction of drilling water or drilling mud. The use of air rotary drilling rigs is usually not appropriate for environmental investigations unless filters are used because the cuttings brought to the ground surface are ejected into the air adjacent to the drilling rig.

4.4.3.5 Rock Coring

Some rock core drilling may be required to complete monitoring well installations at specific sites. Bedrock drilling will be conducted with 4.0-inch ID flush joint casing. Continuous rock core will be collected using H rock coring equipment. The H rock coring device consists of a diamond drilling bit and core tube with inner core barrel. After a length of core drilling is complete, the core barrel is retrieved from the borehole. The core is extruded directly into wooden core boxes for description and storage.

The field geologist will take custody of the rock core after it is extruded from the core barrel. The length of rock core will be described using the procedures outlined below and recorded on the Rock Coring Log (Figure 4-5) and in the field logbook.

1. Scan the core with a PID and record any measurements.
2. Determine the percent recovery from measurement of length of core retrieved versus the length of drill bit advancement (i.e., the core run).
3. Visually examine the core and record its characteristics (including: lithology, petrography, color (wet), layering, fracture spacing, joints, presence of fossils, and visual evidence of possible contamination.
4. Determine rock quality data (RQD). RQD is determined as the total length of rock core segments greater than four inches in length versus the total length of drill bit advancement. RQD is calculated in percent.

4.4.3.6 GeoProbe®/Direct-push Sampling.

A direct-push sampling system may be used to conduct soil, groundwater, and soil vapor sampling surveys. This technology provides screening information that can be used to optimize the future location of soil borings and monitoring well installations and to assess contamination in the vadose zone and saturated overburden. The direct-push explorations shall be completed by a qualified direct-push subcontractor, and directed by a qualified field person. Collection of associated samples is outlined in following Sections.

Direct-Push drilling technique consist of a hydraulic ram unit, usually mounted on a small vehicle (ATV, cargo van, or pick-up truck) that advances small diameter drill rods to obtain overburden soil or groundwater samples or install piezometers. Advantages in environmental investigations include low cost, maneuverability and access to irregular terrain, minimization of investigation derived wastes. Disadvantages include depth limitations and small sample volumes.

The direct push device may employ either dual tube methodology which allows the collection of subsurface soil samples through an outer casing that is set to maintain the integrity of the boring or single-rod method that collects soil into a sleeve liner (e.g., macrocore) within the lead rod.

In the dual-tube method borings are advanced by simultaneously driving an outer stainless steel casing and inner Lexan® tube into the ground. Upon reaching the desired penetration depth, the inner Lexan® tube is extracted to collect the discrete subsurface soil samples, leaving the outer casing in place. To sample the next interval of soil, a new length of Lexan® tubing is then inserted into the outer casing (already in the ground) attached to a length of drive pipe, and another length of outer casing is attached to the top of the outer casing that is already in the ground.

In the single-rod method, ¾-inch diameter rods are advanced in 4-ft sections. The lead section is fitted with an inner polyethylene sleeve. When the top of the desired sampling interval is reached, a tool is used to unlock the drive point and the rod is driven ahead to obtain the soil sample. The entire drill rod is retrieved and the liner removed for characterization. The process is then repeated to collect the next desired sample.

The following materials will be available, as required, during the subsurface soil sampling:

- Health and safety equipment;
- Direct push sampling equipment;
- decontamination equipment as specified in the QAPP;
- Stainless steel trowels or spatulas;
- Aluminum Foil;
- Paper Towels;
- Measuring device;
- Appropriate sample containers and forms, and personal protective equipment (PPE);
- PID;
- Acetate field knife (if liner sleeves are used to collect the soil samples);
- Field notebook.

The following procedures will be employed to collect subsurface soil samples:

1. Identify sample locations from the Work and note the locations in field notebook by obtaining ties to physical features.
2. Don the appropriate PPE.
3. Set up an equipment cleaning station, and decontaminate equipment as described in the QAPP. Use new, clean materials when decontamination is not appropriate (e.g., disposable gloves and dedicated drive points). Document the decontamination procedure in the field notebook.
4. Assemble the appropriate direct-push sampling apparatus or other direct push tool.
5. Drive the sampling tools to the appropriate sampling zone and collect a sample base on the type of direct-push method being used.

6. Retrieve the sample.
7. Screen for VOCs using the PID. Collect the needed soils for laboratory analysis per requirements of the Work Plan. Measure and describe the sample lithology on the boring log (Figure 4.4) using the USCS (Figure 4.6).
8. Evaluate the sample for the presence of visible non-aqueous phase liquid (NAPL). Document samples interpreted to contain visible NAPL with photograph, and record observations in field notebook.
9. Decontaminate non-disposable equipment or tools that may have come into contact with subsurface soil in accordance with the QAPP.
10. Discard all disposable equipment used during sampling activities in a designated location.
11. Record all other appropriate information in the field notebook.
12. Identify the next sequential boring location, move to that location and return to step 2.

Records of each exploration shall be made on a Soil Boring Log (Figure 4.4) and in the field logbook.

4.4.4 Monitoring Well/Piezometer Installation.

The objectives for each monitoring well and/or piezometer may vary from site to site and from well to well. The objectives will be clearly defined in the site-specific Work Plan before the monitoring system is designed. Monitoring wells serving different purposes require different types of construction. The objectives for installing monitoring wells may include:

- determining groundwater flow direction and velocity;
- sampling or monitoring for contaminants;
- determining aquifer characteristics (e.g., hydraulic conductivity (K) testing); and
- performing site remediation (e.g., injection or recovery wells).

In cases where only groundwater flow or velocities are to be determined, piezometers, cluster wells, or well points may be used.

Well Materials. Well riser pipe materials are specified by diameter, type of materials, and thickness of pipe. Well screens require an additional specification of slot size. Well specifications will be presented in the site-specific Work Plan and/or QAPjP.

The selection of well material depends on the method of drilling, the type of contamination expected, natural water quality, and anticipated depth. Cost may also be a consideration. The two most-commonly used materials are polyvinyl chloride (PVC) and stainless steel. PVC is generally preferred to stainless steel because it is light-weight, less expensive, non-corrosive, and generally easier to work with. However, PVC may deteriorate in the presence of ketones, aromatics, alkyl sulfides, and some chlorinated hydrocarbons. In such cases stainless steel may be preferred.

When the aquifer is bedrock, a well screen may not be necessary; the well is simply an open hole in bedrock. Unconsolidated materials such as sands, clay, and silts, require a well screen. The screen slot size should be selected to retain 90 percent of the filter pack material or in-situ aquifer material, after development (Driscoll, 1989). The gradation of the filter pack material will be selected based on the gradation of the native soils within the screened interval. A screen slot size of 0.010-inches is generally used when a screen is necessary and site conditions are not known.

The thickness of pipe depends on the strength required for the well. In general, larger diameter pipe requires greater thickness to maintain adequate strength. Similarly, driven well points require greater strength, and therefore greater thickness, than wells installed inside drilled borings.

Well Design. The well depth and diameter are tailored to the specific monitoring needs of each site and generally depends on the purpose of the monitoring system and the geologic setting. The decision concerning the depth of placement and length of the well screen is based on the following information:

- aquifer depth, thickness, and characteristics (e.g., permeability and specific yield);
- anticipated depth, thickness, and characteristics (e.g., density relative to water) of the

contaminant plume;

- head distribution and estimated flow in the aquifer; and
- fluctuation in groundwater levels.

In most situations, screen lengths are 5 to 10 ft.

Standard well IDs are 2, 4, 6, or 8 inches. For most groundwater monitoring and sampling programs, a 2-inch ID well is preferred. Pumping tests for determining aquifer characteristics may require larger diameter wells; however, in situ K testing can be performed during drilling or after well installation in small diameter wells. Other considerations in selecting well diameters include the types and size of the sampling equipment, and any in situ instrumentation that may be used in the well. In general, the borehole diameter should be at least 4 inches larger than the well riser pipe diameter to provide an annular space of at least 2 inches for placement of filter pack, seal, and grout or backfill.

Well Installation. Monitoring well installation details will be recorded in the field logbook and on an Overburden or Bedrock Monitoring Well Construction Diagram (Figures 4-7 and 4-8).

Materials placed in the annular space between the borehole and the riser includes filter pack, bentonite seal, and grout. In general, all of these materials may be installed using a tremie pipe placed in the annular space. In shallow wells, these materials may be emplaced from the ground surface, but the rationale and procedures must be described in the site-specific Work Plan and/or site-specific QAPjP.

The filter pack is usually a fine to medium uniform sand. The exact filter pack gradation should be chosen to retain approximately 60 percent of the aquifer material after well development (Driscoll, 1989). The filter pack is installed around the well screen and extending 2 to 3 ft above the top of the screen. At least 2 ft of bentonite pellets will be placed above the filter pack.

The bentonite expands by absorbing water and serves to isolate the screened interval from the rest of the annular space and the formation. If the bentonite seal is above the water table, care must be taken to adequately hydrate the pellets before proceeding with well construction. If the seal is below the water table the bentonite slurry may be tremied into place.

Grout is placed from the top of the bentonite to the ground surface. Grout generally consists of a cement-bentonite mixture or Portland cement. The grout minimize the possibility of surface run-off reaching the screened interval and replaces material removed from the boring during drilling thereby minimizing hole collapse and subsidence around the well.

In certain cases, the borehole may be drilled to a depth greater than the well installation depth. For these cases, the well is backfilled to the desired depth with bentonite and sand is placed between the bottom of the well and the bentonite.

Well sections and all materials coming in contact with the well must be cleaned before installation. The screen and well-riser pipe can be placed in the boring either manually or using the rig to hold the pipe, depending on the weight of the well. The pipe is lowered and sections added until desired screen depth is reached. No glues or solvent-cement will be used in well construction monitoring wells. When the screen and riser are in place, the filter pack, bentonite seal, and grout are installed using tremie pipes. The well is completed with a vented PVC cap.

When the well is completed and grouted to the surface, a protective steel casing is often placed over the top of the well. This casing generally has a hinged cap and must be able to be locked to prevent vandalism. The protective casing is larger in diameter than the well and is set over the well into the wet grout or is concreted in place. Protective casings can be above ground or flush-mounted. Above ground protective casings will have weep holes to allow drainage. Special care must be taken with flush-mounted installations to ensure that surface drainage does not enter the well. The protective casing and surface cement should extend below the frost line to prevent heaving.

Well Development. Well development is a process of pumping or purging a new monitoring well, designed to stabilize and increase the permeability of the filter pack around the well screen and to restore the permeability of the formation which may have been reduced by drilling operations. The selection of the well development method will be made by the site hydrogeologist based on the drilling methods, well construction and installation details, and the site geology. Monitoring wells should be allowed to set for a minimum of 24 hours before well development to allow for the seal and grout to set (NYSDEC, 1988). Any equipment introduced into the well will be decontaminated in accordance with the procedures presented in the HASP. Water levels will be taken from each well before and after development. To avoid aeration of the filter pack, the water level will not be allowed, to the extent feasible, to fall below the top of the filter pack during development.

Well development may be accomplished using one of several methods including:

- Overpumping, which uses a pump (e.g., submersible or peristaltic) or compressed air (i.e., air lift) to remove water from the well.
- Surge block which uses a plunger, the approximate diameter of the well, to agitate water in and out of the screen. No water is removed from the well.
- Compressed air which develops a well by either backwashing (i.e., forcing water out of the well and reducing pressure to let water flow back in) or surging (i.e., releasing a large volume of air suddenly into an open well below the water table producing a strong surge due to resistance of water head, friction, and inertia). Water is pumped from the well using airlift.

Well development will continue until the turbidity of the discharge water is 50 nephelometric turbidity units (NTUs) or less. Field measurements of turbidity, temperature, pH, and specific conductivity will be recorded for each well volume removed. If the turbidity of the development water is not less than 50 NTUs within a reasonable amount of time, 2 to 3 hours or as specified in the site-specific Work Plan, field personnel will provide the field data to the Field Operations Leader (FOL) or PM who will contact the NYSDEC PM for guidance on how to proceed. An average of two weeks should be allowed between development and subsequent sampling or water level measurements to allow the aquifer to re-equilibrate.

Well development will be documented in the field notebook and on the Well Development Record (Figure 4-9).

4.5 SAMPLING TECHNIQUES

The rationale for each sampling site location will be identified in the site-specific Work Plan. For meaningful evaluation of the sample analytical results, it is important that the actual location of the samples be properly documented. If possible, sampling sites will be marked in the field with stakes or flagging. All sampling site locations will be referenced on a base map and on sampling records.

The location and distribution of contaminants at a given site are a function of many factors, including but not limited to:

- site operation or waste disposal practices;
- site design;
- site closure;
- waste characteristics;
- site topography and surface drainage;
- climate; and
- site hydrogeology.

The development of a sampling program requires consideration of the factors listed above and the scope and objectives of the project. Development of a sampling plan to evaluate the distribution and magnitude of contamination at a specific site requires at a minimum:

- an assessment of the site conditions;
- evaluation of the methodology and results of any previous sampling and analysis programs which may have been completed at the site; and
- definition of the scope and objectives of the project.

The techniques described herein are those normally employed by MACTEC. They have been selected to provide a practical and efficient means of obtaining samples in a manner consistent with safety protocols and QA/QC requirements. Additionally, they employ equipment that is normally available for use.

All samples collected will be logged in the field at the time of sampling by the field geologist.

At the time samples are obtained, the following must be recorded by the sampler in the field logbook and/or on sample data sheets:

- sample site location (e.g., grid coordinates baseline station and offset, or the location plotted on a map or aerial photograph);
- sample type;
- date and time of sampling;
- project and sample designations;
- sample identification; and
- analyses requested.

For laboratory samples, the sampler must initiate COC procedures and describe the sample site in adequate detail to allow the analytical results to be properly interpreted and, if necessary, to allow collection of additional samples from the same sample location. MACTEC uses labels and standardized record forms to expedite this process and ensure uniformity of records. The sampling protocols and recordkeeping requirements for the types of samples described in the following pages vary according to the sampling techniques. Additional requirements may also be established on a site-specific basis.

4.5.1 GeoProbe® Sampling

A GeoProbe® sampling rig may be used at the site to collect soil, groundwater, or soil vapor samples. The project objectives and DQOs for the GeoProbe® sampling will be described in the project-specific Work Plans.

4.5.1.1 GeoProbe® Subsurface Soil Sampling.

The qualified field person shall collect soil samples for physical and analytical testing and geologic classification during completion of soil borings and direct push explorations. The soil samples shall be collected from pre-determined sampling intervals or, whenever subsurface conditions warrant. The latter condition shall be determined by the qualified field person.

The samples for laboratory analysis shall be collected using a split-spoon (soil borings) or sampling probe with disposable acrylic liner (direct push). The collection of the samples shall be in accordance with the following procedures:

1. Remove the rods and sampler from the borehole/exploration. Open the sampler by unscrewing the cutting shoe and retrieve the liner containing the soil sample. In the case of direct push explorations cut open the acetate liner. Recovered soils contained in the sampler shall be characterized using the USCS, as described previously.
2. Scan the soil sample with a PID and record measurements.
3. Collect sample for chemical analysis as described for Surface Soil Sampling.
4. Decontaminate the sampling device.
5. Record the boring lithology on a Soil Boring Log (Figure 4-4).

Information regarding sample location, depth, and character shall be recorded on the Soil Boring Log (Figure 4.4).

4.5.1.2 GeoProbe® Groundwater Sampling.

A direct-push sampling system (e.g., Geoprobe® or equivalent) may be used to obtain discrete groundwater grab samples.

A direct-push system advances a steel probe assembly to the desired depth. Groundwater samples are collected by allowing formation water to flow into a slotted probe tip or wire rapped stainless steel screen. Water within the probe is purged and sampled from inside the rod assembly using small-diameter tubing and a low-flow rate sampling pump, or a small-diameter bailer. The collection of groundwater grab samples via the direct-push method is dependent on sufficient saturated thickness of overburden soils and an adequate rate of inflow through the probe tip.

Sequential (vertical profile) sampling may be performed by driving the probe assembly to a predetermined depth and collecting a sample. Following sample collection, an additional section of riser is connected, and the sampling device is driven to the next sampling interval, where another sample is collected. Non-dedicated pumps and tubing shall be decontaminated and dedicated tubing shall be discarded between sample collection intervals.

A groundwater grab sample also may be collected from a small-diameter well that has been installed in a direct-push boring.

Groundwater sample collection data shall be recorded on the Groundwater Grab Sample Field Record log sheet (Figure 4-10) and in the field logbook.

4.5.1.3 GeoProbe® Soil Vapor Sampling.

Soil vapor samples will be collected using a GeoProbe® sampling device to evaluate the potential vapor migration of contaminants from the groundwater. Field data and observations will be recorded on the Geoprobe Soil Vapor Sampling Record (Figure 4.11).

The Geoprobe® rods will be pushed to the desired sampling depth (expected to be below the rain infiltration line, but above the water table fringe zone). Soil vapor collected just above the water table will give an indication of the possible vapor migration from potentially contaminated groundwater.

<u>Procedure for GeoProbe® Soil Vapor Sample Collection</u>

Soil vapor samples will be collected from the Geoprobe® points using either the Geoprobe® PRT system, or through open Geoprobe® rods. To sample through the open rods, the rods are pushed down to the target depth and then pulled back slightly, allowing a disposable point to drop off the bottom and expose the bottom of the open (hollow) rods to the soil. The rods will be sealed with O-rings at the joints and have a 1/4-inch tubing attached to the top for vapor purging and sample collection. To sample with the Geoprobe® PRT system, a specialized point is attached to the end of the Geoprobe® rods. The PRT point is also exposed to the soil by allowing a disposable tip to drop off the bottom of the rods when the rods are backed out slightly. This PRT point allows a ¼-inch tubing to be threaded directly to the bottom of the rods, for a small discrete sample point. The tubing is run to the surface and connected directly to the sample collection device. In addition, for both techniques the outside of the rods will be sealed at the ground surface with pre-hydrated bentonite. Approximately 1 liter of soil vapor, plus the volume of the tubing or rods, will be purged using a personal air monitoring pump before collecting samples. During the soil vapor purge, vapors will be screened with a PID. In addition, helium leak tests will be conducted on a subset of samples to ensure samples are representative of sub-surface conditions and not outdoor ambient air. Helium leak tests will be conducted by encapsulating the sample point (such as with a bucket sealed to the ground surface with bentonite), while allowing the tubing to be purged from outside the encapsulated area. The encapsulated area will be filled with helium, but care will be taken not to pressurize the enclosure. The soil vapor sample port will be tested for helium breakthrough with a portable monitoring device (such as the Radiodetection MGD-2002 Multi-Gas Locator) both before and after collection of the soil vapor sample. If greater than 10 percent of the tracer gas is detected in the screening sample, the sample point seal will be enhanced and the procedure repeated. Soil vapor samples will be collected with either 1.4-liter SUMMA®-type canisters with flow valves (set to approximately 20 minutes per sample), or with Tedlar bags (Tedlar bags may be filled using either a Vac-U-Chamber®, or with a syringe with a three way valve).

<u>SUMMA® canister sample collection</u>

- Place SUMMA® canister adjacent to the temporary sampling port.
- Record SUMMA® canister serial number on sampling summary form and COC.
- Record sample identification on canister identification tag, and record on sampling summary form and COC.
- Remove plastic cap canister fitting.
- Open and close canister valve.
- Record gauge pressure on sample summary form and COC. Gauge pressure must read >25 inches Mercury (Hg). Replace SUMMA® canister if gauge pressure reads <25 inches Hg.
- Connect canister to silastic tubing already connected to the subsurface probe.
- Open canister valve and in-line stainless steel valve to initiate sample collection.
- Record date and local time (20-minute basis) of valve opening on sampling summary form and COC.
- Take digital photograph of SUMMA® canister and surrounding area.
- Upon completion of 20 minute sample collection, record gauge pressure on sampling form and COC.
- Record date and local time (20 minute basis) of valve closing on sampling form and COC.

- Close canister valve.
- Disconnect silastic tubing and recap pressure gauge.
- Remove SUMMA® canister from sample collection area.
- Remove temporary probe from hole. Fill hole with a quick drying hydraulic cement.

Tedlar bag sample collection using Vac-U-Chamber®

The sampling line will be connected to a Vac-U-Chamber® Tedlar bag sampling box containing a one liter Tedlar sample bag. The external pump is then connected to the purge port and the soil vapor sampling probe will be purged for two minutes prior to sample collection. After purging the system, the external pump is connected to the vacuum port and the Tedlar bag is allowed to inflate. Upon complete inflation of the Tedlar bag, as observed through the Vac-U-Chamber® viewing window, the Tedlar bag valve is closed and the sample is labeled with the unique sampling location identification code. Upon completion of sampling, the rods and slotted screen are removed from the vapor point and decontaminated. For QC purposes, one duplicate sample will be collected for every twenty sample locations. If QC samples are collected, the duplicate sample will be collected by inserting a tee connector in the sampling line and filling two Tedlar bags from one probe at the same time.

Tedlar bag sample collection using syringe with a three way valve

The sampling line will be connected to the bottom port of a three way valve system. A 60 to 100 milliliter (ml) syringe is then connected to the top purge port. The sampling line valve and the purge port are opened and the syringe is filled. The sampling line valve is then closed and the side port is opened. The syringe is this emptied and the side port is closed. A one liter Tedlar sample bag is connected to the three way valve side port. The sampling line valve and the purge port are opened and the syringe is filled again. The sampling line valve is then closed and the side port is opened. The contents of the syringe are then purged into the Tedlar bag. This process is continued until the Tedlar bag has been filled.

4.5.2 General Soil Sampling Methodology

Development of a soil/sediment sampling plan to evaluate the distribution and magnitude of contamination at a specific site requires at a minimum:

- an assessment of the site conditions;
- evaluation of the methodology and results of any previous sampling and analysis programs which may have been completed at the site; and
- definition of the scope and objectives of the project.

A number of techniques have been developed to obtain samples from various depths below the ground surface. The techniques described herein are those normally employed by MACTEC. They have been selected to provide a practical and efficient means of obtaining samples in a manner consistent with safety protocols and QA/QC requirements. Additionally, they employ equipment that is normally available for use.

The selection of sampling techniques to be employed at a given site is based upon the depth from which samples must be obtained, the types of exploration, and/or the nature of the soils to be sampled. The sampling techniques are categorized by the depths or the types of explorations from which they are obtained:

- surface soil samples, from depths of less than 6 inches (or at depths designated in the project Work Plan;
- subsurface soil samples from test borings and GeoProbe® explorations at variable depths; and
- sediment samples from depths of less than 6 inches (see Subsection 4.5.4).

All soil samples collected will be logged in the field at the time of sampling by the field geologist. Soils shall be classified in accordance with the USCS, Figure 4-6. Soil samples will be described fully on the appropriate sampling logs (Figure 4-12).

At the time samples are obtained, the following must be recorded by the sampler in the field logbook and/or on sample data sheets (Figure 4-12):

- sample site location (e.g., grid coordinates baseline station and offset, or the location plotted on a map or aerial photograph);
- sample type and depth;
- date and time of sampling;
- project and sample designations;
- sample identification; and
- analyses requested.

For laboratory samples, the sampler must initiate COC procedures and describe the sample site in adequate detail to allow the analytical results to be properly interpreted and, if necessary, to allow collection of additional samples from the same sample location. MACTEC uses labels and standardized record forms to expedite this process and ensure uniformity of records. The sampling protocols and recordkeeping requirements for the types of samples described in the following pages vary according to the sampling techniques. Additional requirements may also be established on a site-specific basis.

4.5.2.1 Surface Soil Sampling.

Shallow soil sampling provides samples of surface and near surface soils suitable for chemical analysis. Shallow soil samples are usually obtained by using one of the following devices:

- split-spoon sampler

- hand auger or corer
- trowel or spoon
- spade
- Geoprobe®

The split-spoon sampler is described in detail in Subsection 4.5.1.1. Two distinct types of hand augers are available: a cup-type auger and a screw-type auger. Use of either device is generally limited to the upper portion of the soil profile (i.e., less than 5 ft). These augers are best suited for obtaining composite samples from relatively shallow depths and in relatively loose soils. Use of trowels or spades is straightforward but usually limited to sampling very shallow depths (i.e., less than 18 inches).

Soil samples can be either grab or composite, depending on the objective of the sampling program described in the project-specific Work Plan. In grab sampling, the soil jar is filled directly. In composite sampling, several methods are available:

- Samples can be composited over depth at a single location.
- Samples can be composited laterally, in which one sample comprises several, usually three or four, soil specimens from the same depth in the vicinity of the sampling site.

During composite sampling, several depths or locations are selected and a stainless steel bucket is filled with samples from all locations. The material is then mixed and put into appropriate containers. Samples for VOCs are not mixed. A specific location is chosen and the sample is placed immediately in the appropriate containers with as little agitation or disturbance as possible.

Immediately after taking a sample, COC procedures are initiated and the Surface Soil Sample Data Record (Figure 4-12) is completed. Information recorded on the FDR will include the sample type, depth, date, time and sample identification. Any special observations (staining, odor, etc.) will also be recorded in the "Notes" portion of the FDR.

4.5.2.2 Subsurface Soil Sampling.

Sampling during soil boring allows collection of soil samples from depths greater than 5 ft below ground surface. Borings are advanced using a variety of methods including HSA, drive-and-wash casing, or spun-and-wash casing methods. The boring method chosen is based on subsurface conditions and the method will be specified in the site-specific Work Plan.

Split-spoon Soil Sampling. Soil boring samples are taken from undisturbed soil at the bottom of the boring with a split-spoon sampler. This sampler consists of a split steel tube or sample barrel threaded at both ends. A sharpened drive shoe secures the bottom of the barrel and an adaptor secures the top. The adaptor is threaded to connect directly to the drill rods and contains a check valve (Figure 4-13). The split-spoon is driven into undisturbed soil below the casing using the standard penetration test (ASTM-D-1586-84) (ASTM, 1990a) (Figure 4-13 and Figure 4-14). The standard penetration test consists of driving a 1-inch ID, 2-ft split spoon 18 inches into the soil at the end of the drilling rods using a 150-pound hammer dropped 30-inches. Blows per ft are recorded as a SPT-N value defined as total blows for the penetration from 6 to 18 inches. If the split-spoon is to be driven greater than 18 inches, or will be larger than 1-inch ID, this will be specified in the site-specific Work Plan.

After the sampler has been driven, it is withdrawn from the borehole and the sampler is opened by removing the drive shoe and adaptor. The field geologist will take custody of the sampling device as soon as it is withdrawn from the borehole. The sample will be collected and documented in the field logbook and on the Soil Boring Log (Figure 4-4) in accordance with the following procedures:

1. Scan the soil with a PID and record field measurements.
2. Visually examine the sample and record its characteristics (e.g., texture, color, consistency, moisture content, layering and other pertinent data) and classify using the USCS (ASTM-D-2488-84) (ASTM, 1990b), Figure 4-9.
3. Remove the portion(s) of the sample selected for chemical analysis and place into appropriate

containers using a clean spatula. Soil intended for VOC analysis should be placed in the appropriate wide-mouth glass jar and capped as quickly as possible. The containers should be filled as near to capacity as possible to minimize volatilization of the sample into the container headspace. Soil intended for other types of analyses should be placed in appropriate containers and capped.

4. Place the remainder of the sample in an 8- or 16-ounce (oz) reference jar if specified in the project-specific Work Plan. This sample portion will be used for headspace PID measurement and for any physical materials testing that is required.
5. Discard excessively disturbed or loose material found in the sampler that may not be representative of the interval sampled. This material will be discarded in the same manner as the drill cutting at each boring location.
6. Decontaminate the sampling device in accordance with the procedures specified in Subsection 4.3.2.

In some instances, there may be no analytical samples collected from a given boring. In these instances, steps 2 and 3 of the procedure listed above are omitted and the sample is placed in one or more reference jars.

Immediately after the samples are collected, the boring log is also updated by the geologist. Boring logs may be completed by the driller but for purposes of completeness and documentation a separate boring log is also compiled by the MACTEC geologist. The boring log includes interpretations of subsurface materials and conditions encountered, sample locations, PID readings, and other notes pertinent to how the boring was conducted or conditions encountered during sampling, such as staining, odor, etc. The geologist's boring log will be completed in a site field logbook and/or on a Soil Boring Log (Figure 4-4).

The sampler must exercise considerable care while collecting samples for analysis. Some methods for sample collection are described below.

1. Obtain samples from undisturbed soil below the casing or auger. This is accomplished by monitoring or checking the drill crew's measurements, observing the sampling process and examining the sample once it is retrieved.

2. Carefully remove and discard portions of the sample that are suspected to be contaminated by contact with the casing, auger, or drilling fluids.
3. Conserve sample volume since under certain soil conditions it may be difficult or impossible to achieve good sample recovery with split-spoons.

Procedures employed to minimize cross-contamination during test boring sampling operations include the following:

- Samples are taken immediately after the boring is advanced to the desired sampling depth.
- The sampling tools are decontaminated prior to taking each sample.
- The drilling contractor is not permitted to use oil, grease or other petroleum-based lubricants on the drill rods, casing or sampling tools. Use of any other lubricants will be documented.
- The drilling technique and procedures to be utilized, particularly the use of drilling fluids, are carefully evaluated for each site.

4.5.3 Methanol Extracted Rock Chip Sampling.

The analysis of rock chip samples collected from fracture zones within rock core samples provides data that may be used to evaluate the distribution of VOCs in rock matrix and potential presence of product in the fracture zones. This method of sampling is used in conjunction with rock core drilling techniques. Rock chip samples are usually obtained by using the following devices:

- Drill equipment – rig, core barrel, etc.
- Clean tested water supply
- Pre-weighed 8 or 12 oz clear wide mouth jars (or appropriate size to accommodate core)
- 40 ml amber vials/sample labels/tape
- Purge and trap grade methanol
- Syringes and pipettes
- Balance
- Notebook/field book/rock core logs
- 6 foot folding rule

- Rock hammer and coal chisel
- Core boxes
- Indelible markers
- Stainless steel bowl
- Cooler, ice, zip lock bags, paper towels
- Chain of custody forms/seals

Rock core samples retrieved from a borehole are examined for the presence of natural hydraulically active fractures. The face of a selected fracture is chipped away using a rock hammer, chisel, or rock saw, depending on the nature of the cored bedrock fracture material. Following extraction of the fractured rock interval from the drilling core barrel (depending on the nature of the fracture use of a rock saw may or may not be required), selected fracture face material (i.e. natural fracture rock chips) will be chipped away from the fracture face, pulverized into smaller flakes, and placed in a 8 oz clear wide mouth sample jar or collected in a stainless steel bowl and immediately transferred to a sample jar. The same method is appropriate for sampling rock matrix in proximity to fracture surfaces. Approximately 50 grams of the fractured rock material will be collected. The sample container will be capped. The sample will be weighed to determine the weight of the rock chips/fragments. Final weight will be recorded in the field notebook. The jar will be re-opened and approximately 50 ml of purge and trap grade methanol will be introduced into each sample jar. If necessary, a larger volume of methanol will be used to cover the rock fragments. Caps will be added to the sample jars. The methanol volume will be recorded in the field notebook. The sample will be agitated for one to two minutes and then allowed to sit. After several hours the sample will be re-agitated for approximately one minute and then be allowed to bathe in the methanol for a period of 24-48 hours.

After allowing the sample to soak for 24 to 48 hours, a disposable pipette will be used to collect an aliquot of methanol from the wide mouth sample jar. Approximately 20 ml of the methanol will be transferred to a 40 ml vial and cap (avoiding stirring up the fine particles in the vial). The sample identification information will be recorded on the sample label and attached to the vial.

Samples will be analyzed by purge and trap analysis using USEPA Method 8260B procedures developed for high concentration soils. Sample collection data along with the analytical results from the laboratory will be used to determine total mass of target compounds present in the fracture zone. Detection levels will be approximately 5 µg/core sample for target VOCs reported by the laboratory. The following calculation will be used to determine total mass of a detected target compound:

Mass of Compound (µg) = (A * B * C)/D

A = Concentration of Aqueous Analysis in micrograms per liter (µg/L)
B = Purge and trap purge volume in L
C = Volume of methanol used during sample collection in ml
D = Volume of methanol extract used during analysis in ml

Detection limit example:

5 µg = (1 µg/L * .005 L * 100 ml)/.1 ml

The sample jars should be stored at less than 20 degrees Celsius and should be disposed of if exposed to any volatile vapors or fumes (i.e. gasoline, diesel).

Information and data such as; date, boring ID, overburden thickness, total depth, and other details will be recorded in the field logbook. The sample collection information will be used in calculations of volumes of VOCs present in the rock core.

4.5.4 General Water Sampling Methodology

The location and distribution of contaminants at a given site are governed by many factors, including:

- site operation or waste disposal practices;
- site design;
- site closure;
- waste characteristics;
- site topography and surface drainage;
- climate; and
- site hydrogeology.

Development of a water sampling plan that will effectively reveal the distribution and magnitude of contamination at a specific site requires:

- an assessment of the factors listed above;
- evaluation of the methodology and results of any previous sampling and analysis program which have been completed at the site; and
- definition of the scope and objectives of the project.

4.5.4.1 Surface Water Sampling.

The technique for surface water sampling must be selected after addressing such items as:

- depth of water body;
- flow rate;
- stratification;
- specific gravity/solubility of anticipated analytical parameters;

- seasonal variations; and
- analytical parameters of interest.

The exact location of each surface water sample will be established in the field at the time of sampling. General sampling areas will be presented in the site-specific Work Plan. If surface water samples are to be collocated with sediment samples, surface water samples should always be collected before the sediment sample. The sample site will be noted on a site plan or aerial photograph and marked in the field with flagging and/or a wooden stake. The stake will be labeled with the sample site number.

The sample will be taken in the following manner:

1. Collect the sample from the surface water body by immersing a clean sample bottle. If a stream is being sampled, collect the sample while facing upstream with the opening of the sampling device oriented upstream but avoiding floating debris.
2. Or, directly fill the appropriate sample containers from a sampling device if one is needed.
3. Measure the following parameters, if possible, in the water body, not the sample:

    - PID reading;
    - temperature;
    - pH;
    - specific conductance;
    - elevation of significant surface water bodies; and
    - any other site-specific field measurements required.

    If direct measurement is not possible, measure these parameters from water remaining in the sampling device or another sample bottle. This information will be recorded on the Surface Water and Sediment FDR (Figure 4-15), sample labels will be completed, and COC procedures will be initiated.
4. Complete the sample data record and field logbook entry. Include any observations of special conditions such as color, odor, etc.

4.5.4.2 Pore Water Sampling.

Pore water samples will be collected to locate contamination in groundwater discharge areas (i.e. ponds, steams, etc) in regions down gradient of suspected source areas. Impacted groundwater may then be traced up gradient from the discharge areas to the contaminant source. Pore water samples are usually collected using the following items:

- Peristaltic pump capable of a flow rate between 50 and 500 ml/minute and appropriate power supply.
- Field probe and flow-through cell (e.g., Horiba) for measuring pH, temperature, conductance (and/or specific conductance), DO and oxidation-reduction potential (ORP) of groundwater, and a turbidity meter.
- DO meter
- Pore water sampling device, a 3/8-inch stainless steel slotted tip probe consisting of two parts; a strengthening rod and the pore water sampler, or a hollow tube with small holes in the tip to allow groundwater to percolate through.
- Calibration solutions for the field probes
- Water level tape
- Tubing, connections and tools as appropriate
- Graduated cylinder and stopwatch
- Groundwater grab FDR
- PPE
- Decontamination supplies (e.g., DI water, Liquinox soap, paper towels)
- Sample containers and cooler (provided by the laboratory)
- Ice for sample preservation
- Clean plastic sheeting, paper towels and miscellaneous supplies

The exact location of each pore water sample will be established in the field at the time of sampling. General sampling areas will be presented in the site-specific Work Plan. The sample site will be noted on a site plan or aerial photograph and marked in the field with flagging and/or a wooden stake. The stake will be labeled with the sample site number.

The sample will be taken in the following manner:

1. The pore water sampling device is inserted into the river/stream bed location to a desired depth, deep enough as to ensure the sample collected will contain only groundwater and no surface water.
2 The strengthening rod is then removed from the pore water sampling device, and the pore water sampler is then connected to the peristaltic pump using the appropriate tubing.
3. The pump is then turned on, allowing for the removal of particulate.
4. The DO concentrations will then be measured and compared to the associated surface water DO concentrations to ensure that the representative sample is not surface water.
5. Low flow purging and sampling protocol is not required, but may be conducted if desired.
6. During purging, collect at least one set of field parameters (turbidity, D.O., specific conductivity, temperature, pH, ORP) using a flow through cell (the flow through cell can not be used for turbidity measurements and the sample for turbidity measurement must be collected prior to entering the flow through cell).
   - Turbidity (+/- 10% for values >10 NTU)
   - DO (+/- 10%)
   - Specific conductivity (+/- 3%)
   - Temperature (+/- 10%)
   - pH (± 0.1 unit)
   - ORP (± 10 millivolts)
7. During purging and sampling the tubing should remain filled with water.
8. Disconnect the tubing from the flow through cell to collect the analytical samples. Water samples for laboratory analyses must not be collected after water has passed through the flow through assembly. Fill sample containers directly from the tubing without alterations to the pumping rate.
9. The VOC fraction shall be collected first. The VOC sample container shall be completely filled without air space within the container. The remaining samples shall be collected for polynuclear aromatic hydrocarbons (PAHs), PCBs, metals, and any other fraction specified in the site-specific Work Plan for the sample location.

10. For subsequent sampling efforts, duplicate the pump intake depth and final purge rate from the initial sampling event (use final pump dial setting information).
11. The pore water sampling device and associated strengthening rod will be decontaminated appropriately before further use (See Section 4.3)
12. Complete the Groundwater Sample Data Record (Figure 4-16) after each pore water sample is collected. Include any observations made during sampling such as color, odor, etc., in the field logbook and field sample data record.

4.5.4.3 Groundwater Sampling.

Sampling of groundwater monitoring wells will proceed from the upgradient or background wells to the downgradient or potentially contaminated wells, as best as can be determined. Appropriate groundwater sampling techniques will be identified in the site-specific Work Plan and/or site-specific QAPjP, and approved in advance by NYSDEC. The following activities shall be performed immediately prior to purging each well:

1. Check the well for proper identification and location.
2. Measure and record the height of the protective casing above ground surface.
3. After unlocking the well and removing any well caps, measure and record the ambient and well-mouth organic vapor levels using a PID.
4. Measure and record the distance between the top of the well and the top of the protective casing.
5. Using the electronic water level meter, measure and record the static water level in the well and the depth to the well bottom to the nearest 0.01 ft. Measurements will be referenced from the top of the well riser as opposed to the protective casing, when feasible. The point of measurement and the depth to water will be recorded in the logbook and Groundwater Sample Data Record (Figure 4-16). The water level meter is decontaminated upon removal as described in Subsection 4.3.3. In areas where light non-aqueous phase liquids (LNAPLs) are anticipated, an interface probe will be used to measure the thickness of free product present.
6. Calculate the volume of water in the well. Volume in gallons for a well equals 0.041 times the square of the ID of the well riser, in inches, times the depth of water, in ft. Volume calculations are detailed on the Groundwater Sample Data Record.

4.5.4.3.1 Groundwater Sampling Using Three Purged Well Volumes.

The following steps outline the purging and sample collection activities for purged well volume sampling.

Upon completion of the measurements and calculations described in Section 4.5.2.2., sampling will commence in the sequence listed below, utilizing the appropriate purging technique (1a, 1b, or 1c):

1. Lower the pump intake into the well. For shallow groundwater situations, the pump intake will be lowered to the top of the well screen to begin purging (see Step No. 2). Modifications to this setup may be utilized in certain situations:

    a. If the well screen is very large, and pumping from the top is impractical, the pump intake will be lowered to the approximate mid-point of the screened portion of the well.

    b. If the well is situated in tight formations such as tills, clays or rock, the purging of the well will be performed from near the top of the well screen. As the water level in the well is lowered by purging, the pump is also lowered.

    c. If the well is in a highly productive aquifer, purging will progress by purging at intervals in the well screen, from the top of the water column downward, to avoid leaving stagnant water in the well.

    To avoid aeration of the sandpack, the water level will not be allowed, to the extent feasible, to fall below the top of the filter pack during purging except possibly in tight formations (see 1b above), where purging the well (and sandpack) dry can be unavoidable. The selection of the pump to be used for well purging will be presented in site-specific Work Plan and/or site-specific QAPjP, and approved in advance by NYSDEC.

Considerations in pump selection are depth to water, the level of contamination anticipated, site access, and cost. Readily available choices include peristaltic pumps (good for shallow groundwater depths), disposable submersible pumps, such as a Whale® pump (good for moderate groundwater depths and contamination), and stainless steel/Teflon® submersible pumps, such as the Redi-Flow® (good for most applications). Teflon bailers may also be used (good for shorter water columns).

2. Purge the well. Monitor the field parameters, pH, temperature, turbidity, and specific conductivity, and measure the volume of groundwater being pumped. In situ parameters may be monitored in a beaker filled from the pump discharge or in-line with the pump discharge. Purging of the standing well water is considered complete when any of the following is achieved:

   - a minimum of three well volumes has been purged,
   - the well has been pumped dry and allowed to recharge.

3. Record the in situ parameters, temperature, pH, specific conductivity, and turbidity in the field logbook and Groundwater Sample Data Record (Figure 4-16).
4. After purging, the pump intake or the bailer will be lowered to the middle of the screened interval or mid-point of the static water level. If the analysis to be performed is for LNAPLs, then the bailer will be lowered to the top of the water column for sample collection.
5. Collect the sample(s). VOC samples are filled directly from a bailer or pump discharge with as little agitation as possible. Other samples can be placed directly into the appropriate container from the bailer or pump discharge.
6. Remove the pump or bailer from the well and decontaminate the pump, tubing or bailer by flushing with the decontamination fluid specified in Subsection 4.3.3, or dispose.
7. Complete the Groundwater Sample Data Record (Figure 4-16) after each well is sampled. Include any observations made during sampling such as color, odor, etc., in the field logbook and field sample data record.
8. Secure the well cap and lock.

4.5.4.3.2 Low Flow Groundwater Sampling.

The following steps outline the purging and sample collection activities for low-flow sampling. Data will be recorded on the low-flow groundwater sampling form (Figure 4-16). Pumps and probes may differ depending on the well diameter, groundwater constituents and depth to groundwater, but generally, sampling will require the following equipment:

- Peristaltic, bladder or inertial pump capable of a flow rate between 50 and 500 ml/minute and appropriate power supply. The pump type will principally depend on the depth to water and well diameter. Bladder pumps are preferred; peristaltic pumps are acceptable only for wells where the depth to water is less than about 25 ft; Inertail pumps are only recommended for narrow diameter wells that cannot be sampled using a bladder or peristaltic pump.
- Field probe and flow-through cell (e.g., Horiba) for measuring pH, temperature, conductance (and/or specific conductance), DO and ORP of groundwater, and a turbidity meter.
- Calibration solutions for the field probes
- Water level tape
- Tubing, connections and tools as appropriate
- Graduated cylinder and stopwatch
- 5-gallon bucket and funnel for purge water
- Low flow groundwater FDR
- PPE
- Decontamination supplies (e.g., DI water, Liquinox soap, paper towels)
- Sample containers and cooler (provided by the laboratory)
- Ice for sample preservation
- Clean plastic sheeting, paper towels and miscellaneous supplies

Field parameter measurements shall be made using instrumentation and a commercially manufactured flow through cell. Dedicated high density polyethylene (HDPE) tubing shall be used. Further details on the low-flow purging and sampling procedure are presented in the “USEPA Region 1 - New England Low Stress (low-flow) Purging and Sampling Procedures for the Collection of Ground Water Samples from Monitoring Wells”, Revision 2, July 30, 1996 (USEPA, 1996). Sample collection information shall be recorded on the Low Flow Groundwater Sampling Record (Figure 4-15). The pH stabilization criteria of +/-0.2 units specified in this subsection shall not take precedence over the pH stabilization criteria of +/- 0.1 units specified in the USEPA guidance. The USEPA guidance shall be used for purging and sampling procedures only.

Sampling will be conducted using the following procedure:

1. Determine target depth for location of the pump intake. Target depth should be the portion of the screened interval that intersects the zone of highest K. If the zone of highest K is unknown, or if the screen is placed within homogenous material, then the target depth shall be the midpoint of the saturated screen length. Primary flow zones should be identified in wells with screen lengths longer than 10 ft.
2. Measure and record the depth to water. Care should be taken to minimize disturbance of the water column within the well during pre-sample measurements.
3. Decontaminate pump prior to use (if pumps are dedicated then this applies to the initial effort only). Attach appropriate length of dedicated HDPE tubing or mark the tubing at the appropriate point so that when the pump and tubing are lowered into the well, and the mark is at the top of the well riser, the pump shall be located at the target depth within the screened interval.
4. Carefully lower the pump to the predetermined target depth. Start the pump at a purge rate low enough to achieve 0.3 ft of drawdown or less based on historical data. If sampling the well for the first time, start the pump at the lowest possible setting (or approximately 100-ml per minute) and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no drawdown (less than 0.3 ft) if possible. If stabilized drawdown cannot be achieved, use the no-purge method described later in this section.
5. Monitor and record pumping rate and water levels every 3 to 5 minutes (or as appropriate) during purging. Record any adjustments to pumping rates.
6. During purging, monitor field parameters using a flow through cell (the flow through cell can not be used for turbidity measurements and the sample for turbidity measurement must be collected prior to entering the flow through cell). Purging is considered complete and sampling may begin when the field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at 3 to 5 minute intervals, are within the following limits:
   - Turbidity (+/- 10% for values >10 NTU)
   - DO (+/- 10%)
   - Specific conductivity (+/- 3%)
   - Temperature (+/- 10%)
   - pH (± 0.1 unit)

- ORP (± 10 millivolts)

7. The final purge volume must be greater than the stabilized drawdown volume plus the tubing extraction volume.
8. During purging and sampling the tubing should remain filled with water.
9. Disconnect the tubing from the flow through cell to collect the analytical samples. Water samples for laboratory analyses must not be collected after water has passed through the flow through assembly. Fill sample containers directly from the tubing without alterations to the pumping rate.
10. The VOC fraction shall be collected first. The VOC sample container shall be completely filled without air space within the container. The remaining samples shall be collected for PAHs, PCBs, metals, and any other fraction specified in the site-specific Work Plan for the sample location.
11. For subsequent sampling efforts, duplicate the pump intake depth and final purge rate from the initial sampling event (use final pump dial setting information).
12. If using non-dedicated equipment, remove the pump and decontaminate by flushing with the decontamination fluid specified in Subsection 4.3.3, or dispose. Obtain and record a depth to bottom of well measurement before closing the well.
13. Complete the Low-Flow Groundwater Sample Data Record (Figure 4-16) after each well is sampled. Include any observations made during sampling such as color, odor, etc., in the field logbook and field sample data record.
14. Secure the well cap and lock.

4.5.4.3.3 Groundwater sampling using aqueous diffusion samplers

This procedure is designed to permit the collection of representative groundwater samples for analysis of VOCs. Groundwater sampling using aqueous diffusion samplers will be conducted using the procedures described below and in accordance with the User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells (Vroblesky, 2001).

Aqueous diffusion samplers are constructed by sealing de-ionized water in polyethylene tubing (1-millimeter thickness is typical). Tubing sizes vary, but can be up to 2-feet long. Samplers can be aquired pre-filled with laboratory de-ionized water, or assembled by the sampler. If assembled by the sampler, on option is to seal the de-ionized water in the polytubing by using a heat seal device. One end of the polytube is rolled over onto itself several times then heat is applied to seal this end. The polytube is then filled with de-ionized water. The top end (unsealed end) of the tube is then rolled over onto itself until there is no headspace in the polytube; heat is then applied to seal this end. Care is taken to ensure that no headspace or air bubbles are present in the tube prior to sealing the top end. The samplers are weighted with stainless steel weights, and a stainless steel line is attached to the top of the sampler for placement and retrieval.

THE SAMPLING GENERALLY USES THE FOLLOWING EQUIPMENT/ITEMS:

- Well construction data, location map, and field data from the previous sampling event,
- Diffusion sampler filled with de-ionized water and weight attached to bottom,
- Stainless steel cable of the required length for setting and attaching the sampler,
- Field probe and flow-through cell (e.g., Horiba) for measuring pH, temperature, conductance (and/or specific conductance), DO and ORP of groundwater, and a turbidity meter,
- Calibration solutions for the field probes,
- Water level tape (0.01-ft accuracy),
- Groundwater FDR,
- PPE,
- Decontamination supplies (e.g., DI water, Liquinox soap, paper towels),
- Sample containers and cooler (provided by the laboratory),
- Ice for sample preservation, and
- Clean plastic sheeting, and miscellaneous supplies.

Sampling will be conducted using the following procedures:

1. Enter the following information in the field logbook and FDR, as appropriate, prior to installation of the diffusion sampler: date and time of sampler installation, depth of sampler, and total depth of well.
2. Attaching weight to the base of the sampler and stainless steel line to the top of the sampler.
3. Install the sampler at the predetermined depth, attaching the top of the line to a secure location at the ground surface and the well cap should be replaced to ensure surface water does not enter the well. The depth of the sampler will be determined prior to installation, based on previous sampling data or previously collected aqueous diffusion samplers.
4. Allow the sampler to equilibrate for approximately 14 days. Return after no less than 14 days to retrieve the sampler. Samplers can remain in the well for longer than 14 days, if necessary.
5. Enter the following information in the field logbook and FDR, as appropriate, during retrieval of diffusion sampler: date and time of sampler retrieval, analytical method, and quality assurance/quality control data as necessary.
6. Retrieve the diffusion sampler from the well and note any observations on the FDR (possible tears, iron build up, etc.).
7. After retrieving sampler, install an in-well water quality parameter meter such as a Horiba U-22 or equivalent. Remove the line and weight, and make a diagonal cut toward the top of the sampler. The diagonal cut allows easier filling of the sample containers. A dealer supplied discharge device may also be used.
8. Begin filling the volatile organic compound sample containers from the diagonal cut or discharge device by allowing the water to flow gently down the inside of the container with as little agitation or minimal aeration as possible.
9. Label each sample container upon filling. Placed sample containers into a cooler with ice.
10. After sample collection is complete, record water quality parameter readings and then remove the water quality meter from the well. Cap and lock the well.
11. Complete remaining portions of the FDR after each well is sampled, including sample date and time (time of retrieval from the well), well sampling sequence, types of sample bottles used, sample identification numbers, preservatives used, parameters requested for analysis, and field observations of the sampling event.

4.5.4.4 Domestic Well Sampling.

Domestic wells will be sampled using the same procedures described for groundwater monitoring wells, with the exception of using in-place plumbing equipment. Prior to any sampling, MACTEC personnel will contact the well owner and complete a Groundwater Usage Survey (Figure 4-17). The information provided on the survey will be used to identify downgradient domestic wells.

The sampling point at each domestic well location will be determined at the time of sampling and will be as close to the pump as practical. When possible, samples will be taken up-line from aerators, softeners, or filtering systems. If there is no outlet available up-line from the water treatment system, attempts will be made to by-pass the system, if possible.

When the necessary information is available, the purge volume will be calculated to ensure purging of one storage volume, based on pressure tank volume, before sampling. If such information is unavailable, the tap will be opened and the water will be allowed to run for a minimum of fifteen minutes and until the pH and temperature stabilize. Sample containers will be filled directly from the tap or faucet. Samples will be collected as described for monitoring well samples, except that samples collected for inorganic analyses will not be filtered so that the samples will accurately represent the quality of water ingested by residents.

4.5.5 General Sediment Sampling Methodology

Sediment sampling procedures are designed to obtain representative samples of the sediment from streams, lakes, ponds, wetlands, and lagoons for chemical analysis.

The exact location of each sediment sample will be established in the field at the time of sampling. Sediment sampling points are often collocated with surface water samples. Sediment samples should always be collected after the surface water sample. Sediments in shallow water conditions may be collected without the use of a boat if agitation of sediment prior to collection can be avoided.

Sediment samples will be collected in the following manner:

1. Select the sample location, identify it on a Site map, and set the wooden stake, as close as practicable, onshore. For offshore sampling locations, temporary buoys may be set or the location may be located with global positioning system (GPS).
2. Verify sediment sampling point is within the depositional area identified during the initial Site reconnaissance.
3. Remove large stones and plant debris that are not an integral component of this sediment media. Exercise caution to avoid disturbing the sediments at the sampling point.
4. Use a gravity corer, hand corer, hand auger, trowel, Ponar® dredge, or other equivalent equipment to collect sediment samples. A stainless steel spoon and bowl may be used for locations that are shallow (i.e., less than 6-inches). If the water is shallow enough, push the gravity corer or hand auger directly into the substrate until approximately one inch or less of the sampling device is above the sediment/water interface. If the substrate is hard or coarse, the corer may be rotated gently while it is pushed to facilitate greater penetration and reduce core compaction.
5. Remove the sampling apparatus gently from the sediment to avoid losing the sample, and rise to the surface.
6. Hold the sampling device above the water to allow residual surface water to run off the device. When water is no longer running off the device, transfer the sediment sample to a stainless steel bowl. Collect a minimum of 500 grams of sediment at each location. For example, with the gravity corer, one tube with a 4-inch-long core, 2-inch outside diameter, and wall thickness of 1/8-inch is adequate for one sample, as the volume of each core would be approximately 750 ml. For other tube sizes and core lengths, the number of tubes necessary can be calculated by using the formula for the volume of a cylinder (i.e., $\pi r^2 h$).
7. Sediment samples may have high percent moisture content. Prior to transferring sample aliquots to appropriate containers, standing water should be decanted from the stainless steel bowl.
8. If soil samples are scheduled for VOC analysis, collect this parameter first. Do not homogenize the sample at this point. For VOC sample collection, preserved (methanol) or unpreserved sampling techniques may be used. The use of the preserved or unpreserved sampling technique may be decided by the NYSDEC PM prior to sample collection and will be identified in the site-specific QAPjP.

Preserved Collection - Advance a latex free, medical grade 10 cubic centimeter (cc) plastic syringe, designed to reduce the exposure of the sediment sample to air, directly into the sediment core or contents in the stainless steel bowl. Transfer the sediment sample into the pre-labeled, pre-preserved and pre-weighed vial and replace the cap. Do not attach any labels or tape to the pre-weighed sample vials. The volume of sediment collected will depend on the volume of methanol. An approximate equal volume of sediment and methanol will be added to the sample vials. Collect an additional sediment jar for percent solids determination. Label this additional jar "VOC percent solid" and the same sample information as the original sample.

Unpreserved Collection – Transfer the sediment sample using a stainless steel spoon or spatula directly to a 2 oz sample container. Fill the sample container completely to reduce the exposure of the sediment sample to air and cap.

9. If Acid Volatile Sulfide: Simultaneously Extracted Metals (AVS:SEM) will be collected, collect the AVS:SEM sample in air-tight syringes to prevent exposure of sediments to oxygen during sample collection and storage. The field samplers will collect approximately 10 grams of sample in each syringe. The filled syringe will be capped immediately. The laboratory must keep the sample in the syringe until introduction to the apparatus. The sample will remain capped until the AVS:SEM apparatus is set up and purged to eliminate oxygen. The sample syringe will be opened and sediment will be immediately transferred to the apparatus. Sample weight will be determined by calculation by weighing the syringe before and after sample transfer.
10. After the AVS:SEM sample has been collected, homogenize the sediment within the stainless steel bowl with a stainless steel spoon so that each sample aliquot is representative of the whole. Take care to ensure that sufficient sediment is present in the stainless steel bowl to fill all of the associated sample fractions (containers) and duplicate fractions, if necessary. Collect the remaining sample fractions (e.g., SVOCs, PCBs, and metals) using a stainless steel spoon and transfer the sediment into the sample containers.

Sediment sampling information is recorded on the Surface Water Sediment FDR (Figure 4-15) and/or in the logbook.

4.5.6 General Substructure Soil Vapor Sampling Methodology

Substructure soil vapor sampling is used to evaluate human exposure to VOCs through vapor intrusion (NYSDOH, 2006). Field data will be recorded on a field data form (Figure 4-18).

4.5.6.1 24-Hour Substructure Soil Vapor Sampling.

Substructure soil vapor samples will be collected from beneath residential, commercial, industrial, institutional, and multiuse buildings using SUMMA® type air canisters equipped with metering flow controllers for the purpose of collecting a "time-averaged" soil vapor sample. This technique is intended for 24-hour sample collection and may be collected in conjunction with indoor air samples. In some instances, 20-minute grab soil vapor samples will be permitted to identify potential VOC contamination beneath the slab (See Subsection 4.5.5.2). Substructure soil vapor samples may be collected from one of the following areas:

Area 1) Subslab soil vapor sample obtained via a temporary installed sampling port through apparent vapor barrier (such as floor slab or plastic liner); or

Area 2) Air sample obtained from crawl space or basement without an apparent vapor barrier.

Substructure soil vapor grab sampling will require the following equipment:

- Documentation of access permission from the owner to complete the sampling
- 6-liter, stainless steel, pre-evacuated SUMMA®-type canister - laboratory provided
- Pressure gauge with integrated 24-hour metering valve - laboratory provided
- Two, 9/16-inch, open-end wrenches
- PID – part per billion range -for screening crawl space/cracks
- Utility Knife
- Electric hammer drill with 1-inch and 3/8-inch diameter drill bits
- Two 50-ft long electrical extension cords
- ¼-inch O.D. Teflon® tubing
- ¼-inch stainless steel valve and stainless steel "tee" type fitting
- 60 cc polyethylene syringe for purging tubing
- 1-inch diameter laboratory grade rubber stopper with ¼-inch port
- Unscented beeswax, pan, and heat plate, or other NYSDEC approved seal.

- Quick-drying expansive Portland cement
- Wristwatch
- Digital camera
- Flashlight
- Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A)
- COC form - laboratory provided

Procedure for Substructure Soil Vapor Sample Collection

The procedures for substructure soil vapor sample collections will be dependant on location category. During the occupant/owner interview and building survey the lowest accessible portion of the building (e.g., crawl space, basement, or first floor of slab-on-grade construction) will be observed to assess which substructure sampling area category is applicable. The steps provided below should be considered a general guidance on the collection of substructure soil vapor samples for each location category; the sequence can be modified as needed based on site- or project-specific conditions at the time of sample collection.

Area 1: Subslab soil vapor sample obtained via temporary installed sampling port through apparent vapor barrier (i.e. floor slab or plastic liner).

Selection and preparation of sample collection point

A. Conduct interview with occupant/owner. Complete Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A).

B. Observe the condition of the building floor slab for apparent penetrations such as concrete floor cracks, floor drains, or sump holes. Note the floor conditions on the sampling form and select a potential location or locations for a temporary subsurface probe. The location or locations should be central to the building away from foundation walls and apparent penetrations. Review the proposed location or locations with the occupant/owner describing how the sampling port or ports will be installed. After receiving' permission from the occupant/owner, mark the proposed location(s) and describe the location(s) on the sampling form.

C. Using the PID, screen indoor air in the area of floor penetrations such as concrete floor cracks, floor drains, or sump holes. Record the indoor air PID readings on the sampling form.

Installation of temporary subsurface sample point

A. Drill a 1-inch diameter hole about to 2 inches into the concrete slab using an electric hammer drill.

B. Extend the hole through the remaining thickness of the slab using a 3/8-inch drill bit. Extend the hold about three inches into the subslab material using either the drill bit or a steel probe rod. Sweep hole to remove excess dust.

C. Insert a section of ¼-inch O.D. Teflon® tubing to the bottom of the floor slab. Seal the annular space between the 1-inch hole and 1/4-inch tubing by seating a tapered laboratory-grade rubber plug perforated with a 1/4-inch hole into the probe hole and if necessary capping the stopper with a beeswax seal, or other seal approved by the NYSDEC. The beeswax will be melted with an electric heat plate.

D. Connect the ¼ -inch Teflon® tubing to a stainless steel valve using compression fittings. Open the in-line valve and purge the probe tubing using a polyethylene 60 cc syringe. Close the valve, remove and cap the syringe, and connect the ¼-inch Teflon® tubing and in-line valve to a SUMMA®-type canister. The air/soil vapor syringe will be discharge out of doors. For duplicate sample locations connect a second canister before purging by installing a 1/4-inch stainless steel "tee" fitting between the probe discharge tubing and the stainless steel valve.

Preparation of 24-hour SUMMA®-type canister and collection of sample

A. Place SUMMA®-type canister adjacent to the temporary sampling port.

B. Record SUMMA®-type canister serial number on sampling summary form and COC.

C. Record sample identification on canister identification tag, and record on sampling summary form and COC.

D. Remove brass plug from canister fitting.

E. Install pressure gauge/metering valve on canister valve fitting and tighten. If pressure gauge has additional (2nd) fitting, install brass plug from canister fitting into gauge fitting and tighten.

F. Open and close canister valve.

G. Record gauge pressure on sample summary form and COC. Gauge pressure must read >25 inches Hg. Replace SUMMA®-type canister if gauge pressure reads <25 inches Hg.

H. Remove brass plug from gauge fitting and store for later use.

I. Connect subsurface probe to end of in-line particular filter via ¼-inch O.D. Teflon® tubing and "swagelok®-type" fittings.

J. Open canister valve and in-line stainless steel valve to initiate sample collection.

K. Record date and local time (24-hour basis) of valve opening on sampling summary form and COC.

L. Take digital photograph of SUMMA®-type canister and surrounding area.

Termination of 24-hour sample collection

A. Revisit SUMMA®-type canister approximately at end of sample collection period (e.g., 24 hours after initiation of sample collection) and record gauge pressure on sampling form and COC.

B. Record date and local time (24-hour basis) of valve closing on sampling form and COC.

C. Close canister valve.

D. Disconnect Teflon® tubing and remove pressure gauge / flow valve from canister.

E. Reinstall brass plug on canister fitting and tighten.

F. Remove SUMMA®-type canister from sample collection area.

G. Remove temporary probe and rubber stopper and fill the hole with a quick drying hydraulic cement. Finish flush with floor surface.

Area 2: Air sample obtained from crawl space or basement without an apparent vapor barrier.

Selection and Preparation of sample collection area

A. Conduct interview with occupant/owner. Complete Indoor Air Quality Questionnaire and

Building Inventory Form (Appendix A).

B. Observe the area for the apparent presence of items or materials that may potentially produce or emit VOCs and interfere with analytical laboratory analysis of the collected sample. Record relevant information on Building Inventory Form and document with digital photographs.

C. Using the PID, screen indoor air in the location intended for sampling and in the vicinity of potential VOC sources (i.e. paints, glues, household cleaners, dry cleaned clothes, etc.) to assess the potential gross presence of VOCs. Record PID readings on the sampling form. Items or materials exhibiting PID readings shall be considered probable sources of VOCs and, given approval of the owner or occupant, will be removed prior to sampling. If practical, sampling will be rescheduled for 24-hours later.

Preparation of 24-Hour SUMMA®-type canister and collection of sample

A. Place SUMMA®-type canister at breathing zone height (approximately 3 to 5 ft above basement floor or about 1 ft above floor of crawl space). Canister can be placed on a stable surface, such as a table or bookshelf, or affixing to a wall or ceiling support with nylon rope. Avoid placing canisters near windows or other potential sources of drafts and air supply vents.

B. Record SUMMA®-type canister serial number on sampling summary form and COC.

C. Record sample identification on canister identification tag, and record on sampling summary form and COC.

D. Remove brass plug from canister fitting.

E. Install pressure gauge / metering valve on canister valve fitting and tighten. If pressure gauge has additional (2nd) fitting, install brass plug from canister fitting into gauge fitting and tighten.

F. Open and close canister valve.

G. Record gauge pressure on sample summary form and COC. Gauge pressure must read >25 inches Hg. Replace SUMMA®-type canister if gauge pressure reads <25 inches Hg.

H. Remove brass plug from gauge fitting and store for later use.

I. Open canister valve to initiate sample collection.

J. Record date and local time (24-hour basis) of valve opening on sampling summary form and COC.

K. Take digital photograph of SUMMA®-type canister and surrounding area.

Termination of 24-hour sample collection

A. Revisit SUMMA®-type canister approximately at end of sample collection period (e.g., 24 hours after initiation of sample collection) and record gauge pressure on sampling form and COC.
B. Record date and local time (24-hour basis) of valve closing on sampling form and COC.
C. Close canister valve.
D. Remove pressure gauge / flow valve from canister.
E. Reinstall brass plug on canister fitting and tighten.
F. Remove SUMMA®-type canister from sample collection area.

Preparation and shipment of sample to analytical laboratory

A. Pack SUMMA®-type canister in shipping container, note presence of brass plug installed in tank fitting.
B. Complete COC and place requisite copies in shipping container.
C. Close shipping container and affix custody seal to container closure.

Quality Assurance/Quality Control (QA/QC) samples:

The collection of QA/QC samples will include the submittal of blind sample duplicates to the analytical laboratory for analyses of target compounds. Area 2- type duplicate samples will be collected "side-by-side" over the same time interval. Area 1- type duplicate samples will be obtained using a stainless steel "tee" type fitting and 1/4-inch O.D. Teflon®- tubing connected to the same subsurface probe.

4.5.6.2 Substructure Soil Vapor Grab Sampling.

Substructure soil vapor grab samples will be collected from beneath residential, commercial, industrial, institutional, and multiuse buildings with an apparent vapor barrier using SUMMA® type air canisters equipped with metering flow controllers. This technique is intended for 20 minute sample collection. Substructure soil vapor grab samples may be collected from a temporary installed sampling port through an apparent vapor barrier (such as floor slab or plastic liner).

Substructure soil vapor grab sampling will require the following equipment:

- Documentation of access permission from the owner to complete the sampling
- 1.4-liter, stainless steel, pre-evacuated SUMMA® canister - laboratory provided
- Pressure gauge with integrated 20-minute metering valve - laboratory provided
- PID
- Utility Knife
- Electric hammer drill with 3/8-inch diameter drill bit
- Two 50-ft long electrical extension cords
- ¼-inch O.D. Teflon® tubing
- ¼-inch stainless steel valve and stainless steel "tee" type fitting
- 3/16-inch I.D. silastic tubing
- 60 cc polyethylene syringe for purging tubing
- Quick-drying hydraulic cement
- Wristwatch
- Digital camera
- Flashlight
- Dust pan and broom
- Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A)
- COC form - laboratory provided

Procedure for 20-Minute Substructure Soil Vapor Grab Sample Collection

During the occupant/owner interview and building survey the lowest accessible portion of the building (e.g., crawl space, basement, or first floor of slab-on-grade construction) will be observed to assess applicability of sampling technique (i.e., Is there a vapor barrier?). The steps provided below should be considered a general guidance on the collection of substructure soil vapor samples; the sequence can be modified as needed based on site- or project-specific conditions at the time of sample collection.

Selection and preparation of sample collection point

A. Conduct interview with occupant/owner. Complete the Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A).

B. Observe the condition of the building floor slab for apparent penetrations such as concrete floor cracks, floor drains, or sump holes. Note the floor conditions on the sampling form and select a potential location or locations for a temporary subsurface probe. The location or locations should be central to the building away from foundation walls and apparent penetrations. Review the proposed location or locations with the occupant/owner describing how the sampling port or ports will be installed. After receiving' permission from the occupant/owner, mark the proposed location(s) and describe the location(s) on the sampling form.

C. Using the PID, screen indoor air in the area of floor penetrations such as concrete floor cracks, floor drains, or sump holes. Record the indoor air PID readings on the sampling form.

Installation of temporary subsurface sample point

A. Drill a 3/8-inch diameter hole through the thickness of the slab. Extend the hold about two inches into the subslab material using either the drill bit or a steel probe rod.

C. Insert a section of 1/4-inch O.D. Teflon® tubing to the bottom of the floor slab. Seal the annular space between the 3/8-inch hole and 1/4-inch tubing with either a beeswax seal, or with a NYSDEC approved putty/seal (i.e. non-VOC emitting play dough). The beeswax will be melted with an electric hot plate.

D. Connect the 1/4-inch Teflon® tubing to a stainless steel valve using 3/16-inch ID silastic tubing. Open the in-line valve and purge the probe tubing using a polyethylene 60 cc syringe (purging with a PID is also acceptable if no indoor air samples are to be collected). Close the valve, remove and cap the syringe, and connect the silastic tubing to the in-line valve on the SUMMA® canister. The air/soil vapor syringe will be discharge out of doors if indoor air samples are to be collected. For duplicate sample locations connect a second canister before purging by installing a 1/4-inch stainless steel "tee" fitting between the probe discharge tubing and the stainless steel valve.

Preparation of 20-minute SUMMA® canister and collection of sample

A. Place SUMMA® canister adjacent to the temporary sampling port.

B. Record SUMMA® canister serial number on sampling summary form and COC.

C. Record sample identification on canister identification tag, and record on sampling summary form and COC.

D. Remove plastic cap canister fitting.

E. Open and close canister valve.

F. Record gauge pressure on sample summary form and COC. Gauge pressure must read >25 inches Hg. Replace SUMMA® canister if gauge pressure reads <25 inches Hg.

G. Connect canister to silastic tubing already connected to the subsurface probe.

J. Open canister valve and in-line stainless steel valve to initiate sample collection.

K. Record date and local time (20-minute basis) of valve opening on sampling summary form and COC.

L. Take digital photograph of SUMMA® canister and surrounding area.

Termination of 20-minute sample collection

A. Upon completion of 20 minute sample collection, record gauge pressure on sampling form and COC.

B. Record date and local time (20 minute basis) of valve closing on sampling form and COC.

C. Close canister valve.

D. Disconnect silastic tubing and recap pressure gauge.

E. Remove SUMMA® canister from sample collection area.

G. Remove temporary probe from hole. Fill hole with a quick drying hydraulic cement. Finish flush with floor surface.

4.5.7 Indoor Air Sampling

Indoor air samples will be collected from residential, commercial, industrial, institutional, and multiuse buildings. This technique is intended to be a general directive for the collection of indoor air samples using SUMMA®-type air canisters equipped with metering flow controllers for the purpose of collecting a "time-averaged" indoor air sample. This procedure is intended for 24-hour sample collection and may be collected in conjunction with 24 hour substructure soil vapor sampling. Indoor air data will be recorded on a field data form (Figure 4-18).

For the purposes of evaluating the potential vapor migration from soils and groundwater into indoor air, samples will be collected from the lowest usable area of the building. Indoor air samples may be collected from one of the following areas:

1) Unfinished basement or unfinished first floor of slab-on-grade building;

2) Finished basement or finished first floor of slab-on-grade building; or

3) First floor living area above a dirt-floored crawl space or unfinished basement.

Indoor air sampling will require the following equipment:

- Documentation of access permission from the owner to complete the sampling
- 6-liter, stainless steel, pre-evacuated SUMMA®-type canister - laboratory provided
- Pressure gauge with integrated 24-hour metering valve - laboratory provided
- Two, 9/16-inch, open-end wrenches

- PID – part per billion range detector for screening indoor air
- Wristwatch
- Digital camera
- Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A)
- COC form -laboratory provided

Procedure for Indoor Air Sample Collection

The following section provides a general guidance on the collection of indoor air samples; the sequence can be modified as needed based on site specific conditions at the time of sample collection.

Selection and Preparation of indoor air sample collection area

A. Conduct interview with occupant/owner. Complete Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A).

B. Observe the area for the apparent presence of items or materials that may potentially produce or emit VOCs and interfere with analytical laboratory analysis of the collected sample. Record relevant information on Building Inventory Form and document with digital photographs.

C. Using the PID, screen indoor air in the location intended for sampling and in the vicinity of potential VOC sources (i.e. paints, glues, household cleaners, dry cleaned clothes, etc.) to assess the potential gross presence of VOCs. Record PID readings on the sampling form. Items or materials exhibiting PID readings shall be considered probable sources of VOCs and, given approval of the owner or occupant, will be removed prior to sampling. If practical, sampling will be rescheduled for 24-hours later.

Preparation of SUMMA®-type canister and collection of indoor air sample

A. Place SUMMA®-type canister at breathing zone height (approximately 3 to 5 ft above floor). Canister can be placed on a stable surface, such as a table or bookshelf, or affixing to a wall or ceiling support with nylon rope. Avoid placing canisters near windows or other potential sources of drafts and air supply vents.

B. Record SUMMA®-type canister serial number on sampling summary form and COC.

C. Record sample identification on canister identification tag, and record on sampling summary form and COC.

D. Remove brass plug from canister fitting.

E. Install pressure gauge / metering valve on canister valve fitting and tighten. If pressure gauge has additional (2nd) fitting, install brass plug from canister fitting into gauge fitting and tighten.

F. Open and close canister valve.

G. Record gauge pressure on sample summary form and COC. Gauge pressure must read >25 inches Hg. Replace SUMMA®-type canister if gauge pressure reads <25 inches Hg.

H. Remove brass plug from gauge fitting and store for later use.

I. Open canister valve to initiate sample collection.

J. Record date and local time (24-hour basis) of valve opening on sampling summary form and COC.

K. Take digital photograph of SUMMA®-type canister and surrounding area.

Termination of indoor air sample collection

A. Revisit SUMMA®-type canister approximately at end of sample collection period (e.g., 24 hours after initiation of sample collection) and record gauge pressure on sampling form and COC.

B. Record date and local time (24-hour basis) of valve closing on sampling form and COC.

C. Close canister valve.

D. Remove pressure gauge / flow valve from canister.

E. Reinstall brass plug on canister fitting and tighten.

F. Remove SUMMA®-type canister from sample collection area.

Preparation and shipment of sample to analytical laboratory

A. Pack SUMMA®-type canister in shipping container, note presence of brass plug installed in tank fitting.
B. Complete COC and place requisite copies in shipping container.
C. Close shipping container and affix custody seal to container closure.

Quality Assurance/Quality Control (QA/QC) samples:

The collection of QA/QC samples will include the submittal of blind sample duplicates to the analytical laboratory for analyses of target compounds. Duplicate samples will be collected "side-by-side" over the same time interval.

4.5.8 Ambient Air Sampling

Ambient (outdoor) air samples will be collected in the vicinity of residential, commercial, industrial, institutional, and multiuse buildings. This technique is intended to be a general directive for the collection of ambient air samples using SUMMA®-type air canisters equipped with metering flow controllers for the purpose of collecting a "time-averaged" ambient air sample. This procedure is intended for 24-hour sample collection. Ambient air sampling information will be recorded on the FDR (Figure 4-18).

Ambient air sampling will require the following equipment:

- Documentation of access permission from the owner to complete the sampling
- 6-liter, stainless steel, pre-evacuated SUMMA®-type canister - laboratory provided
- Pressure gauge with integrated 24-hour metering valve - laboratory provided
- Two, 9/16-inch, open-end wrenches
- PID – part per billion range detector for screening air

- Wristwatch
- Digital camera
- Indoor Air Quality Questionnaire and Building Inventory Form (Appendix A)
- COC form - laboratory provided

Procedure for Ambient (outdoor) Air Sample Collection

The following section provides a general guidance on the collection of ambient air samples; the sequence can be modified as needed based on site specific conditions at the time of sample collection.

Selection and Preparation of ambient sample collection area

A. Conduct interview with occupant/owner. Complete Indoor Air Quality Questionnaire and Building Inventory Form. (Appendix A).
B. Choose an area for sample collection that is upwind of the property (properties) being assessed, if possible. Collect sample away from wind breaks, if possible.
C. Observe the area for the apparent presence of items or materials that may potentially produce or emit VOCs and interfere with analytical laboratory analysis of the collected sample (i.e. fuel tanks, gasoline, paint storage, etc.). Record relevant information on Building Inventory Form and document with digital photographs.
D. Using the PID, screen ambient air in the location intended for sampling to assess the potential gross presence of VOCs. Record PID readings on the sampling form.

Preparation of SUMMA® canister and collection of ambient sample

A. Place SUMMA®-type canister approximately 5 ft above ground (or equivalent to the mid-point of the ground story of the building(s). Canister can be placed on a stable surface, or suspended from structure with nylon rope.
B. Record SUMMA®-type canister serial number on sampling summary form and COC.

C. Record sample identification on canister identification tag, and record on sampling summary form and COC.

D. Remove brass plug from canister fitting.

E. Install pressure gauge/metering valve on canister valve fitting and tighten. If pressure gauge has additional (2nd) fitting, install brass plug from canister fitting into gauge fitting and tighten.

F. Open and close canister valve.

G. Record gauge pressure on sample summary form and COC. Gauge pressure must read >25 inches Hg. Replace SUMMA®-type canister if gauge pressure reads <25 inches Hg.

H. Remove brass plug from gauge fitting and store for later use.

I. Open canister valve to initiate sample collection.

J. Record date and local time (24-hour basis) of valve opening on sampling summary form and COC.

K. Take digital photograph of SUMMA®-type canister and surrounding area.

Termination of ambient sample collection

A. Revisit SUMMA®-type canister approximately at end of sample collection period (e.g., 24 hours after initiation of sample collection) and record gauge pressure on sampling form and COC.

B. Record date and local time (24-hour basis) of valve closing on sampling form and COC.

C. Close canister valve.

D. Remove pressure gauge / flow valve from canister.

E. Reinstall brass plug on canister fitting and tighten.

F. Remove SUMMA®-type canister from sample collection area.

Preparation and shipment of sample to analytical laboratory

A. Pack SUMMA®-type canister in shipping container, note presence of brass plug installed in tank fitting.

B. Complete COC and place requisite copies in shipping container.

C. Close shipping container and affix custody seal to container closure.

Quality Assurance/Quality Control (QA/QC) samples:

The collection of QA/QC samples will include the submittal of blind sample duplicates to the analytical laboratory for analyses of target compounds. Duplicate samples will be collected "side-by-side" over the same time interval.

4.6 DRUM SAMPLING

Sampling personnel will develop an exclusion zone at the drum location in accordance with the site-specific HASP. The work area will be cleared of all physical hazards. Plastic sheeting will be used around the drums to protect the ground surface during sampling. Sample jars will be labeled in accordance with the site-specific QAPjP. Sampling will be performed at the level of personal protection specified in the site-specific HASP. Due to the potential release of hazardous gases, MACTEC will only sample drums already open to the atmosphere and will not open drums or perform remote sampling. The ambient air conditions in and around the drums will be monitored using a PID.

Documentation in the field logbook should begin with a visual inspection of the drum, noting any holes, markings and weak spots. Any readings detected with the PID should be recorded. A description of the drum contents should be recorded (color, consistency, etc.).

Solids can be sampled from the drums using several methods: a bucket auger, hand auger, or hand scoop; if the drums are open to the atmosphere. When the drum has been sampled, all sampling equipment should be decontaminated as described in the site-specific HASP.

4.7 AQUIFER CHARACTERIZATION

Aquifer testing activities include water level measurements and in situ K testing. These tests are designed to characterize groundwater flow patterns and to assess aquifer characteristics.

4.7.1 Water Level Measurements

Groundwater level measurements can be made in monitoring wells, private or public drinking water wells, piezometers, or open boreholes. Water level measurements in monitoring wells should be made before purging and evacuation for groundwater sampling.

The procedures for water level measurements are:

1. Check the well for proper identification and location.
2. Measure and record the height of protective casing from ground surface to check for settlement or heave.
3. After unlocking the well and removing any well caps, measure and record the ambient and well-mouth organic vapor levels using a PID. This level will be recorded in the field notebook and the appropriate health and safety actions taken, in accordance with the site-specific HASP.
4. Measure and record the distance between the top of the well riser and the top of the protective casing to check for heave or settling.
5. Using an electronic water level meter (or similar measuring device), measure and record the static water level in the well and the depth to the well bottom to the nearest 0.01 ft. Measurements will be referenced from the top of the well riser, as opposed to the protective casing, when feasible. An interface probe will be used in areas where LNAPLs are anticipated. (The water level meter should be decontaminated after use according to the procedures specified in Subsection 4.3.3).

All well measurements will be recorded, along with the date and time of measurement, in the field notebook. Every well will have a clearly established reference point of known elevation, normally a painted mark on the upper edge of the riser pipe.

4.7.2 Hydraulic Conductivity Testing

In situ K testing is designed to provide information about aquifer characteristics by measuring aquifer response to stress, such as a sudden fall or rise in water levels. The most common form of K testing is called a slug test. Slug tests yield approximate values for K; representative of the portion of aquifer within a small radius directly adjacent to the well boring that is stressed.

There are two kinds of slug tests, rising-head and falling-head tests. In a falling-head test, the operator induces a rise in the water level and records the water level return to static. In a rising-head test, the water level in the well is suddenly lowered and the water level rise to static is recorded. Rising-head tests are preferred in wells with screens that straddle the water table. Either rising- or falling-head tests may be performed in wells completed below the water table. The type of tests to be run will be specified in the site-specific Work Plan.

Prior to beginning the test, the static water level will be measured and recorded using the procedures for obtaining water levels presented in Subsection 4.7.1.

To begin the test, there are several ways to induce a rise or fall in water levels including:

- introduction of a cylindrical mass, or slug, into the well that displaces a volume of water and raises the water level above static;
- removal of the slug, after aquifer equilibration, effectively lowering the water level below static level;
- addition of a volume of water to the well raising the water level; or
- removal of a volume of water by pumping and lowering the water level.

Choice of a method depends on several factors, most concerning the level of contaminants in the well. Pumping to lower the water level is less desirable if the purged water will require containerization due to contaminant concentrations. In such cases, introduction of a slug is preferred, taking proper precautions to minimize cross-contamination between wells. The purpose of the well is also important in choosing a method. Water should not be added to a well that will be sampled for chemical analysis. Well design also should be considered. The method of inducing stress in the aquifer will be specified in the site-specific Work Plan.

The water level return to static can be measured using an electronic water level meter or a pressure transducer connected to a data logger. Readings should be taken at least every half minute for the first 10 minutes, every 5 minutes for the period of 10 to 50 minutes, every 10 minutes for the period 50 to 100 minutes, every 30 minutes for the period of 100 minutes to 5 hours, and every hour for the period 5 to 24 hours. The pressure transducer with data logger is the preferred method and is required for wells with high K values and short recovery times. The data logger can be set to record data several times a second. Recovery data should be recorded until the well recovers 90 percent of its static water level.

When using a pressure transducer and data logger, all input parameters for equipment operation will be recorded in the field notebook and on an Aquifer Testing Completion Checklist (Figure 4-19). Test data from the data logger will be downloaded to a computer disk either in the field or upon return to the office.

The following additional information is required to reduce the test data and derive a value for the K:

- initial drawdown (i.e., difference between static water level and the level after stressing);
- well screen and riser diameter;
- effective length of the screened interval; and
- borehole diameter.

In water table wells where the head changes occur in the sandpack/screen interval during aquifer testing or where permeability of the sandpack is much greater than the formation, the riser radius (r) approaches the borehole radius (R) and the length (L) varies over the duration of the test. In order to avoid selection of an inappropriate value of riser radius and resulting permeability underestimates, compensation for the extra void space is necessary. The "effective radius (r_e)", derived from the radii of the borehole (R) and riser (r), and the porosity of the sandpack (n), should be considered as:

$$r_e = [r^2 (1-n) + nR^2]^{1/2}$$

The value of L (length of sandpack) should also be adjusted accordingly (Bouwer, et al., 1976; Palmer and Paul, 1987).

The data will be reduced using the AQTESOLV software package (Geraghty & Miller, 1991). This program utilizes either Bouwer and Rice (1976) or Cooper, Bredehoeft, and Papadopulos (1976) methodologies for slug test data reduction. The output of the AQTESOLV program is a graph of data with a fitted curve and K or transmissivity value. Any other data reduction method to be used will be specified in the site-specific Work Plan.

4.7.3 Packer Testing

Water pressure tests or "packer tests" are in situ tests performed to measure the permeability of a specific zone in a bedrock borehole. Water pressure tests are used to estimate bedrock permeabilities for hydrogeologic studies and in estimating grouting and dewatering requirements for construction purposes.

Packer tests may be done during the advancement of the borehole or after drilling is completed. Packer tests are usually conducted in NW-size (i.e., 3-inch) boreholes, but can be conducted in boreholes of a larger size. The test involves placing expandable packers, either mechanical or pneumatic in a borehole. A pneumatic packer assembly is preferred because it is easier to use and provides a more positive seal. A section of the borehole, usually five ft in length, is sealed off with the packers. Water is then pumped through the zone between the packers at a known pressure. The rate of flow into the formation is measured with a flow meter. The apparent gross permeability of the test zone is calculated using the data obtained in the test.

Methodology.

1. Flush the borehole with clean water to remove cuttings. Measure the depth of the borehole, and check for caving. Be sure that an adequate reserve of water is available to avoid running out of water during a test.
2. Determine the test zone. The test section length should be a minimum of 5 times the diameter of the borehole. Avoid placing the packer in a zone of fractured rock or in the bottom of the casing because leakage will occur. Keep the rock core or drilling logs handy to refer to during the test.
3. Determine Maximum Allowable Gauge Pressure (MGP) according to the formula below (U.S. Bureau of Reclamation, 1977). In order to avoid hydrofracturing (i.e., loosening) the rock mass, do not exceed MGP during testing.

$$MGP\ (psi) = (Z)(K)$$

where,

Z	=	depth in ft from top of the upper packer to ground surface
K	=	0.5 pounds per square inch (psi)/ft

4. Prior to the start of actual permeability testing, the packer system should be tested for leakage by installing the packer in a piece of steel casing and conducting the test as if it was being done in the borehole. The water pressure must not exceed maximum packer inflation pressure. Check the hose for leaks. Check the water meter to assure that it is working properly.
5. If possible, determine the static water level in the borehole prior to the installation of the packer.
6. Assemble and install the packer equipment in the borehole. Measure each rod and top of coupling as it goes into the hole. Be sure rods are tightened to prevent leakage at the joints; Teflon® tape may be helpful. Number the rods for easy tracking of the packer location for sequential tests. Lower the equipment to the location of the deepest test. Figures 4-20, 4-21,

and 4-22 depict arrangement of equipment.

7. Before performing the first test, bleed air out of the lines by forcing water through the packer system assembly before the packers are inflated. Inflate both packers to at least 150 psi. Double packers are usually spaced five ft apart, but spacing can be varied to meet specific test requirements.

8. Before starting the test, record the following information in the field logbook and Packer Test Log (Figure 4-23).

   - test number;
   - test section;
   - hole size;
   - height of pressure gauge above ground surface;
   - ground surface elevation; and
   - depths to rock surface, groundwater, bottom of boring, bottom of upper packer to top of lower packer.

9. Test should be conducted in three steps: The first at one-half the MGP with packers at 150 psi; the second at full MGP with packers at 150 psi; and the third at full MGP with the packers at 170 psi.

   <u>Step 1, One-half MGP at 150 psi on Packers</u>. Pump water into the system and record observations of gauge pressure and water meter at 30 second intervals until a constant rate of flow is reached.

   <u>Step 2, Full MGP at 150 psi on Packers</u>. Pump water into system and record observations of gauge psi pressure and water meter at 30 second intervals until a constant rate of flow is reached

   <u>Step 3, Full MGP at 170 psi on Packers</u>. Increase pressure on packers by 20 psi. Pump water into the system and record observations of gauge pressure and water meter at 30 second intervals until a constant rate of flow is reached. The results of Steps 2 and 3 should be similar. If they are not, Step 3 should be repeated, increasing the packer pressure by an additional 20 psi until consistent results are achieved. Do not exceed the maximum packer pressure (220 psi).

   For all test steps, record water levels in the casing during test, if the water level rises during the test, the packers may not be sealed and the test results may be suspect. Measurements of doubtful accuracy must be noted, along with a description of the questionable aspects. If possible, testing should be continued until accurate data is obtained. It may be necessary to move the packer assembly a short distance to obtain an adequate seal.

10. If leakage of water from the packed section into the surrounding rock is so great that the MGP cannot be reached, run the pump at its full capacity with the bypass valve closed. Record the amount of water pumped into the test section, at 30-second intervals, with associated pressure readings.
11. Upon completion of the test, deflate the packers and move to the next test depth. Complete log sheets (Figure 4-22).
12. The same test methodology may be used with a single packer. Single packer tests are conducted as the borehole is advanced using the bottom of the borehole in place of the second packer.

Resolution of Common Packer Test Problems.

<u>Packers move up out of the hole at the start of the test</u>. Occasionally, particularly in low permeability rocks, the packer assembly may lift out of the hole due to the water pressure. Observers should stay clear of the top of the borehole to avoid injury. It may be helpful to deflate and re-inflate the packers to obtain a more positive seal in the borehole. Also, the rig drive head can be placed over the top of the swivel to help to hold the packers in place during the testing.

<u>Pumping excessive amounts of water into the formation</u>. In certain types of hydrogeologic or contaminant investigations, large quantities of water should not be pumped into the aquifer as this may impact local groundwater quality. If this is a concern, packer tests should be avoided. Alternatively, falling or rising head tests may be performed or geophysical borehole data may be obtained.

<u>Jamming of the packers in the borehole</u>. Packers may become caught in the borehole for two reasons: (1) caving of the formation amount the packers, or (2) failure of the packers to deflate. In the later case, it is generally advisable to re-inflate and deflate the packers a second time to try and remedy the problem. Forcibly removing the packers from the hole should be avoided as they may become permanently lodged or damaged. In some instances it may be helpful to pump water through the

system to help lubricate the equipment for removal. Packer tests in soft, broken or cavernous formations should be attempted with great caution.

Malfunctioning water meter. Water meters are sensitive instruments and are subject to malfunctions due to clogging by debris or mechanical failure. It is important to check the water meter prior to use to be certain that it is working properly. Generally, it is best to place the water meter in a horizontal position, particularly for low flow measurements. It is also important to determine what the units of the meter dial are prior to use, as they are often poorly marked.

Data Evaluation. Compute the rock mass K. Additional data required for each test are as follows: (1) depth of hole at time of each test; (2) depth to bottom of top packer; (3) depth to top of bottom packer; (4) depth to water level in borehole at frequent intervals; (5) elevation of piezometric level; (6) length of test section; (7) radius of hole; (8) length of packer; (9) height of pressure gauge above ground surface; (10) height of water swivel above ground surface; and (11) description of material tested. Item 4 is important since a rise in water level in the borehole may indicate leakage from the test section.

The formulas used to compute the K from pressure test data are:

$$K = C\frac{Q}{2(\prod)LH}\ln\frac{L}{r} \qquad L \geq 10r$$

$$K = C\frac{Q}{2(\prod)LH_T}\ln\frac{L}{2r} \qquad 10r \;\phi\; L \;\phi\; r$$

where,

K	=	hydraulic conductivity (ft/day)
Q	=	constant rate of flow into the hole (gallons per minute)
L	=	length of the test section (ft)
H_T	=	differential head on the test section ($H_g + H_p$ in ft)

r = radius of the borehole (ft)

C = Conversion factor for K in units of ft/day C equals 1.928×10^2

Note: Hg is equal to elevation head (distance from swivel to static water level). Hp is equal to pressure head calculated in ft from pressure gauge. For the unsaturated condition (i.e., static water is below bottom of lower packer), Hg is equal to distance in ft from swivel to center of test section.

These formulas provide only approximate values of K since they are based on several simplifying assumptions and do not take into account the flow of water from the test section back to the borehole (U.S. Bureau of Reclamation, 1968). Because of the heterogenous and anisotropic nature of water bearing rock formations, K value is referred to as apparent gross K. However, they give values of the correct magnitude and are suitable for practical purposes. The following listing provides a general grouping of rock mass K.

ROCK MASS HYDRAULIC CONDUCTIVITY

Hydraulic Conductivity Grouping	Range of Results
Very Low, equivalent to clay	Less than 1×10^{-4} ft/day
Low, equivalent to silt	1×10^{-4} to 1×10^{-2} ft/day
Medium, equivalent to fine sand	1×10^{-2} to 10^{-1} ft/day
High, equivalent to sand	1×10^{-1} to 1×10^{1} ft/day
Very High, equivalent to clean sand or gravel	More than 1×10^{1} ft/day

4.8 SURVEYS

4.8.1 Elevation and Location Survey

Elevation and location surveys will be conducted by a New York-registered professional land surveyor.

Elevations will be referenced to mean sea level, 1983 General Adjustment and will be measured at 0.01 ft for monitoring well casings and 0.1 ft for ground surfaces. Horizontal locations will be tied into the NYS Plane Coordinate system, to the nearest 0.1 ft.

The actual surveying techniques and the required equipment to be employed, and the required accuracy and precision, are dependant upon the field conditions and the nature of the sampling stations and/or techniques to be employed. All field measurements shall be performed at least once and remeasured (i.e., checked) at least once. All survey observations and measurements shall be properly recorded by the designated member of the survey crew in bound field books, in accordance with the requirements of these guidelines.

Any calibrations performed upon surveying equipment in connection with this work shall be properly documented with regard to personnel, date, instrument number, calibration readings, procedures and standards employed, adjustments made, comments and/or observations, etc.

All analysis employed in the reduction of field data, calculations, production of maps, etc. shall follow commonly-accepted professional survey practices which are appropriate for the task at hand, including all appropriate procedures for QC to check and review the work. Where a computer is used to reduce data, the program employed shall have first been certified to yield repeatable results within the required limits of accuracy. All office calculations, data reduction, map making, etc. shall be performed in a neat, sequential, and logical order to facilitate future review.

The installed locations of all benchmarks, baselines and monuments shall be appropriately documented on a base map to indicate their relative locations. Benchmarks will be described with respect to their construction and location, on map, in addition to their grid coordinates.

If required, final maps will be submitted as an original or Mylar, in the specified map size. If one sheet is not sufficient, the mapped area may be divided into sections, one per sheet, and appropriate references and match lines provided. Maps shall be of a suitable scale to show appropriate detail clearly. Although this varies with the size of the site mapped, appropriate map scales generally range from 1 inch = 50 ft to 1 inch = 200 ft. The scale utilized will be clearly shown on the map both graphically (e.g., bar scale) and numerically (e.g., 1 inch = 50 ft). Each map will also indicate a true north meridian, preferably oriented toward the top of the page, and will be provided with appropriate borders, legends, title boxes, notes, data references and means of identifying author, checkers, etc.

The following paragraphs summarize specific surveying requirements appropriate to various sampling locales.

Borings and Test Pits. Horizontal locations and ground surface elevations for borings and test pits are indicated on boring/test pit logs and may be used to construct geologic sections or profiles. Horizontal locations should be staked to the nearest ft, and ground surface elevations measured to 0.1 ft.

Monitoring Wells and Piezometers. In general, horizontal location, well riser elevation, and ground surface elevation criteria for wells and piezometers are similar to those of test pits or borings. However, the surveyor should measure and mark the elevation of the top of the riser to 0.01 ft as this point will be used as a reference to measure precise groundwater elevations. For monitoring wells, pumping wells, and piezometers, a permanent mark will be made on the riser, protective casing, or other point of reference both for surveying purposes and to enable reproducible depth to water measurements.

Surface Water Sampling. When grab samples are obtained from the edges of surface water bodies, the samplers should install a location stake at the shoreline marked with the station number and coordinates, if appropriate. This stake may also be used as a reference point for measuring the water surface elevation (to the nearest 0.01 ft). In certain cases, this may not be required, since the sampler can estimate and mark the appropriate location and elevation directly on a Site Topographic Map. Such locations do not require great location accuracy (within several ft), since they are usually only indicated graphically on the Site Map.

When samples are to be taken within the surface water body away from the shoreline, better horizontal control is usually required. Sampling locations are determined by the sampler using on-shore baselines or ranges.

Surface Soil/Waste Sampling. Measurement and layout requirements for obtaining a single grab sample of soil or waste are comparable to those for obtaining surface water grab samples from the shoreline. Where a composited sample is to be collected from a sampling grid, the surveyors must stake out the grid, and indicate the station number(s), coordinates or orientation of the grid, and ground elevation(s) on the stakes. Generally, a precision of no better than the nearest ft for location, and 0.1 ft for elevation will suffice from grab or grid surface sampling.

4.8.2 Global Positioning Survey

GPS is a geographic data collection system which uses satellites to locate positions and log time. GPS is an all weather, 24 hour, world wide service maintained by the Department of Defense. The system can be used as a data capture or in navigation mode to assist in geographic referencing for returning to points previously entered. GPS used at environmental sites has shown to be a low cost, accurate tool for rapid surveys.

GPS systems typically consist of a portable receiver, a base station receiver, data loggers, processing software, and a field computer. Data can be collected in point, line, or area format. The datum and coordinate system used can be specified to the nature of the job and application. For differential correction, used to correlate a known steady position relative to the rover - mobile data collection unit, a fixed community base station within 300 miles of the survey can be employed or a field operated base station unit can be used.

Accuracy is determined by several factors including the type of equipment. Sub-meter accuracy systems are most often used. A few constraints for acquiring sub-meter accuracy are based on the satellite geometry - the arrangement and number of satellites in 'view' of the position, the altitude of the satellites, and the satellite's health. Signal strength can be affected by buildings blocking the satellite's signal or a dense tree canopy that can weaken the signal will also limit the accuracy of the survey. Another consideration is Position Dilution of Precision which needs to be within a specified range to acquire high accuracy. The amount of time at each position increases the accuracy of the fix by allowing more positions to be logged. Timing and careful planning can remedy or limit the affects to most signal strength problems (Trimble, 1994).

The Department of Defense purposely degrades GPS accuracy through selective availability. Post processing of collected GPS data is necessary to remove the effects of selective availability in order to transform data to a usable format (Trimble, 1994). Data can then be transferred onto an existing computer aided design (CADD) map or used to construct a site map. Typical environmental applications include generating real time site maps, wetland delineation, mapping soil boring locations, GeoProbe® locations, and mapping surface water/sediment sampling locations.

4.9 MANAGEMENT OF INVESTIGATION-DERIVED WASTES

Specific procedures for handling contaminated environmental materials and contaminated, disposable, personal safety equipment will be presented in the site-specific Work Plan and/or HASP. In general, MACTEC is responsible for collecting, controlling, and staging hazardous materials generated during field investigations. Manifest signature and ultimate disposal are the responsibility of NYSDEC; however, MACTEC may assist in the planning and coordination of these activities, if required.

Contaminated soil and water will be handled in accordance with NYSDEC guidance documents unless otherwise specified in the site-specific QAPjP (NYSDEC, 1989 and no date).

4.9.1 Soil Disposal

NYSDEC TAGM 4032, Disposal of Drill Cuttings, distinguishes between soils from Class 2 inactive hazardous waste sites and soils from investigations near or adjacent to Class 2 sites (NYSDEC, 1988). Class 2 site soils are presumed to be hazardous while soils from areas off-site are presumed to be non-hazardous.

Alternatives for on-site disposal of non-hazardous soils include:

- backfill inside test borings not completed as monitoring wells;
- collect and dispose on-site;
- temporarily store on-site for dewatering prior to off-site disposal;
- transport from off-site areas to site (without need to manifest or contract with licensed hauler)

Non-hazardous waste can also be transported off-site to a solid waste management facility.

Hazardous soils can be transported off-site to a RCRA-permitted treatment, storage, or disposal facility. Prior to shipping for off-site disposal, representative samples of waste material will be analyzed to establish requirements for the proper management and disposal of wastes. These materials will be transported by a licensed hauler and accompanied by the proper manifests.

All of these disposal alternatives are subject to precautions listed in TAGM 4032, including the general requirement that the soils "be handled and disposed of in a manner that does not pose a threat to health and the environment." Overall, handling and disposal of drill cuttings and other soil will be identified and addressed in the site-specific Work Plan.

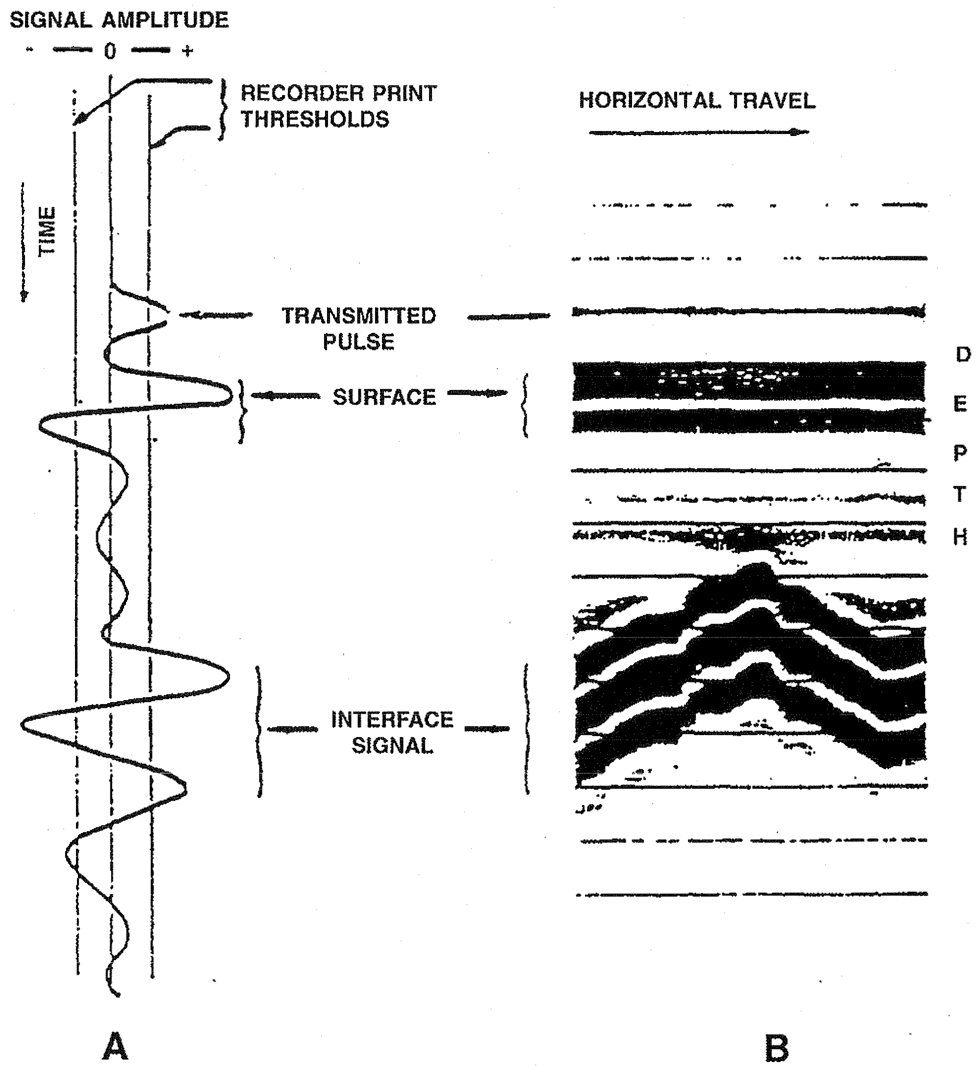
4.9.2 Water Disposal

NYSDEC guidance for the control and management of contaminated groundwater presents five alternatives for the disposal of groundwater generated during investigations at hazardous waste sites, including:

- transportation off-site to an RCRA-permitted treatment facility;
- discharge to a sanitary sewer for treatment at a publicly-owned treatment works (POTW);
- on-site treatment and discharge to a storm sewer or receiving stream;
- transport by truck to a POTW; or
- on-site disposal by allowing water to infiltrate into the ground (NYSDEC, no date).

Interim storage and implementation of these disposal alternatives are subject to further conditions and procedures as required by NYSDEC.

In order to determine if groundwater is non-hazardous, representative samples must be sent to an approved laboratory for analysis. Non-hazardous groundwater may be discharged to the ground, a sanitary sewer, or a surface water body; subject to conditions as required by NYSDEC. Overall, the management and disposal of groundwater will be specified in the site-specific Work Plan.

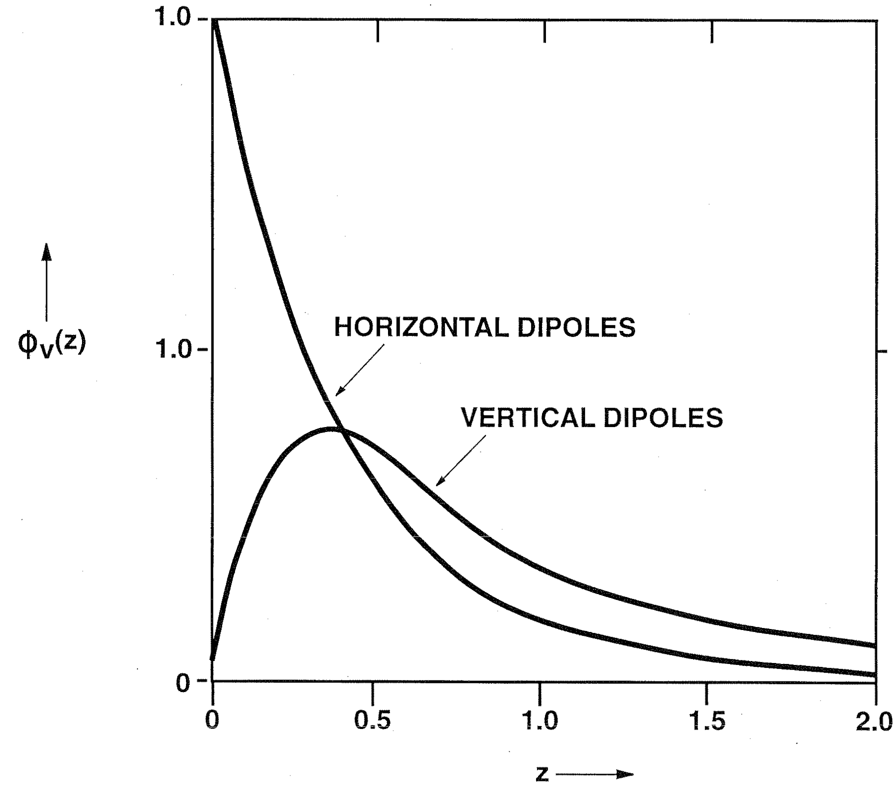


(A) SKETCH OF A SINGLE PULSE AND REFLECTIONS AS SEEN BY THE RECEIVER.

(B) EXAMPLE OF PROFILE INFORMATION AS DISPLAYED BY THE GRAPHIC RECORDER.

MACTEC
511 Congress Street
Portland, ME 04101

FIGURE 4-1
GPR SYSTEM DATA
NYSDEC QUALITY ASSURANCE PROJECT PLAN



Note: "$\phi_V(z)$" is the relative contribution to the secondary magnetic field intensity from material in a thin layer (dz) located at (normalized) depth "z".

"z" is the depth of the thin layer (dz) divided by the intercoil spacing between transmitter and receiver

MACTEC
511 Congress Steet
Portland, ME 04101

FIGURE 4-2
TERRAIN CONDUCTIVITY SURVEY COMPARISON OF RELATIVE RESPONSES FOR VERTICAL AND HORIZONTAL DIPOLES
NYSDEC QUALITY ASSURANCE PROGRAM PLAN

TEST PIT RECORD

Project Name:______________________ Geologist:________________________ Test Pit Number: __________________

Project Number:____________________ Date:____________________________ Checked By/Date:_________________

DEPTH (FT.)	0	5	10	15
0				
5				
10				
15				

Location Sketch

N

Total Depth: ____________________

Depth to Water ____________________

Samples Collected: ____________________

____

____

____

Excavating Co.: ____________________

Geologist/date: ____________________

Notes:

MACTEC

511 Congress Street Portland, ME 04101

FIGURE 4-3
TEST PIT RECORD
NYSDEC QUALITY ASSURANCE PROJECT PLAN

MACTEC

SOIL BORING LOG

Project		Boring/Well No.	Project No.
Client	Site	Sheet No. ________ of ________	
Logged By	Ground Elevation	Start Date	Finish Date
Drilling Contractor	Driller's Name	Rig Type	
Drilling Method	Protection Level	P.I.D. (eV)	Casing Size	Auger Size
Soil Drilled	Rock Drilled	Total Depth	Depth to Groundwater/Date — Piez ☐ Well ☐ Boring ☐

Depth(Feet)	Sample No. & Penetration/ Recovery (Feet)	SPT Blows/6" or Core Rec./Rqd. %	SPT-N (Blows/Ft.)	Sample Description	USCS Group Symbol	Monitoring (ppm) PI Meter Field Scan	Monitoring (ppm) PI Meter Head Space	Lab Tests ID Sample

MACTEC
511 Congress Steet
Portland, ME 04101

FIGURE 4-4
SOIL BORING LOG
NYSDEC QUALITY ASSURANCE PROGRAM PLAN

PORT2007022w.mac

ROCK CORING LOG

Project:	Site:	Exploration/Well No.:		Project No.:
Client:	Driller's Name:	Logged by:	Checked by:	Ground Elev.:
Drilling Contractor:	Protection Level:	Rig Type:	Start Date:	Finish Date:
Drilling Method:		P.I.D. (eV):	Casing Size:	Auger Size:

Bit type/size:	Bit Use:	Core Interval (to/from)(ft):

Depth (feet) Below GRD Sort.	Sample No. & Penetration/ Recovery (feet)	Graphic Log	Natural Core Breaks		Weathered Condition	Rock Quality			Drilling Rate min/ft	Color	Rock Description and Comments on Drilling
			Type/Dip	Surface Condition		Total 4" Core	RQD (%)	Rock Quality Description			

MACTEC
511 Congress Steet
Portland, ME 04101

FIGURE 4-5
ROCK CORING LOG
NYSDEC QUALITY ASSURANCE PROGRAM PLAN

MACTEC

PORT2007022d.mac

KEY TO SOIL DESCRIPTIONS AND TERMS

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS (more than half of material is larger than No. 200 sieve size)	GRAVELS (more than half of coarse fraction is larger than No. 4 sieve size)	CLEAN GRAVELS (little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel sand mixtures, little or no fines.
		GRAVEL WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (more than half of coarse fraction is smaller than No. 4 sieve size)	CLEAN SANDS (little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly-graded sands, gravelly sand, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (more than half of material is smaller than No. 200 sieve size)	SILTS AND CLAYS (liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, clean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS (liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
	HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.

Desired Soil Observations: (in this order)

Color (Munsell color chart)
Name (sand, silty sand, clay, etc., including portions - trace, little, etc.)
Gradation (well-graded, poorly-graded, uniform, etc.)
Density/Consistency (from above, based on SPT "N" Value)
Moisture (dry, damp, moist, wet, saturated)
Plasticity (non-plastic, slightly plastic, moderately plastic, highly plastic)
Structure (layering, fractures, cracks, etc.)
Geologic Origin (till, marine clay, alluvium, etc.)
Unified Soil Classification Designation

TERMS DESCRIBING DENSITY/CONSISTENCY

Coarse-grained soils (more than half of material is larger than No. 200 sieve): Includes (1) clean gravels; (2) silty or clayey gravels; and (3) silty, clayey or gravelly sands. Consistency is rated according to standard penetration resistance.

Descriptive Term	Portion of Total
(Modified Burmister System)	
trace	0% - 10%
little	10% - 20%
some	20% - 35%
adjective (e.g. sandy, clayey)	35% - 50%

Density of Cohesionless Soils	Standard Penetration Resistance N-Value (blows per foot)
Very loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

Fine-grained soils (more than half of material is smaller than No. 200 sieve): Includes (1) inorganic and organic silts and clays; (2) gravelly, sandy or silty clays; and (3) clayey silts. Consistency is rated according to shear strength as indicated.

Consistency of Cohesive soils	SPT N-Value blows per foot	Approximate Undrained Shear Strength (psf)	Field Guidelines
Very Soft	0 - 2	0 - 250	Fist easily Penetrates
Soft	2 - 4	250 - 500	Thumb easily penetrates
Medium Stiff	4 - 8	500 - 1000	Thumb penetrates with moderate effort
Stiff	8 - 15	1000 - 2000	Indented by thumb with great effort
Very Stiff	15 - 30	2000 - 4000	Indented by thumbnail
Hard	>30	over 4000	Indented by thumbnail with difficulty

Rock Quality Designation (RQD):

$$RQD = \frac{\text{sum of the lengths of intact pieces of core* >100mm (0.3ft.)}}{\text{length of core advance}}$$

*Minimum NQ rock core (1.88 in. OD of core)

Quality Description	RQD
Very Poor	<25%
Poor	25% - 50%
Fair	50% - 75%
Good	75% - 90%
Excellent	>90%

Desired Rock Observations: (in this order)

Color (Munsell color chart)
Texture (aphanitic, fine-grained, etc.)
Lithology (igneous, sedimentary, metamorphic, etc.)
Hardness (very hard, hard, mod. hard, etc.)
Weathering (fresh, very slight, slight, moderate, mod. severe, severe, etc.)
Geologic discontinuities/jointing:
- -dip (horiz - 0-5, low angle - 5-35, mod. dipping - 35-55, steep - 55-85, vertical - 85-90)
- -spacing (very close - <5 cm, close - 5-30 cm, mod. close 30-100 cm, wide - 1-3 m, very wide >3 m)
- -tightness (tight, open or healed)
- -infilling (grain size, color, etc.)

Formation (Waterville, Ellsworth, Cape Elizabeth, etc.)
RQD and Rock Mass Description (very poor, poor, fair, etc.)
Recovery

Sample Container Labeling Requirements:

Site:
Boring Number: Blow Counts:
Sample Number: Sample Recovery:
Sample Depth: Personnel Initials:

FIGURE 4-6
USCS KEY TO SOIL DESCRIPTIONS
NYSDEC QUALITY ASSURANCE PROGRAM PLAN

Overburden Well Construction Diagram

Well No.:

Project No.:		Project Name:	
		Project Area:	
Contractor:	Driller:	Method:	
Logged By:		Date Started:	Completed:
Checked By:	Date:	Well Development Date:	

Not To Scale

Lock Identification:

Surface Casing Type:

Ground Surface Elevation:

Surface Casing Diameter:

Inside Diameter of Surface Casing:

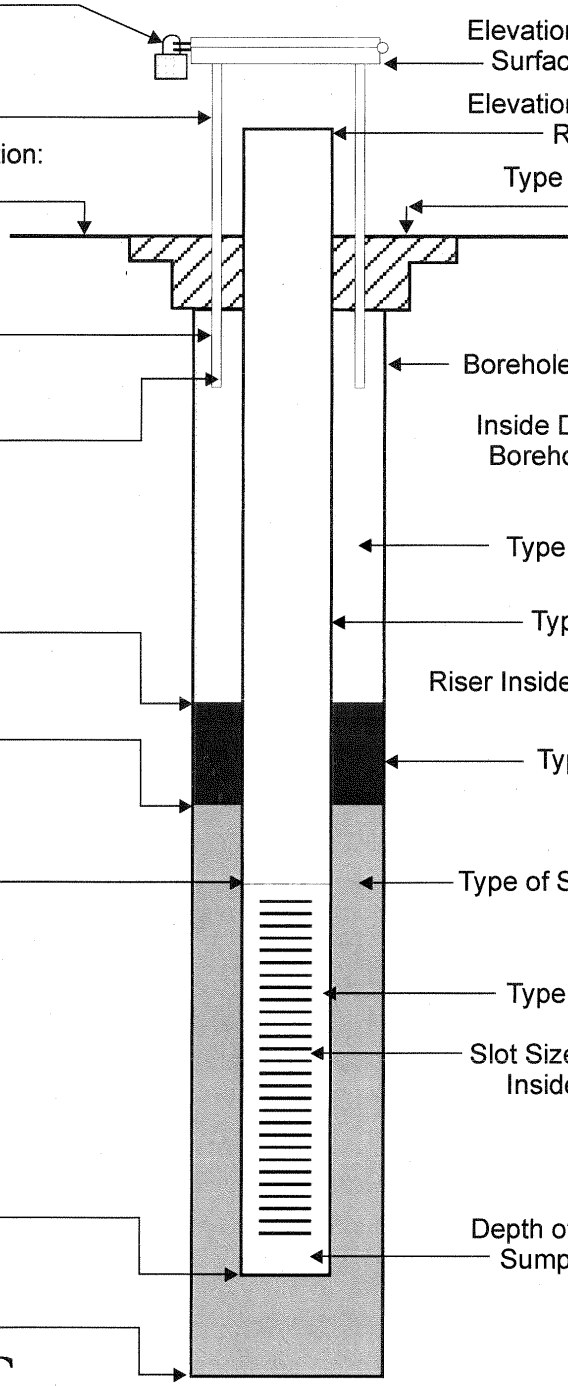
Depth/Elevation of Top of Well Seal: /

Depth/Elevation of Top of Sand: /

Depth/Elevation of Top of Screen: /

Depth/Elevation of Bottom of Screen: /

Depth/Elevation of Bottom of Boring: /



Elevation of top of Surface Casing:

Elevation of top of Riser Pipe:

Type of Surface Seal:

Borehole Diameter:

Inside Diameter of Borehole Casing:

Type of Backfill:

Type of Riser:

Riser Inside Diameter:

Type of Seal:

Type of Sand Pack:

Type of Screen:

Slot Size x Length:

Inside Diameter of Screen:

Depth of Sediment Sump with Plug:

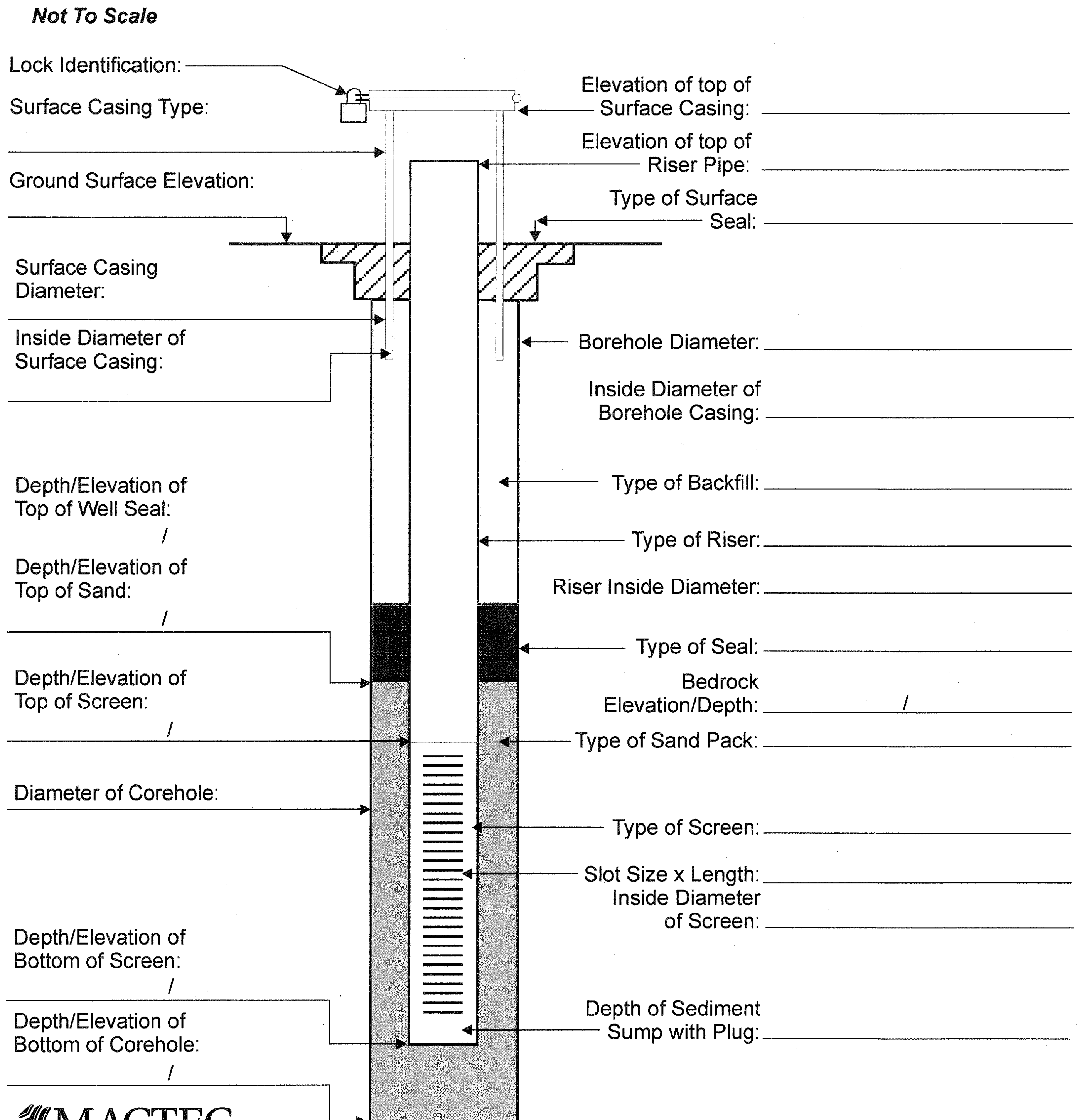
MACTEC
511 Congress Street
Portland, ME 04101

FIGURE 4-7
OVERBURDEN MONITORING WELL CONSTRUCTION DIAGRAM
NYSDEC QUALITY ASSURANCE PROJECT PLAN

PORT2007022f.cdr

Bedrock Well Construction Diagram

Well No.:				
Project No.:		Project Name:		
		Project Area:		
Contractor:	Driller:	Method:		
Logged By:		Date Started:	Completed:	
Checked By:	Date:	Well Development Date:		



MACTEC
511 Congress Street
Portland, ME 04101

FIGURE 4-8
BEDROCK MONITORING WELL CONSTRUCTION DIAGRAM
NYSDEC QUALITY ASSURANCE PROJECT PLAN

PORT2007022g.cdr

WELL DEVELOPMENT RECORD

Project:	Well Installation Date:		Project No.
Client:	Well Development Date:	Logged by:	Checked by:
Well/Site I.D.:	Weather:	Start Date:	Finish Date:
		Start Time:	Finish Time:

Well Construction Record Data:

Well Diameter ______ in.

- Bottom of Screen ______ ft.
- Sediment Sump/Plug ______ ft.
- Screen Length ______ ft.

From Ground Surface ❑ From Top of Riser ❑

Fluids Lost during Drilling ______ gal.

Protective Casing Stick-up ______ ft. Protective Casing/Well Diff. ______ ft.

PID Readings: Ambient Air ______ ppm; Well Mouth ______ ppm

Well Levels:

- Initial ______ ft.
- End of Development ______ ft.
- 24 Hours after Development ______ ft.

Sediment:

- Well Depth before Development ______ ft. (from top of PVC)
- Well Depth after Development ______ ft.
- Sediment Depth Removed ______ ft.

HT of Water Column ______ ft. x ❑ 1.68* gal./ft. ❑ ______ = ______ gal./vol.
*for 4" HSA Installed Wells

Equipment:

- ❑ Dedicated Submersible Pump
- ❑ Surge Block
- ❑ Bailer ❑ 2" ❑ ________
- ❑ Grundfos Pump 2" _____ 4" _____

Approximate Recharge Rage ______ gpm

Total Gallons Removed ______ gal.

Well Development Criteria Met:

Notes: ____

____

	Yes	No
■ Well water clear to unaided eye	❑	❑
■ Sediment thickness remaining in well is <1.0% of screen length	❑	❑
■ Total water removed = a minimum of 5x calculated well volume plus 5x drilling fluid lost	❑	❑
■ Turbidity < 5NTUs	❑	❑
■ 10% change in field parameters	❑	❑

End of Well Development Sample (1 pint) Collected? Yes ❑ No ❑

Water Parameter Measurements

Record at start, twice during and at the end of development (minimum):

Time	Volume	Total Gallons	pH	Temp.	Conductance	Turbidity	Pumping Rate

Well Developer's Signature ____________________________

MACTEC
511 Congress Steet
Portland, ME 04101

FIGURE 4-9
WELL DEVELOPMENT RECORD
NYSDEC QUALITY ASSURANCE PROGRAM PLAN

MACTEC Engineering and Consulting, Inc.

PAGE ____ OF _____

GROUNDWATER GRAB SAMPLE FIELD RECORD

PROJECT | JOB NUMBER | DATE

FIELD SAMPLE NUMBER | ACTIVITY TIME: START END | BOTTLE TIME

QC SAMPLES COLLECTED:

SAMPLE TYPE: GEOPROBE GRAB ☐ MICROWELL ☐ MONITORING WELL ☐ PORE WATER ☐

WATER LEVEL / WELL DATA

MEASURED WELL DEPTH ____ FT (TOR) | HISTORICAL WELL DEPTH ____ FT (TOR) | PROTECTIVE CASING STICKUP (FROM GROUND) ____ FT | PROTECTIVE CASING / WELL DIFFERENCE ____ FT

DEPTH TO WATER ____ FT (TOR) | SCREEN LENGTH ____ FT | WELL DIAMETER ____ IN | WELL MATERIAL ____

HEIGHT OF WATER COLUMN ____ FT x ☐ 0.06 GAL/FT (1 IN) ☐ 0.16 GAL/FT (2 IN) ☐ 0.65 GAL/FT (4 IN) = ☐ 1.5 GAL/FT (6 IN) ____ GAL/VOL + ANNULUS ____

TOTAL VOLUME PURGED ____ GAL

PURGE DATA

TIME					
PURGE RATE (mLs)					
TEMPERATURE (degrees C)					
pH (units)					
TURBIDITY (ntu)					
SPEC. COND. (uhmos/cm)					
DISSOLVED OXYGEN (mg/L)					
REDOX POTENTIAL (mV)					

SAMPLE OBSERVATIONS:

☐ CLEAR
☐ COLORED ______________
☐ CLOUDY ________________
☐ TURBID ________________
☐ ODOR _________________
☐ OTHER (see notes)

EQUIPMENT DOCUMENTATION

PURGING / SAMPLING

☐ ☐ PERISTALTIC PUMP
☐ ☐ SUBMERSIBLE PUMP
☐ ☐ BLADDER PUMP
☐ ☐ PVC/SILICON TUBING
☐ ☐ TEFLON/SILICON TUBING
☐ ☐ WATTERA
☐ ☐ GEOPROBE SCREEN
☐ ☐ ____________________

DECON FLUIDS USED

☐ LIQUINOX
☐ POTABLE WATER
☐ DEIONIZED WATER
☐ ______________

WATER LEVEL EQUIPMENT USED

☐ ELECTRIC COND. PROBE
☐ FLOAT ACTIVATED
☐ ________________

NUMBER OF FILTERS USED ___________

TYPE OF FILTER USED ______________

ANALYTICAL PARAMETERS

	PARAMETER	METHOD NUMBER	FILTERED	PRESERVATION METHOD	VOLUME REQUIRED	SAMPLE COLLECTED	SAMPLE BOTTLE ID NUMBERS
☐	VOLATILE ORGANIC COMPOUNDS			HCL	40 mL	☐	______
☐	SEMIVOLATILE ORGANIC COMPOUNDS			4 Degrees C	1000 mL	☐	______
☐	INORGANICS			HNO3	500 Ml	☐	______
☐						☐	______
☐						☐	______
☐						☐	______
☐						☐	______

NOTES

MACTEC

511 Congress Street, Portland, ME 04101

FIGURE 4-10
GROUNDWATER GRAB SAMPLE FIELD RECORD
NYSDEC QUALITY ASSURANCE PROJECT PLAN

SOIL VAPOR IMPLANT SAMPLING RECORD

Boring ID:

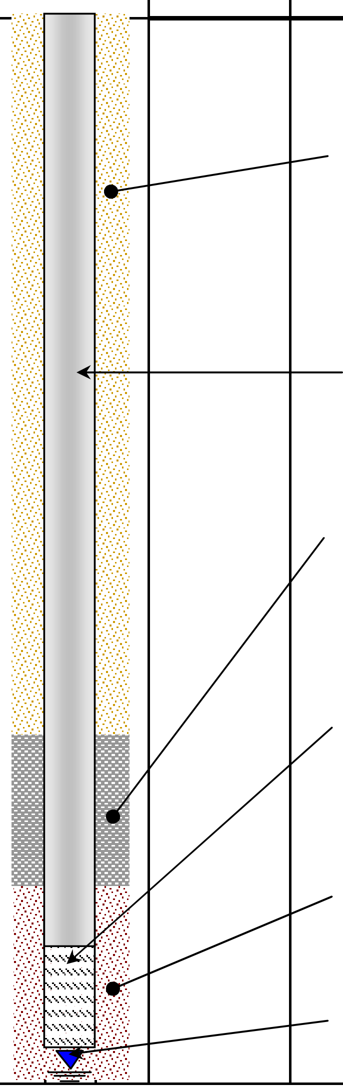
Project No.:	**Project:**	**Checked By:**

Client Name: NYSDEC	**Logged By:**	**Protection Level:**	**Ground Elevation:**

Drilling Contractor:	**Drilling Method:**	**Driller's Name:**

Installation Date/Time:	**Sample Date/Time:**	**Start Time:**	**End Time:**	**Rig Type:**
He Breakthrough %:		**Initial He %:**	**Final He %:**	**Auger Size:**

Depth (feet)	Recovery	Blow Counts	Graphic Log	Soil Vapor Diagram	Vapor Point Construction Notes	Overburden Drilling Notes:
0						



Soil Vapor Point Construction Notes:

MACTEC
511 Congress Street, Portland, Maine 04101

FIGURE 4-11
SOIL VAPOR SAMPLING RECORD
NYSDEC QUALITY ASSURANCE PROJECT PLAN

SURFACE SOIL SAMPLE FIELD DATA RECORD

Project: ____________________ Site: ____________________
Project Number: ____________________ Date: ____________________
Sample Location ID: [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] Time: Start: __________ End: __________
Signature of Sampler: ____________________

SOIL SAMPLE

DEPTH OF SAMPLE INTERVAL: ____________
(Feet below ground surface)
reported to 1/10 foot

EQUIPMENT USED FOR COLLECTION:
[ ] HAND AUGER
[ ] S.S. SPLIT SPOON
[ ] SHOVEL
[ ] HAND SPOON
[ ] ALUMINUM PANS
[ ] SS BUCKET
[ ] ____________

TYPE OF SAMPLE COLLECTED:
[ ] DISCRETE
[ ] COMPOSITE

SAMPLE OBSERVATIONS:
[ ] ODOR ____________
[ ] COLOR ____________
[ ] ____________

DECONTAMINATION FLUIDS USED:
✓ ALL USED
[ ] ETHYL ALCOHOL
[ ] 25% METHANOL/ 75% ASTM TYPE II WATER
[ ] DEIONIZED WATER
[ ] LIQUINOX SOLUTION
[ ] HEXANE
[ ] HNO_3 SOLUTION
[ ] POTABLE WATER
[ ] NONE

SOIL TYPE:
[ ] CLAY
[ ] SAND
[ ] ORGANIC
[ ] GRAVEL

FIELD GC DATA: [ ] FIELD DUPLICATE COLLECTED
DUPLICATE ID: ____________

SAMPLE LOCATION SKETCH:
[ ] YES
[ ] NO

PID Reading ____________

SAMPLES COLLECTED

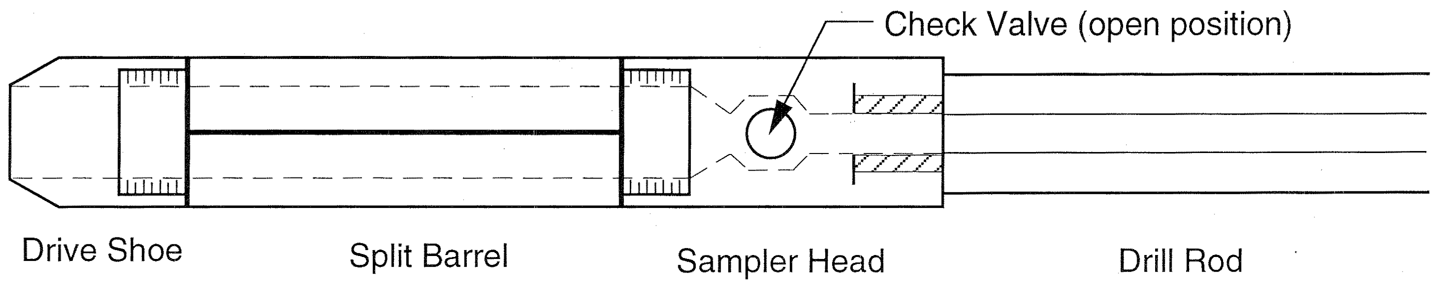
✓ IF REQUIRED AT THIS LOCATION	MATRIX: SURFACE SOIL	✓ IF SAMPLE COLLECTED	✓ IF PRESERVED	VOLUME COLLECTED/NOTES
[ ] VOC	[ ]	[ ]	[ ]	
[ ] SVOC	[ ]	[ ]	[ ]	
[ ] PEST	[ ]	[ ]	[ ]	
[ ] PCB	[ ]	[ ]	[ ]	
[ ] INORGANICS	[ ]	[ ]	[ ]	
[ ]	[ ]	[ ]	[ ]	
[ ]	[ ]	[ ]	[ ]	
[ ]	[ ]	[ ]	[ ]	
[ ]	[ ]	[ ]	[ ]	
[ ]	[ ]	[ ]	[ ]	
[ ]	[ ]	[ ]	[ ]	

NOTES/SKETCH

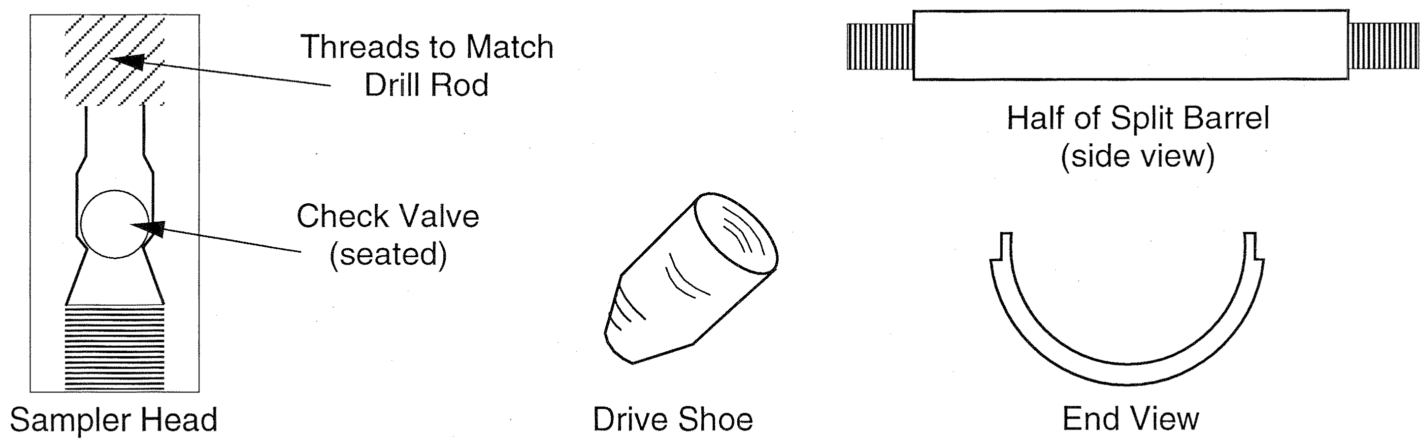
MACTEC
511 Congress Steet
Portland, ME 04101

FIGURE 4-12
SURFACE SOIL SAMPLE DATA RECORD
NYSDEC QUALITY ASSURANCE PROGRAM PLAN

SPLIT-SPOON SAMPLER



SPLIT-SPOON SAMPLER DISASSEMBLED

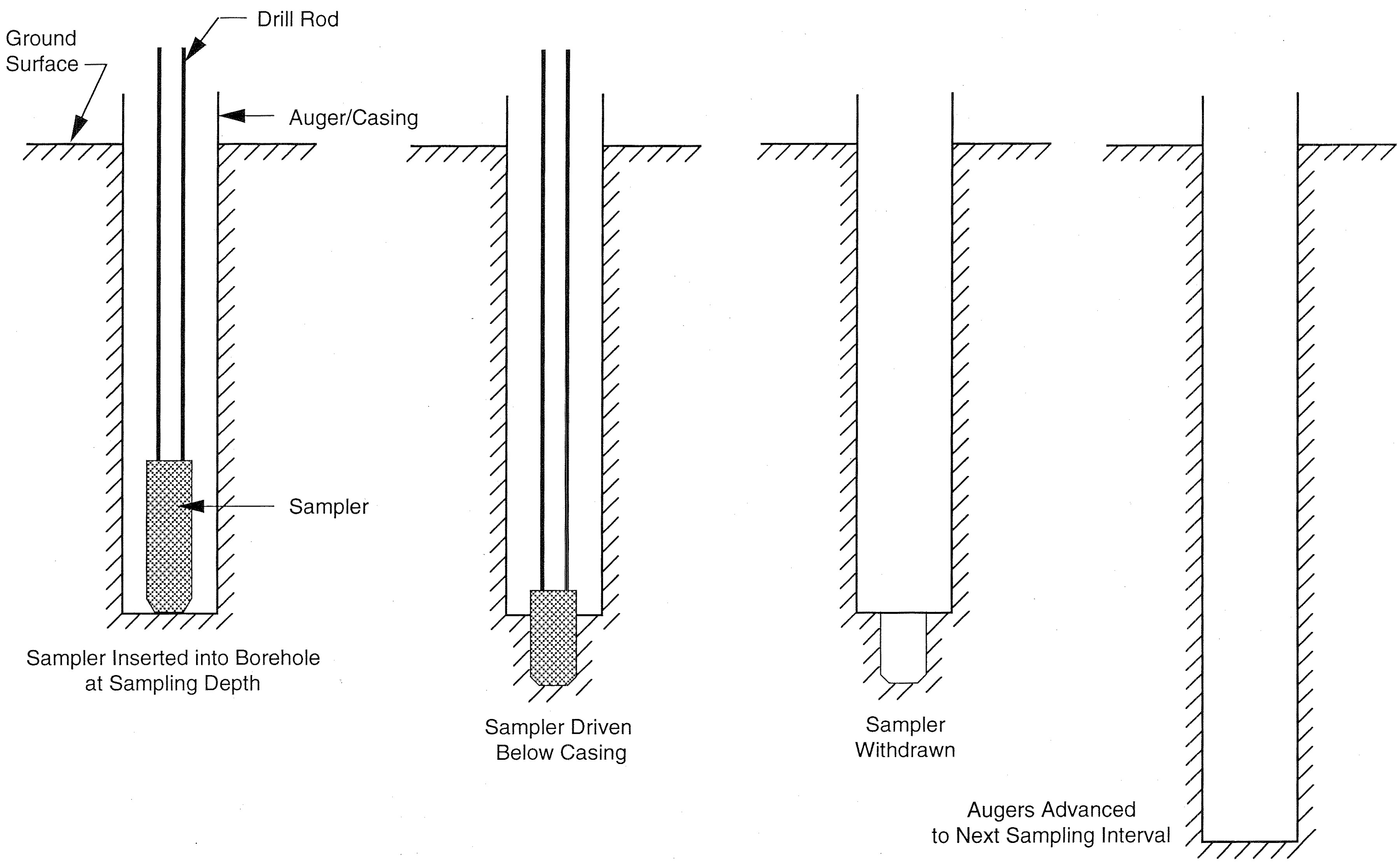


NOT TO SCALE

MACTEC
511 Congress Steet
Portland, ME 04101

FIGURE 4-13
SPLIT-SPOON SAMPLER
NYSDEC QUALITY ASSURANCE PROGRAM PLAN

PORT2007022k.mac



MACTEC
511 Congress Steet
Portland, ME 04101

FIGURE 4-14
STEPS IN SAMPLING A TEST BORING
NYSDEC QUALITY ASSURANCE PROGRAM PLAN

SURFACE WATER AND SEDIMENT SAMPLE FIELD DATA RECORD

Project: ______________________________ Site: ______________________________
Project Number: ______________________________ Date: ______________________________
Sample Location ID: [| | | | | | | | | | | | |] Time: Start: ____________ End: ____________
Signature of Sampler: ______________________________

SURFACE WATER INFORMATION

TYPE OF SURFACE WATER:
[ ] STREAM [ ] RIVER
[ ]POND/LAKE [ ] SEEP

WATER DEPTH AT SAMPLE LOCATION ____________ (ft)

DEPTH OF SAMPLE FROM TOP OF WATER ____________ (ft)

EQUIPMENT USED FOR COLLECTION:
[ ] NONE, GRAB INTO BOTTLE
[ ] BOMB SAMPLER
[ ] PUMP ____________

DECONTAMINATION FLUIDS USED:
✓ ALL USED
[ ] ETHYL ALCOHOL
[ ] 25% METHANOL/ 75% ASTM TYPE II WATER
[ ] DEIONIZED WATER
[ ] LIQUINOX SOLUTION
[ ] HEXANE
[ ] HNO_3 SOLUTION
[ ] POTABLE WATER
[ ] NONE

VELOCITY MEASUREMENTS OBTAINED? [ ] YES, SEE FLOW MEASUREMENT DATA RECORD ____________

TEMPERATURE ____________ Deg. C. SPEC. COND. ____________ µmhos/cm pH ____________ Units DISS. O_2 ____________ ppm

[ ] FIELD DUPLICATE COLLECTED
DUPLICATE ID: [| | | | | | | | | | | | |]

SAMPLE LOCATION SKETCH:
[ ] YES
[ ] NO

METHOD USED:
[ ] WINKLER
[ ] PROBE

SEDIMENT INFORMATION

DEPTH OF SEDIMENT SAMPLE ____________ (ft)

EQUIPMENT USED FOR COLLECTION:
[ ] GRAVITY CORER
[ ] S.S. SPLIT SPOON
[ ] DREDGE
[ ] HAND SPOON
[ ] ALUMINUM PANS
[ ] SS BUCKET
[ ] ____________

TYPE OF SAMPLE COLLECTED:
[ ] DISCRETE
[ ] COMPOSITE

SAMPLE OBSERVATIONS:
[ ] ODOR ____________
[ ] COLOR ____________
[ ] ____________

DECONTAMINATION FLUIDS USED:
✓ ALL USED
[ ] ETHYL ALCOHOL
[ ] 25% METHANOL/ 75% ASTM TYPE II WATER
[ ] DEIONIZED WATER
[ ] LIQUINOX SOLUTION
[ ] HEXANE
[ ] HNO_3 SOLUTION
[ ] POTABLE WATER
[ ] NONE

SEDIMENT TYPE:
[ ] CLAY
[ ] SAND
[ ] ORGANIC
[ ] GRAVEL

[ ] FIELD DUPLICATE COLLECTED
DUPLICATE ID: [| | | | | | | | | | | | |]

SAMPLES COLLECTED

✓ IF REQUIRED AT THIS LOCATION	MATRIX: SURFACE WATER	MATRIX: SEDIMENT	✓ IF SAMPLE COLLECTED	✓ IF PRESERVED	OBSERVATIONS/NOTES
[ ] VOC	[ ]	[ ]	[ ]	[ ]	
[ ] SVOC	[ ]	[ ]	[ ]	[ ]	
[ ] PEST/PCB	[ ]	[ ]	[ ]	[ ]	
[ ] INORGANICS	[ ]	[ ]	[ ]	[ ]	
[ ]	[ ]	[ ]	[ ]	[ ]	
[ ]	[ ]	[ ]	[ ]	[ ]	
[ ]	[ ]	[ ]	[ ]	[ ]	
[ ]	[ ]	[ ]	[ ]	[ ]	
[ ]	[ ]	[ ]	[ ]	[ ]	

NOTES/SKETCH

MACTEC
511 Congress Steet
Portland, ME 04101

FIGURE 4-15
SURFACE WATER AND SEDIMENT SAMPLE FIELD DATA RECORD
NYSDEC QUALITY ASSURANCE PROGRAM PLAN

LOW FLOW GROUNDWATER SAMPLING RECORD

PROJECT ______ SAMPLE I.D. NUMBER ______ SAMPLE TIME ______

EXPLORATION ID: ______ SITE ______ DATE ______

TIME START ______ END ______ JOB NUMBER ______ FILE TYPE ______

WATER LEVEL / PUMP SETTINGS

MEASUREMENT POINT
- ☐ TOP OF WELL RISER
- ☐ TOP OF PROTECTIVE CASING
- ☐ OTHER ______

PROTECTIVE CASING STICKUP (FROM GROUND) ______ FT

PROTECTIVE CASING / WELL DIFFERENCE ______ FT

INITIAL DEPTH TO WATER ______ FT

WELL DEPTH (TOR) ______ FT

PID AMBIENT AIR ______ PPM

WELL DIAMETER ______ IN

FINAL DEPTH TO WATER ______ FT

SCREEN LENGTH ______ FT

PID WELL MOUTH ______ PPM

WELL INTEGRITY:	YES	NO	N/A
CAP	___	___	___
CASING	___	___	___
LOCKED	___	___	___
COLLAR	___	___	___

DRAWDOWN VOLUME ______ GAL
(initial - final x 0.16 {2-inch} or x 0.65 {4-inch})

RATIO OF DRAWDOWN VOLUME TO TOTAL VOLUME PURGED ______

PRESSURE TO PUMP ______ PSI

TOTAL VOL. PURGED ______ GAL
(purge rate (milliliters per minute) x time duration (minutes) x 0.00026 gal/milliliter)

REFILL TIMER SETTING ______ SECONDS

DISCHARGE TIMER SETTING ______ SECONDS

PURGE DATA

TIME	DEPTH TO WATER (ft)	PURGE RATE (ml/m)	TEMP. (deg. c)	SPECIFIC CONDUCTANCE (ms/cm)	pH (units)	DISS. O2 (mg/L)	TURBIDITY (ntu)	REDOX (mv)	PUMP INTAKE DEPTH (ft)	COMMENTS

EQUIPMENT DOCUMENTATION

TYPE OF PUMP	TYPE OF TUBING	TYPE OF PUMP MATERIAL	TYPE OF BLADDER MATERIAL
☐ MARSCHALK BLADDER	☐ SILASTIC	☐ POLYVINYL CHLORIDE	☐ TEFLON
☐ SIMCO BLADDER	☐ HIGH DENSITY POLYETHYLENE	☐ STAINLESS STEEL	☐ OTHER ______
☐ GEOPUMP	☐ OTHER ______	☐ OTHER ______	

ANALYTICAL PARAMETERS
To Be Collected

	METHOD NUMBER	PRESERVATION METHOD	VOLUME REQUIRED	SAMPLE COLLECTED
☐ VOC	8260B	HCL / 4 DEG. C	3 X 40 mL	☐ VOC
☐ SVOC	CLP	4 DEG. C	2 X 1 L AG	☐ SVOC
☐ PEST / PCBs	CLP	4 DEG. C	2 X 1 L AG	☐ PEST / PCBs
☐ TAL INORGANICS	CLP	HNO3 to pH <2	1 x 1 L P	☐ TAL INORGANICS
☐ Other______	______	______	______	☐

PURGE OBSERVATIONS

PURGE WATER CONTAINERIZED YES NO

NUMBER OF GALLONS GENERATED ______

Signature: ______

MACTEC

511 Congress Street, Portland, Maine 04101

NOTES/LOCATION SKETCH

FIGURE 4-16
LOW FLOW GROUNDWATER DATA RECORD
NYSDEC QUALITY ASSURANCE PROGRAM PLAN

revised 10/12/2007

GROUNDWATER USAGE SURVEY

Name: ______________________________

Address: ______________________________

____

Telephone Number: (   ) ______________________________

DOMESTIC WATER SOURCE: (Circle One) **Private Well** **City Water Supply**

Do you foresee any changes in this source in the future ? ______________

If so, what ? ______________________________

If you have a private well:

How deep ? ________ **How old ?** ______ **Diameter ?** ______ **Drilled or Dug ?** ______

Plumbing material (Circle One) **PVC** (Plastic) **Copper**

Is the line connected to a Water Softening or other Treatment System ? ______________

____

Any problems ? (color, odor, taste, staining, inadequate supply) ______________

____

SEWAGE SYSTEM: (Circle One) **Private Septic System** **City Sewer Line**

Any problems ? ______________________________

____

Please sketch Well location, and Septic system with approximate distances to each other.

MACTEC
511 Congress Steet
Portland, ME 04101

FIGURE 4-17
GROUNDWATER USAGE SURVEY
NYSDEC QUALITY ASSURANCE PROGRAM PLAN

INDOOR AIR SAMPLING RECORD

Project Name:______________________ Client:___________________________ Location ID:___________________

Project Number:____________________ Collector:_________________________ Date:_________________________

SUMMA Canister Record Information:

SUBSLAB SOIL VAPOR SAMPLE		INDOOR AIR - BASEMENT		INDOOR AIR - FIRST FLOOR		ASSOCIATED AMBIENT	
Flow Regulator No:		Flow Regulator No:		Flow Regulator No:		Flow Regulator No:	
Flow Rate (mL/min):		Flow Rate (mL/min):		Flow Rate (mL/min):		Flow Rate (mL/min):	
Canister Serial No:		Canister Serial No:		Canister Serial No:		Canister Serial No:	
Start Date/Time:		Start Date/Time:		Start Date/Time:		Start Date/Time:	
Start Pressure ("Hg):		Start Pressure ("Hg):		Start Pressure ("Hg):		Start Pressure ("Hg):	
Stop Date/Time:		Stop Date/Time:		Stop Date/Time:		Stop Date/Time:	
Stop Pressure ("Hg):		Stop Pressure ("Hg):		Stop Pressure ("Hg):		Stop Pressure ("Hg):	
Sample ID:		Sample ID:		Sample ID:		Sample ID:	

Other Sampling Information:

Finished Basement, Crawl Space, Unfinished Basement		Story/Level:		Story/Level:		Direction from Building:	
Floor Slab Thickness:		Room:		Room:		Distance from Building:	
Potential Vapor Entry Points:		Potential Vapor Entry Points:		Potential Vapor Entry Points:		Distance from Roadway:	
Floor Surface:		Floor Surface:		Floor Surface:		Ground Surface:	
Noticable Odor:		Noticable Odor:		Noticable Odor:		Noticable Odor:	
PID Reading (ppb):		PID Reading (ppb):		PID Reading (ppb):		PID Reading (ppb):	
Intake Depth/Height:		Intake Height:		Intake Height:		Intake Hieght Above Ground Surface:	
Helium Test Conducted? Breakthrough %:		Indoor Air Temp:		Indoor Air Temp:		Intake Tubing Used?	

Comments/Location Sketch:

MACTEC

511 Congress Street, Portland, ME 04101

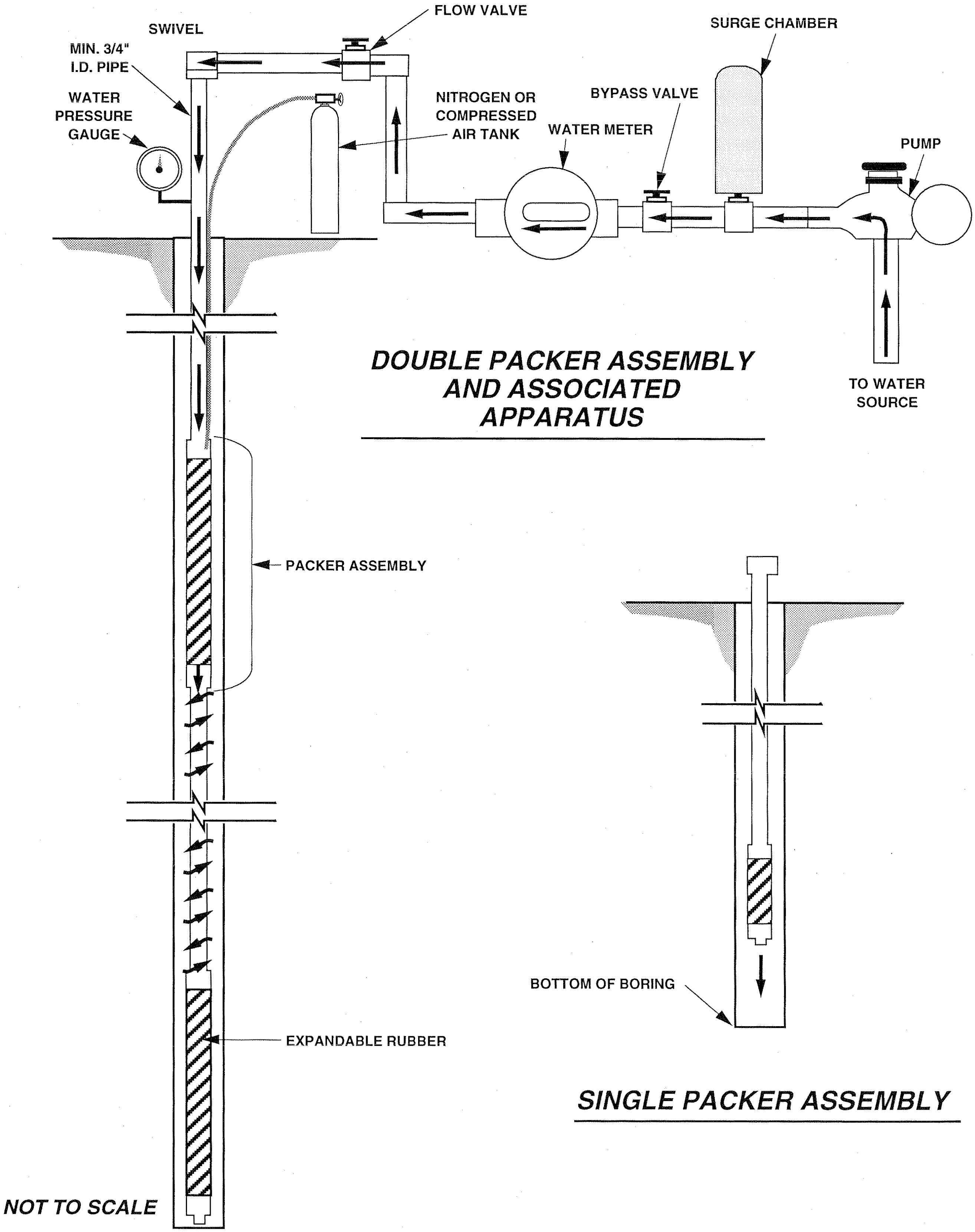
FIGURE 4-18
INDOOR AIR SAMPLING RECORD
NYSDEC QUALITY ASSURANCE PROJECT PLAN

AQUIFER TEST COMPLETION CHECKLIST

SETUP	DATE	AQUIFER TEST NO. ________ PERFORMED BY: ________
MONITORING WELL ID		
DATE OF TEST		
TYPE OF TEST		
HERMIT TYPE/SERIAL#		
TEST #		
DATA COLLECTION RATE		
TRANSDUCER		
SERIAL #		
PSIG		
SCALE FACTOR		
OFFSET		
INPUT CHANNEL		
TEST DATA		
INPUT MODE (TOC/SUR)		
STATIC WATER LEVEL (FT./TOC)		
WELL DEPTH (FT./TOC)		
XD DEPTH (FT.TOC)		
INITIAL XD REFERENCE		
SLUG DEPTH (FT./TOC)		
TIME OF SLUG PLACEMENT		
TIME OF WL EQUILIBRATION		
NEW XD REFERENCE		
START TIME OF TEST		
END TIME OF TEST		
NOTES:		

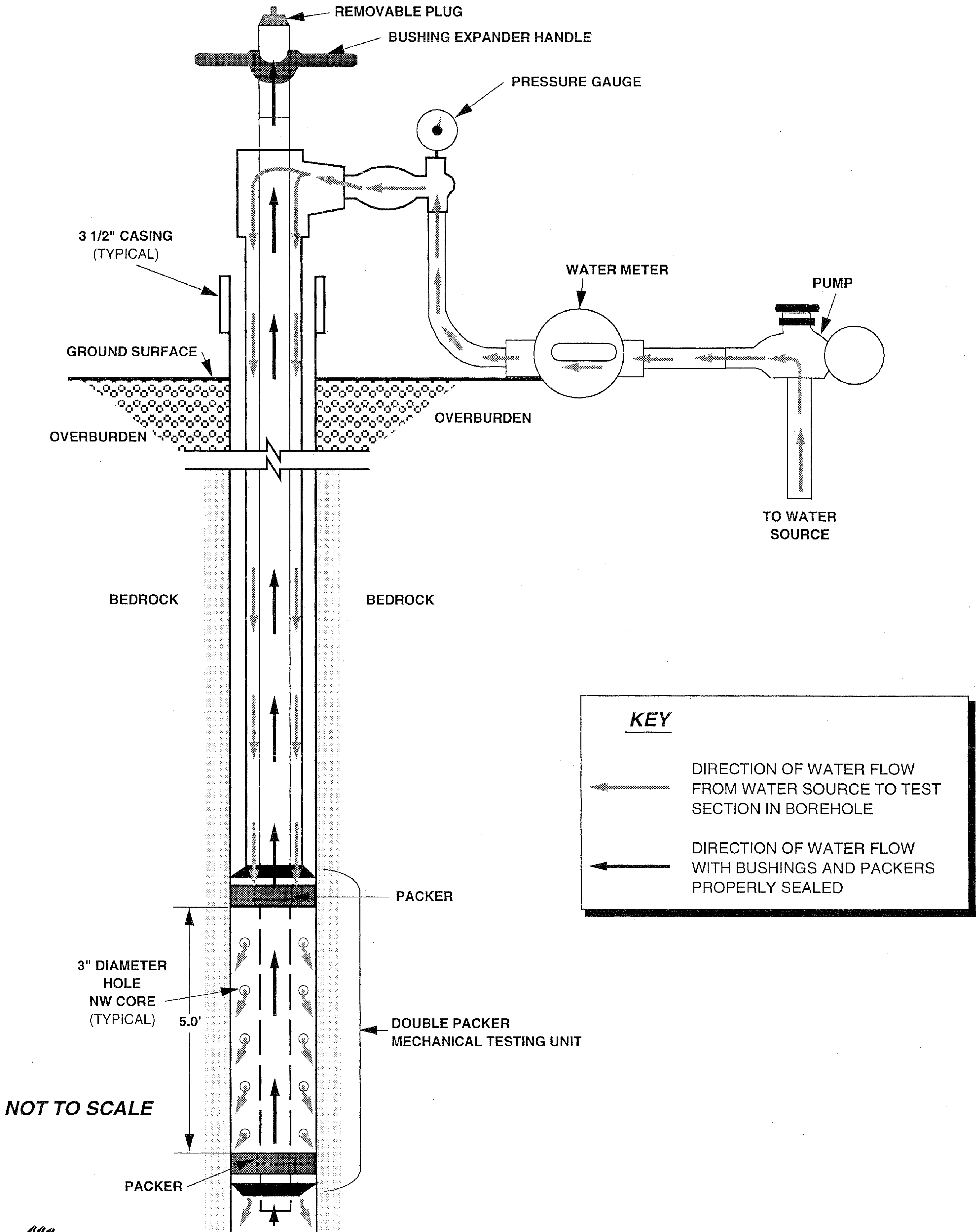
MACTEC
511 Congress Steet
Portland, ME 04101

FIGURE 4-19
AQUIFER TEST COMPLETION CHECKLIST
NYSDEC QUALITY ASSURANCE PROGRAM PLAN



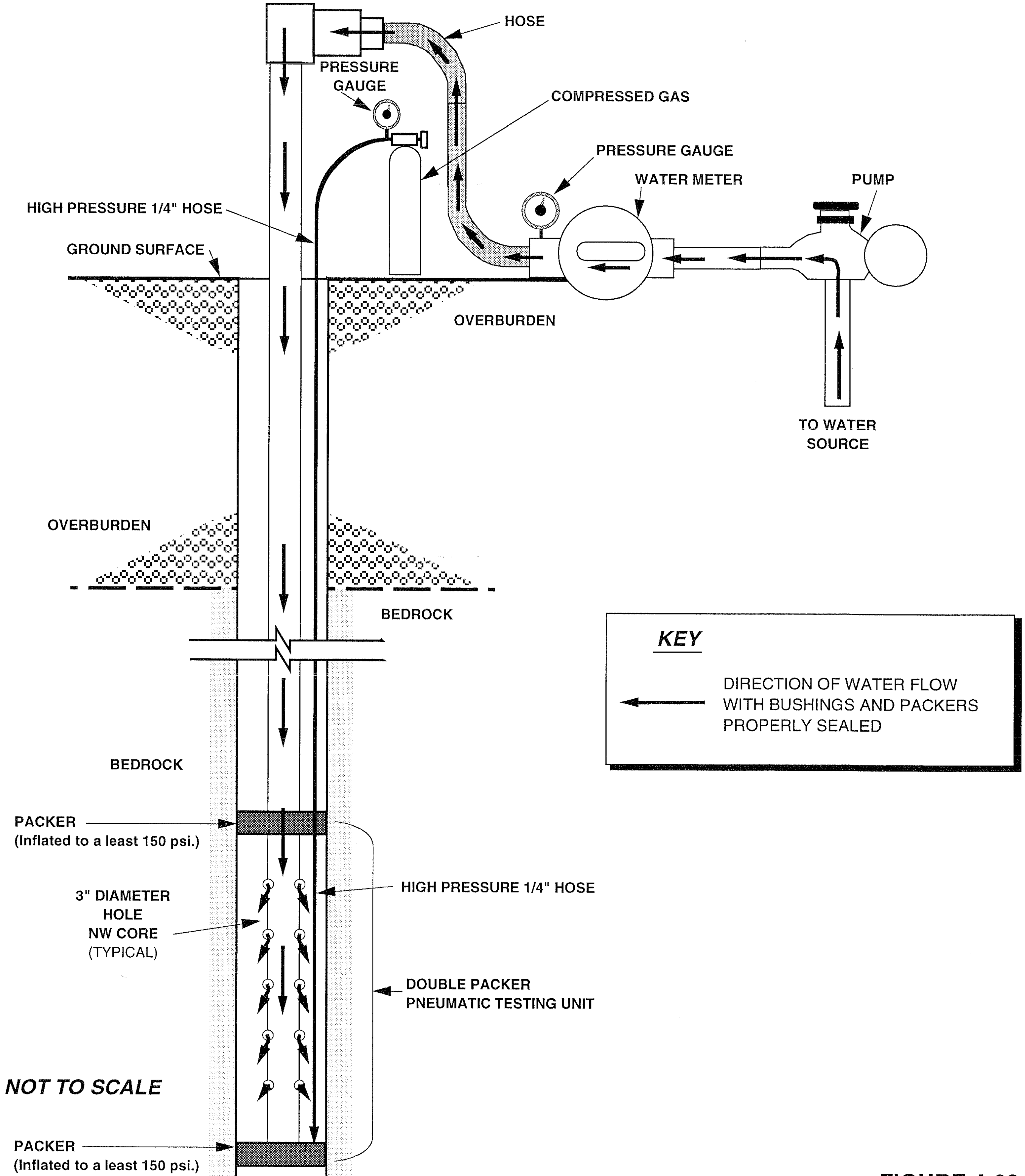
MACTEC
511 Congress Steet
Portland, ME 04101

FIGURE 4-20
EXAMPLE OF PACKER TEST SET UP
NYSDEC QUALITY ASSURANCE PROGRAM PLAN



MACTEC
511 Congress Steet
Portland, ME 04101

FIGURE 4-21
SCHEMATIC OF MECHANICAL PACKER PRESSURE TEST AND RELATED EQUIPMENT
NYSDEC QUALITY ASSURANCE PROGRAM PLAN



MACTEC
511 Congress Steet
Portland, ME 04101

FIGURE 4-22
SCHEMATIC OF PNEUMATIC PACKER PRESSURE TEST AND RELATED EQUIPMENT
NYSDEC QUALITY ASSURANCE PROGRAM PLAN

PACKER TEST LOG

Project: ______________________ Page 1 of ___

Client: ______________________ Contractor: ______________________

	Packer System	Water Meter	Water Gauge	Surge Chamber
Type:				
Manufacturer:				
Model Number:				

M.G.P. = (0.566 to 1.0) x Z

Computed Maximum Gauge Press (mgp): ______________

Computed Internal Friction: ______________

Rock Type: ______________

Hole Radius (Feet): ______________

Boring Number: ______________

Test Numbers: ______________

Job Number: ______________

Location: ______________

____

Elevation: ______________

Date Start: ______________

Date Finish: ______________

Driller: ______________

Geologist: ______________

Depths (all distances measured from ground surface in feet)

To Top of Rock: ______________ To Top of Lower Packer: ______________

To Bottom of Boring: ______________ To Bottom of Upper Packer: ______________

To Water Table: ______________ Length of Test Section: ______________

Height of Water Pressure Gauge Above Ground Surface: ______________

Test Interval (feet)	Test Number	Start Time	Elapsed Time (min)	Packer Pressure (psi)	Gauge Pressure (HP) (psi)	Meter Reading (gals)	Volume of Flow (Q) (gals/min)	Permeability (K) (feet/day)

Formula to Compute Permeability: $k = C \frac{Q}{2p\ L\ H_T} \text{IN} \frac{L}{r}$

Assumptions:
$L \geq 10r$
$H_T = (H_p \times 2.307) + H_g$
$C = 1.928 \times 10^2$

k = Permeability (feet/day)
Q = Constant Flow Rate (gallons per minute)
L = Length of Test Section (feet)
H_T = Differential Head on Test Section (feet)
r = Radius of Borehole (feet)
C = Conversion Factor to Obtain k in units of feet/day

MACTEC
511 Congress Street
Portland, ME 04101

FIGURE 4-23
PACKER TEST LOG
NYSDEC QUALITY ASSURANCE PROGRAM PLAN

TABLE 4-1
SAMPLE CONTAINER, PRESERVATION AND HOLD TIME REQUIREMENTS

NYSDEC QUALITY ASSURANCE PROGRAM PLAN

PARAMETER	MEDIUM	CONTAINER	VOLUME REQUIREMENTS	PRESERVATION	HOLDING TIMES[1]
Volatile Organics					
TCL VOCs	Low Soil/Sediment	VOA Vial	Fill - no headspace	Cool, 4°C	7 days
	Low Soil/Sediment	VOA Vial - field preserved	5 g	Cool, 4°C with sodium bisulfate	14 days
	High Soil/Sediment	VOA Vial - field preserved	10 g	Cool, 4°C with methanol	14 days
	Groundwater/Liquid	glass, Teflon® lined septa	(2) 40 mL	Cool, 4°C HCL to pH <2	14 days
Extractable Organics					
TCL SVOCs, TCL Pesticides/PCBs	Soil/Sediment	Glass, Teflon® lined lid	100 g	Cool, 4°C	14 days extract/40 days analyze
	Groundwater/Liquid	Glass, Teflon® lined cap	(2) l-L	Cool, 4°C	7 days extract/40 days analyze
Inorganics					
TAL Inorganics	Soil/Sediment	Glass	2g	Cool, 4°C	6 months
Mercury		Glass	1g	Cool, 4°C	28 days
Cyanide		Glass	10g	Cool, 4°C	14 days
Hexavalent Chromium		Glass	2g	Cool, 4°C	24 hrs.
TAL Inorganics	Groundwater/Liquid	Glass or Polyethylene	450 mL	HNO_3 to pH<2, 4°C	6 months
Mercury		Glass or Polyethylene	200 mL	HNO_3 to pH<2, 4°C	28 days
Cyanide		Glass or Polyethylene	1 L	NaOH to pH>12, 4°C	14 days
Hexavalent Chromium		Glass or Polyethylene	500 mL	Cool, 4°C	24 hrs.
TCLP					
VOCs	Soil/Sediment	Glass, Teflon® lined lid	3x100g	Cool, 4°C	7 days extraction/7 days analyze
SVOCs	Soil/Sediment	Glass, Teflon® lined lid	200g	Cool, 4°C	7 days extraction/7 days extraction/40 days analyze
Mercury	Soil/Sediment	Glass, Teflon® lined lid	200g	Cool, 4°C	7 days extraction/28 days analyze
Inorganics	Soil/Sediment	Glass, Teflon® lined lid	200g	Cool, 4°C	180 days extraction/180 days analyze
Pesticides	Soil/Sediment	Glass, Teflon® lined lid	200g	Cool, 4°C	7 days extraction/40 days analyze
Herbicides	Soil/Sediment	Glass, Teflon® lined lid	200g	Cool, 4°C	7 days extraction/40 days analyze
Ignitability	Soil/Sediment	Glass, Teflon® lined lid	25g	Cool, 4°C	28 days
Reactivity	Soil/Sediment	Glass, Teflon® lined lid	40g	Cool, 4°C	28 days
Corrosivity	Soil/Sediment	Glass, Teflon® lined lid	30g	Cool, 4°C	28 days

Notes:

[1] All holding times are from date of sample collection.

°C = Celsius
g = gram
Hg = mercury
HNO_3 = nitric acid
L = liter
mL = milliliter
NaOH = sodium hydroxide
PCB = polychlorinated biphenyls
SVOC = semivolatile organic compound
TAL = Target Analyte List
TCL = Target Compound List
VOC = volatile organic compound

TABLE 4-2
APPROXIMATE ELECTROMAGNETIC PROPERTIES OF VARIOUS MATERIALS

MATERIAL	RELATIVE DIELECTRIC PERMITIVITY	PULSE VELOCITY (ns/ft)
Air	1	1
Freshwater	81	9
Seawater	81	9
Sand (dry)	4 - 6	2.1 - 2.4
Sand (saturated)	30	5.5
Silt (saturated)	10	3.1
Clay (saturated)	8 - 12	2.8 - 3.3
Average "dirt"	16	4
Dry sandy coastal land	10	3.1
Marshy forested flat land	12	3.5
Rich agricultural land	15	3.9
Pastoral land, hilly, forested	13	3.6
Freshwater ice	4	2.0
Permafrost	4 - 8	2.0 - 2.9
Granite (dry)	5	2.2
Limestone	7 - 9	2.6
Concrete	6.4	2.5
Asphalt	3 - 5	1.7 - 2.5

Notes:

ns/ft = nanoseconds per foot

5.0 SAMPLE CUSTODY

5.1 GENERAL

MACTEC has established a program of sample COC that is followed during analytical sample handling activities in both field and laboratory operations. This program is designed to assure that each sample is accounted for at all times. To maintain this level of sample monitoring, computer-generated sample container labels and shipping manifests are normally employed. Field data sheets, COC records, and analytical request forms (ARFs) must be completed by the appropriate sampling and laboratory personnel for each sample. The objectives of the MACTEC COC program are to ensure:

- samples are uniquely identified;
- samples are collected for all scheduled analyses;
- the correct samples are analyzed for requested analyses and are traceable to their records;
- descriptions of important sample characteristics and field observations are recorded;
- samples are protected from loss or and area identified if damaged;
- alteration of samples (e.g., filtration, preservation) is documented;
- a forensic record of sample integrity is established;
- sample security is maintained; and
- relevant field information is recorded including location, sample number, date and time, identification of field samples, and individuals collecting the samples.

The COC protocol followed by the sampling crews involves the following steps:

- documenting procedures and amounts of reagents added to the sample during sample preparation and sample preservation;
- recording sampling locations, sample bottle identification, and specific sample collection procedures on the appropriate forms;

- using pre-prepared sample labels that contain all information necessary for effective sample tracking; and
- completing standard FDR forms to establish analytical sample custody in the field before sample shipment (see Subsection 4.5).

Prepared labels are normally developed for each sample to be collected. Each label is numbered to correspond with the appropriate sample(s) to be collected.

The COC record is used to document sample-handling information (i.e., sample location, sample identification, and number of containers corresponding to each sample number). The following information is recorded on the COC record:

- project reference;
- the site location code, sample identification number, date of collection, time of collection, sample bottle number, preservation, and sample type, number of containers, sample matrix;
- the names of the sampler(s) and the person shipping the samples;
- serial number of custody seals and shipping cases;
- the date and time that the samples were delivered for shipping;
- analyses required; and
- the names of those responsible for receiving the samples at the laboratory.

An example of a COC is shown in Figure 5-1. The COC is completed in triplicate. Two copies accompany the analytical samples to the laboratory; another is kept by the sample crew leader and maintained in the project file. The third copy is sent back with the analytical data package.

5.2 ANALYTICAL SAMPLE TRACKING

Tracking of samples commences at the time of sample collection. A site-specific database of anticipated sample collection is created as COCs are received from the field. The FOL will contact the laboratory to verify:

- analytical program;
- turnaround time;
- laboratory internal identification numbers; and
- COC for shipped samples

MACTEC uses the computerized tracking database to verify the completeness of data packages and electronic deliverables. Missing information is pursued by the project chemist, technical project leader, and QAO.

5.3 ANALYTICAL SAMPLE SHIPPING

Packing. Sample containers are generally packed in metal or hard plastic, insulated coolers for shipment. Bottles are packed tightly to minimize motion. Styrofoam, vermiculite, and "bubble pack" are suitable packing material for most instances. Ice is placed in double Ziploc® bags and added to the cooler along with all paperwork which is sealed in a separate Ziploc® bag. The cooler top is then taped shut. The samples are shipped to the laboratory together with the COC documents and the ARFs.

Shipping. The standard procedure for shipping environmental samples to the analytical laboratory is as follows:

1. All shipping of environmental samples collected by MACTEC personnel must be done through FedEx, or equivalent overnight delivery service. Receipts are retained as part of the

COC documentation. Samples will be shipped to the laboratory within 24 to 48 hours of sampling unless other arrangements are made with the laboratory.

2. If prompt shipping and laboratory receipt of the samples can not be guaranteed, (e.g., Sunday arrival), the samplers will be responsible for proper storage and custody of the samples until adequate shipping arrangements can be made.

The site leader keeps the laboratory informed of all field sampling activities. This communication is critical to allow the laboratory enough time to prepare for the sample shipment arrival.

Shaded Areas: Lab Use Only

Form No. ____________

MACTEC, Inc.
511 Congress Street
P.O. Box 7050
Portland, ME 04112-7050

CHAIN OF CUSTODY FORM

Page _____ of ____

Agreed Turnaround Time	Lab Batch No.	Lab ID:
☐ 24 hour ☐ 72 hour ☐ 5 Day ☐ 10 Day ☐ 3 Week ☐ Other	Seals Intact? ☐ Yes ☐ No ☐ NA	Shipping Container Damage? ☐ Yes ☐ No ☐ NA

PROJECT INFO		LABORATORY INFO		INVOICE (if other than MACTEC contact)	
MACTEC Contact	Project No.	Laboratory Name	Phone	Company Name	Phone
Project Title/No.	Purchase Order No.	Laboratory Contact	Fax	Company Contact	Fax
Address		Address		Address	
City/State/Zip		City/State/Zip		City/State/Zip	

Special Handling Instructions

Lab Sample No.	Date/Time Collected	Sample ID.	Sample Type[1]	Sample Media[2]	[C]omposite [G]rab	Sample Volume	Sample Location/Depth/Fraction/Etc. (describe if necessary)	Requested Analysis								

[1]Type	[2]Sample Media	[3]Analysis Requested
BIO - In-Vitro RS - Rad EN - Environ. MIX - Rad + Chem HAZ - Hazardous OTH - Other (describe)	VOL - Volumetric AF - Air Filter WIPE - Smear LIQ - Liquid OTH - Other (describe)	ALPHA - Alpha Spec. GROSS - Gross beta/gamma GAMMA - Gamma Spec. LSC - Liquid Scintillation OTH - Other (describe)

Relinquished by: Date/Time	Relinquished by: Date/Time
Received by: Date/Time	Received by: Date/Time
Relinquished by: Date/Time	Relinquished by: Date/Time
Received by: Date/Time	Received by: Date/Time

WHITE: Laboratory Copy   YELLOW: Report Copy   PINK: MACTEC Copy

FIGURE 5-1
CHAIN OF CUSTODY RECORD

6.0 CALIBRATION PROCEDURES

6.1 CALIBRATION PROCEDURES FOR LABORATORY EQUIPMENT

The calibration procedures used by the contract laboratories are specified by the NYSDEC ASP (NYSDEC, 2000) and are addressed in the QA documents for the laboratory subcontractor.

6.2 CONTROL OF MEASURING AND TEST EQUIPMENT

Inspection, measurement, and test equipment shall be controlled, calibrated, adjusted, and maintained at prescribed intervals. Critical spare parts will be kept on inventory to minimize downtime. Calibration shall be performed against certified equipment having known valid relationships to nationally recognized standards. If no national standard exists, the basis for calibration shall be documented.

The method and interval of calibration shall be defined and shall be based on equipment type, stability characteristics, required accuracy, and other considerations affecting measurement control. Special calibration shall be performed when accuracy of the equipment becomes suspect. When inspection, measurement, or test equipment are found to be out of tolerance, an evaluation shall be made of the validity and acceptability of previous inspection or test results. If any inspection, measurement, or test equipment is consistently found to be out of calibration, it shall not be made available for use. Records shall be maintained and equipment shall be suitably marked to indicate calibration status.

6.3 FIELD INSTRUMENT CALIBRATION

Each piece of equipment will be calibrated daily prior to use or as specified by the manufacturer. Calibration procedures and corrective actions are summarized on Table 6-1. Calibration data are recorded on a Field Instrumentation QA Record (Figure 6-1). The manufacturer and lot number of all standards will be noted on the field instrument QA record. The types of field measurements that may be made include but are not limited to the following:

- pH;
- specific conductance;
- temperature;
- DO;
- organic vapors; and
- turbidity.

FIELD INSTRUMENTATION CALIBRATION RECORD

PROJECT NAME ______________________ DATE __________ TIME __________

TASK ID ______________________ PROJECT NUMBER ______________________

SAMPLER SIGNATURE ______________________ CHECKED BY ______________________

EQUIPMENT CALIBRATION			CALIBRATION STANDARD VALUE	METER VALUE	ACCEPTANCE CRITERIA
HORIBA MODEL NO: ______					
UNIT ID NO: ______					
	pH	units	______	______	+/- 10% of Standard
	Redox	+/- mV	______	______	+/- 10% of Standard
	Conductivity	mS/cm	______	______	See Note 1
	DO	mg/L *	______	______	+/- 10% of Standard
	Thermometer Temperature	deg. C	______	______	+/- 10% of Standard
TURBIDITY					
METER TYPE ______		NTU (low)	______	______	Within 0.3 NTU of the Standard
MODEL NO: ______		NTU (other)	______	______	+/- 10% of Standard
UNIT ID NO: ______		NTU (other)	______	______	+/- 10% of Standard
		NTU (high)	______	______	+/- 10% of Standard
PHOTOIONIZATION		Background			
METER TYPE ______		ppmv	______	______	Within 5 ppm of Zero
MODEL NO: ______					
UNIT ID NO: ______		Span Gas ppmv	______	______	+/- 10% of Standard
OTHER METER TYPE ______					
MODEL NO: ______					
UNIT ID NO: ______			______	______	See Note 2

Check One

☐ Equipment calibrated within the Acceptance Criteria specified for each of the parameters listed above.

☐ Equipment (not) calibrated within the Acceptance Criteria specified for each of the parameters listed above (see notes below).

MATERIALS RECORD	LOT NUMBER
Deionized Water Source: ______	pH ______
Trip Blank Water Source: ______	ORP ______
Sample Preservatives Source: ______	Conductivity ______
Disposable Filter Type: ______	Turbidity ______
Calibration Fluids / Standard Source: ______	Other ______

NOTES:

* = Indicate in notes section what was used as the DO standard (ie, based on saturation at room temperature)

** = If the meter reading is not within acceptance criteria, clean or replace probe and re-calibrate, or use a different meter if available. If project requirement necessitate use of the instrument, clearly document on all data sheets and log book entries that the parameter was not calibrated to the acceptance criteria.

1 = meter must read within specified range of the Hannah solution (usually 240 +/- 10 mV) or within the range of another equivalent solutic

2 = specify acceptance criteria in the Notes section

MACTEC

511 Congress Street

Portland, ME 04101

FIGURE 6-1

FIELD INSTRUMENT CALIBRATION RECORD

NYSDEC QUALITY ASSURANCE PROJECT PLAN

Table 6-1: Field Instrument Calibration

Instrument	Activity	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA
pH Probe	Calibrate probe with temperature-equilibrated standards to bracket expected pH values	Daily-before use Calibration check - at end of day, or if instrument gives erratic results	Stable readings $\pm$ 0.1 pH units within 3 minutes	If probe reading fails to stabilize, do not use. Check/replace membrane and recalibrate or service as necessary. Repeat analysis of affected samples or qualify data if analysis cannot be repeated.	Task Leader and Field Samplers
DO Probe	Calibrate with 2 standards – saturated DO standard and 0.0 mg/L DO standard	Daily-before use Calibration check - at end of day, or if instrument gives erratic results	$\pm$ 0.2 mg/L for 0.0 mg/L.	If DO reading exceeds criterion, then prepare new 0.0 mg/L DO standard, clean probe and/or change membrane. Recalibrate or service as necessary. Repeat analysis of affected samples or qualify data if analysis cannot be repeated.	Task Leader and Field Samplers
Specific Conductance Electrode	Calibrate electrode with a standard solution close to expected sample values.	Daily-before use Calibration check - at end of day, or if instrument gives erratic results	$\pm$ 1 mS/cm of standard	If sp. conductance electrode reading exceeds criterion, then clean probe or service as necessary and recalibrate. Repeat analysis of affected samples or qualify data if analysis cannot be repeated.	Task Leader and Field Samplers
Thermistor-Temperature Sensor	Calibrate against NIST-certified thermometer.	Calibration check –prior to onset of program	$\pm$ 0.15 ^{o}C of NIST certified thermometer.	If temperature sensor reading exceeds criterion, then clean probe, or service as necessary and recalibrate. Repeat analysis of affected samples or qualify data if analysis cannot be repeated.	Task Leader and Field Samplers

Table 6-1: Field Instrument Calibration

Turbidimeter	HACH-calibrate with <0.01, 20, 100, and 800 NTU standards. LaMotte-calibrate with 0.1 and 10 NTU standards.	Daily-before use Calibration check-at end of day, or if instrument gives erratic results	$\pm$ 10% per scale.	If turbidity reading exceeds criterion, then calibrate or service as necessary. Repeat analysis of affected samples or qualify data if analysis cannot be repeated.	Task Leader and Field Samplers
ORP/ Eh Probe	Calibrate against a Zobell solution.	Daily-before use Calibration check -at end of day, or if instrument gives erratic results	$\pm$ 30 mv of standard	If ORP/Eh reading exceeds criterion, then have manufacture recalibrate. Repeat analysis of affected samples or qualify data if analysis cannot be repeated.	Task Leader and Field Samplers
Electronic Water-Level Indicator	Water Test	Daily-before use	$\pm$ 0.1 feet	Service.	Task Leader and Field Samplers
FID	Calibrate with 100 ppmV methane standard. Blank: zero air check	Daily-before use Calibration check – every 4 hours, at end of day, or if instrument gives erratic results	$\pm$ 10% of true value	Recalibrate or service; rerun affected sample.	Task Leader and Field Samplers
PID	Calibrate with 100 ppmV isobutylene standard. Blank: zero air check	Daily-before use Calibration check – every 4 hours, at end of day, or if instrument gives erratic results	$\pm$ 10% of true value	Recalibrate or service; rerun affected sample.	Task Leader and Field Samplers

7.0 ANALYTICAL PROGRAM

7.1 SELECTION OF PARAMETERS

Laboratory analyses will be scheduled based on historical information regarding potentially hazardous material disposal, previous site information, the determination of data objectives, and NYSDEC criteria. Specific parameters will be outlined in the site-specific Work Plan and/or QAPjP.

7.2 SELECTION OF PROCEDURES

The detailed sampling program and associated analytical methods will be documented in the site-specific Work Plan and QAPjP. The subcontract laboratory analytical procedures to be used for this program will be selected from the NYSDEC ASP (NYSDEC, 2000).

The uses of on-site field screening procedures may also be incorporated into field investigation programs. Target analytes and field screening procedures will be defined in the project Work Plans.

7.2.1 Subcontract Laboratory Analytical Methods

Off-site subcontract laboratory methods will be identified in the project Work Plans. The analytical parameters listed below represent methods that are commonly used during site investigation projects

<u>USEPA CLP</u>

VOCs by CLP SOW
SVOCs by CLP SOW
Pesticide/PCBs by CLP SOW

TAL Metals by CLP SOW

Detection limits defined as Contract Required Quantitation Limits and Contract Required Detection Limits are established in the CLP SOW. The CLP program has SOWs for low/medium Multi-Media, Multi-Concentration Organics Analysis (OLM) and Multi-Media, Multi-Concentration Inorganic Analysis (ILM) Methods) and organic, low concentration analysis (OLC methods). Projects that use CLP SOW procedures will identify the exact concentration range SOW in the project Work Plan.

USEPA SW-846

VOCs by Method 8260B
SVOCs by Method 8270C
Pesticides by Method 8081
PCBs by Method 8082
Organophosphorus Pesticides by Method 8141A
Herbicides by Method 8151A
Metals by Methods 6010B and 6020
Cyanide by Method 9010C or 9012B
Toxicity Characteristics Leaching Procedure 1311
RCRA Characteristics

USEPA Drinking Water

VOCs by Method 524.2

USEPA Waste Water Methods

VOCs by Method 624

SVOCs by Method 625

Pesticides/PCBs by Method 608

For non-CLP methods, the exact TCL, and the quantitation limits and method detection limits, will be identified for each project sampling task in the project Work Plans. The detection limits will be evaluated during the development of data quality objects to ensure that detection limits are low enough to meet project objectives.

7.2.2 Field Screening Methods

Analytical chemistry data may be collected in the field using field analytical techniques. Field screening procedures may be used to support a number of activities that require real time data for decision making in the field. Use of field screening may also be added to a project as a cost effective means of collecting a larger number of samples. Field screening data may be qualitative or quantitative depending on the project objectives. In situations where obtaining quantitative data is a DQO, a subset of samples will be collected as split samples and analyzed at an off-site laboratory. A data comparison study will be completed to evaluate the comparability of the results.

The following scenarios may incorporate the use of field screening data:

- Screening of soil, water, or air samples for presence, absence, or relative concentration of contaminants
- Screening of soil sampling intervals to provide data for selection of samples shipped to an off-site laboratory
- Screening of groundwater intervals for well screen placement decisions
- Screening of soil, water, or air samples for the selection of soil or groundwater exploration locations

Portable Gas Chromatograph

A 10S50 Portable Gas Chromatograph may be used for VOC screening of soil, water, or air samples. The instrument is calibrated with know concentration standards and provides a means of collecting real time data on VOCs. Field screening objectives, target compounds, reporting limits, and Standard Operating Procedures (SOPs) will be identified in the project Work Plans.

Mobile Laboratory Sevices

For some projects, a mobile laboratory may be set up on the facility to provide on-site laboratory services using USEPA methods. These methods may include analyses for VOCs, SVOCs, pesticides, PCBs, metals, or any other target analytes that are included in the program. Mobile laboratory objectives, target analytes, reporting limits, and SOPs will be identified in the project Work Plans.

Field Test Kits

A variety of field test kits are available for testing water chemistry parameters or target analytes. Methods have been approved as field screening procedures by the USEPA (USEPA; 1996). These include colorimetric tests and immunoassay methods. The following field screening methods may be considered for use in support of field investigation activities:

Pentachlorophenol by Method 4010A
PCBs by Method 4020
Petroleum Hydrocarbons by Method 4030
PAH by Method 4035
Ferrous Iron by HACH kit
Hexavalent Chromium by HACH kit
Sulfide by HACH

Field screening objectives, target compounds, reporting limits, and SOPs will be identified in the project Work Plans.

7.2.3 Sediment Moisture Content.

Sediment samples may have high percent moisture content. With the exception of samples for VOC and AVS:SEM analysis, the laboratory will take steps to reduce the effect of moisture content and achieve the reporting limits and project action limits. Potential steps include:

- Centrifuging the sample and decanting off the layer of water above the solid matrix;
- Sample drying;
- Increasing sample volume size;
- Performing multiple extractions and combining extracts prior to analysis; or,
- Other alternatives proposed by the laboratory.

7.3 LABORATORY CERTIFICATION

Analyses will be performed by a laboratory certified by the NYSDOH. The selected laboratory will be identified in the site-specific Work Plan.

7.4 LABORATORY DATA PACKAGE DELIVERABLES

Data reporting requirements for each site-specific sampling event will be defined in the project Work Plan. Data packages for most analytical data sets will be either Category A, Category B, or CLP as defined in the ASP (NYSDEC, 2000).

7.5 ELECTRONIC DATA DELIVERABLE

MACTEC uses a standardized data management process for all NYSDEC projects completed under the Superfund programs. This includes routines to capture sample information at all stages of a site investigation and storage of electronic data in a permanent database. MACTEC has developed the TED (Technical Environmental Database), a SQL Server based relational database. MACTEC uses an Equis based TED electronic data deliverable (EDD) format that laboratories can use to provide electronic data deliverables need to load laboratory results into TED. A description of the TED EDD format is presented in Table 7-1. MACTEC has also developed programs to read and parse USEPA CLP data formats into TED.

TABLE 7-1
ELECTRONIC DATA DELIVERABLE REQUIREMENTS
NYSDEC QUALITY ASSURANCE PROJECT PLAN

Equis "EZEDD01" Field Name	data type	Required For "EDD"	Description	"TED" Table	"TED" Column
project_code	1 Text20	X	This field contains the internal project_code used by TED to identify a unique site. This will be provided to the lab on a per project basis.	Location	Site_id
sample_name	2 Text30	X	This field contains the sample number as written in the Analysis Request and Chain of Custody (AR/COC) form sent to the laboratory with the field samples for analysis. This is a unique number assigned to each sample by sampling personnel. For laboratory samples enter "LAB QC".	sample_collection	field_sample_id
sys_sample_code	3 Text20				
sample_date	4 Date	X	mm/dd/yyyy. Date sample was collected in the field. Date information must be identical with the date from the AR/COC form. Leave blank for lab samples. Year may be entered as yyyy.	sample_collection	field_sample_date
sample_time	5 Time				
analysis_location	6 Text2				
lab_name_code	7 Text10	X	Laboratory that performed the analysis.	sample_analysis	lab_id
lab_sample_id	8 Text20	X	Unique sample ID internally assigned by the laboratory.	sample_analysis	lab_sample_id
sample_type_code	9 Text10	X	Specifies sample type. For field samples, enter FS (regular environmental sample), otherwise, use values listed in the LOV. For example, normal field samples must be distinguished from laboratory method blank samples, etc.	sample_collection	qc_code
Lab_Del_Group	10 Text20	X	Tracking code used by the laboratory. Commonly called Sample Delivery Group (SDG).	sample_analysis	lab_sample_delivery_group
Lab_Batch_Number	11 Text20		Tracking number used by the laboratory to identify a group of samples analyzed in the same batch. This field, in conjunction with laboratory blank ID, is used to link the relationship between field samples and laboratory blank and other QC samples.		
lab_anl_method_name	12 Text35	X	Test method used in the analysis of the analyte.	sample_analysis	analysis_method

TABLE 7-1
ELECTRONIC DATA DELIVERABLE REQUIREMENTS
NYSDEC QUALITY ASSURANCE PROJECT PLAN

Equis "EZEDD01" Field Name	data type	Required For "EDD"	Description	"TED" Table	"TED" Column
cas_rn	13 Text15	X	Unique analyte identifier. Use assigned CAS number when one is identified for an analyte. Tentatively Identified Compounds (TICs) and a number of other analytes are not assigned a standard CAS number. The laboratory is required to assign a UNIQUE identifier for all chemical_names.	sample_analysis_results	casno
chemical_name	14 Text60	X	Name of analyte or parameter analyzed.		
result_value	15 Text20	X	Must only be a numeric value. It is stored as a string of characters so that significant digits can be retained. Must be identical with values presented in the hard copy. Analytical result is reported left justified. Reported as the reporting_detection_limit for non-detects.	sample_analysis_results	lab_result
lab_qualifiers	16 Text7	X	Qualifier flags assigned by the laboratory.	sample_analysis_results	lab_qualifier
result_unit	17 Text15	X	This format assumes that the result value and detect limit have the same units.	sample_analysis_results	result_uom
result_type_code	18 Text10	X	Type of result (TIC, target analyte, etc.)	sample_analysis_results	result_type
detect_flag	19 Text2	X	Enter “Y” for detected analytes or “N” for non-detected analytes.	sample_analysis_results	report_hit_flag
reporting_detection_limit	20 Text20	X	Must only be a numeric value. Use the value of the Reported Detection Limit (RDL), Practical Quantitation Limit (PQL), or Contract Required Quantitation Limit. Value is stored as a string to retain significant figures. Unit of measure must be identical with result_unit value.	sample_analysis_results	detection_limit
dilution_factor	21 Text6	X	Must be a numeric entry. The factor by which the sample was diluted as part of the preparation process. If no dilution was done, enter the value 1. Value is stored as a string to retain significant figures.	sample_analysis	dilution_factor
sample_matrix_code	22 Text10	X	Code which distinguishes between different type of sample matrix. For example, soil samples must be distinguished from ground water samples, etc. Valid codes for HESE are "G" (gas), "L" (liquid), "S" (solid), and "P" (free or raw liquid product).	sample_collection	matrix

TABLE 7-1
ELECTRONIC DATA DELIVERABLE REQUIREMENTS
NYSDEC QUALITY ASSURANCE PROJECT PLAN

Equis "EZEDD01" Field Name	data type	Required For "EDD"	Description	"TED" Table	"TED" Column
total_or_dissolved (or fraction)	23 Text1	X	Must be "T" for total metal concentration, "D" for dissolved or filtered metal concentration, or "N" for organic (or other) parameters for which neither "total" nor "dissolved" is applicable. Also, HESE requires "C" for TCLP and "S" for SPLP fractions.	sample_analysis	fraction
basis	24 Text10				
analysis_date	25 Date	X	mm/dd/yyyy. Date sample was analyzed.	sample_analysis	analysis_date
analysis_time	26 Time				
method_detection_limit	27 Text20				
lab_prep_method_name	28 Text35		Description of sample preparation or extraction method.	sample_analysis	prep_method_name
prep_date	29 Date	X	mm/dd/yyyy. This field is used to determine whether holding times for field samples have been exceeded.	sample_analysis	extraction_date
prep_time	30 Time				
test_batch_id	31 Text20				
result_error_delta	32 Text20				
TIC_retention_time	33 Text8				
qc_level	34 Text10		Laboratory QC level associated with the analysis	sample_analysis	qc_level
result_comment	35 Text255		Any comments related to the analysis.	sample_analysis_results	comments
sample_quantitation_limit (may be REQUIRED FIELD for certain projects)	36 Text20		Must only be a numeric value. Use the value of the Sample Quantitation Limit (SQL). Value is stored as a string to retain significant figures. Unit of measure must be identical with result_unit value.	sample_analysis_results	TBD

Note: All "X" marked fields are minimum data required to load data to "TED".

8.0 DATA REDUCTION, VALIDATION AND REPORTING

MACTEC will establish protocols for data reduction, validation, and reporting in the site-specific Work Plan and/or QAPjP.

8.1 REDUCTION

Data reduction is the process of converting measurement system outputs to an expression of the parameter which is consistent with the comparability objective. Calculations made during data reduction are described in the referenced analytical methods and in the participating laboratory QA Program.

Upon receipt, analytical data packages are turned over to the data management staff for reduction to standard data tabulations. Analytical data includes hard copy, and electronic data deliverables that are downloaded directly to the TED. During the data review process the electronic data are checked against the hardcopy data package to verify that no systematic error occurred during the production of the electronic deliverable.

Completed data tabulations are provided to the data validation staff along with the original data packages.

8.2 VALIDATION

For the majority of analytical data collected under this program, a data usability review will be completed in accordance with NYSDEC Data Usability Summary Report Guidelines (DUSR) [NYSDEC, 2002a]. During the DUSR review the results are reviewed using the laboratory hardcopy deliverables to verify that results were reported and qualified correctly by the laboratory, and to evaluate QC measurements to determine the usability of results. Additional data qualifiers may be added to the results using professional judgment of the project chemist and general procedures specified in USEPA Region II validation guidelines.

A DUSR is prepared for each project sampling task. The MACTEC QAO completes a final review of the DUSR before data are finalized. The DUSR includes the following information:

- Site Location and Sampling Event
- Subcontract Laboratory Name and Address
- Summary of Analytical Methods
- Data Quality Observations and Data Qualification Summary
- Table of Final Results and Qualifiers

If a formal validation of data is required, the requirement will be identified in the project Work Plan and confirmed with the NYSDEC PM. Validation of laboratory data will be performed in accordance with *National Functional Guidelines for Organics Review*, (USEPA, 1999) and *Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analyses* (USEPA, 2004), as well as the appropriate USEPA Region II revisions to these protocols.

An example summary of the presentation of final DUSR or validation results is included in Figure 8-1.

8.3 DATA MANAGEMENT AND REPORTING

MACTEC uses a standardized data management process for all NYSDEC projects completed under the Superfund programs. This includes routines to capture sample information at all stages of a site investigation and storage of electronic data in a permanent database. MACTEC has developed the TED, a SQL Server based relational database. TED contains fields to store raw laboratory results, validated laboratory results, site spatial data and geotechnical information. Federal and NY State site-specific regulatory standards have also been included in the database and are available to project for comparison to laboratory results.

MACTEC uses an Equis based TED EDD format that laboratories can use to provide electronic data deliverables need to load laboratory results into TED. A description of the TED EDD format is presented in Table 7-1. MACTEC has also developed programs to read and parse USEPA CLP data formats into TED.

Computerized routines in TED are used to produce temporary data spreadsheets for data review and data qualification during completion of DUSRs and validation reports. These spreadsheets are used to input final results and qualifiers into the TED once data review is completed. Final cross tabulation data tables including complete results for all samples and methods are produced with each DUSR directly from the TED. An example of a final data table is included in Figure 8-1.

A variety of other data outputs are routinely created from data in TED. These include risk assessment statistical tables, laboratory split sample comparison tables, detected contaminant crosstab tables (hit tables), and comparison to applicable or relevant and appropriate requirements (ARARs) crosstab tables (Exceedance tables). Analytical results in TED can be used in a variety of GIS data graphics and plotting programs including CADD. The following tables are often prepared to present data in site reports:

- Hits Only Cross Tabulation Tables
- Analyte Frequency and Concentration Summary Tables
- Data Comparisons to Regulatory Standards

User access to TED projects is password protected. Users are assigned roles which limit their ability to modify data. The majority of users have only read capability. TED files are fully backed up on a nightly schedule, with incremental backups scheduled throughout the day. Updates and

Deletes to the database are recorded and preserved for tracking, along with a date stamp and the users initials.

TED is also used for computerized sample tracking for projects that choose to use the Tracking Module. In TED, the sample tracking programs are used to provide labels and bottle information before samples are collected through automated COC and shipping information for shipping samples to the lab to producing a tracking file to quickly verify that all analyses requested from the lab are returned.

Region II Multimedia Electronic Data Deliverable

The delivery of data in the Region II Multimedia Electronic Data Deliverable (MEDD) may be specified for a subset of projects in the project specific Work Plans. For these projects, a computerized routine is used to convert the TED data directly into the MEDD format. It will be the responsibility of the MACTEC PM to identify the need for an MEDD prior to initiating field activities.

FIGURE 8-1: FINAL RESULTS CROSS TABULATION TABLE

Lab Sample Id	X4779-20		X4779-21		X4826-01		X4826-02		X4826-06	
SDG	X4779		X4779		X4826		X4826		X4826	
Location	MW-13D		MW-3		MW-16L		MW-16U		GW-14	
Field Sample Id	HTMWD1302601XX		HTMW00301801XX		HTMW16L03001XX		HTMW16U02201XX		HTGW01402501XX	
Field Sample Date	10/3/2006		10/3/2006		10/4/2006		10/4/2006		10/9/2006	
Qc Code	FS		FS		FS		FS		FS	
Parameter	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**
1,1,1-Trichloroethane	10	U	10	U	10	U	10	U	10	U
1,1,2,2-Tetrachloroethane	10	U	10	U	10	U	10	U	10	U
1,1,2-Trichloro-1,2,2-Trifluoroethane	10	U	10	U	10	U	10	U	10	U
1,1,2-Trichloroethane	10	U	10	U	10	U	10	U	10	U
1,1-Dichloroethane	10	U	10	U	10	U	10	U	10	U
1,1-Dichloroethene	10	U	10	U	10	U	10	U	10	U
1,2,4-Trichlorobenzene	10	U	10	U	10	U	10	U	10	U
1,2-Dibromo-3-chloropropane	10	U	10	U	10	U	10	U	10	U
1,2-Dibromoethane	10	U	10	U	10	U	10	U	10	U
1,2-Dichlorobenzene	10	U	10	U	10	U	10	U	10	U
1,2-Dichloroethane	10	U	10	U	10	U	10	U	10	U
1,2-Dichloropropane	10	U	10	U	10	U	10	U	10	U
1,3-Dichlorobenzene	10	U	10	U	10	U	10	U	10	U
1,4-Dichlorobenzene	10	U	10	U	10	U	10	U	10	U
2-Butanone	50	U	50	U	50	U	50	U	50	U
2-Hexanone	50	U	50	U	50	U	50	U	50	U
4-Methyl-2-pentanone	50	U	50	U	50	U	50	U	50	U
Acetic acid, methyl ester	10	U	10	U	10	U	10	U	10	U
Acetone	50	U	50	U	50	U	50	U	50	U
Benzene	10	U	10	U	10	U	10	U	10	U
Bromodichloromethane	10	U	10	U	10	U	10	U	10	U
Bromoform	10	U	10	U	10	U	10	U	10	U
Bromomethane	10	U	10	U	10	U	10	U	10	U
Carbon disulfide	10	U	10	U	10	U	10	U	10	U
Carbon tetrachloride	10	U	10	U	10	U	10	U	10	U
Chlorobenzene	10	U	10	U	10	U	10	U	10	U
Chlorodibromomethane	10	U	10	U	10	U	10	U	10	U
Chloroethane	10	U	10	U	10	U	10	U	10	U
Chloroform	10	U	10	U	10	U	10	U	10	U
Chloromethane	10	U	10	U	10	U	10	U	10	U
Cis-1,2-Dichloroethene	10	U	0.88	J	9.8	J	6.4	J	23	
cis-1,3-Dichloropropene	10	U	10	U	10	U	10	U	10	U
Cyclohexane	10	U	10	U	10	U	10	U	10	U
Dichlorodifluoromethane	10	U	10	U	10	U	10	U	10	U
Ethyl benzene	10	U	10	U	10	U	10	U	10	U
Isopropylbenzene	10	U	10	U	10	U	10	U	10	U

FIGURE 8-1: FINAL RESULTS CROSS TABULATION TABLE

Lab Sample Id	X4779-20		X4779-21		X4826-01		X4826-02		X4826-06	
SDG	X4779		X4779		X4826		X4826		X4826	
Location	MW-13D		MW-3		MW-16L		MW-16U		GW-14	
Field Sample Id	HTMWD1302601XX		HTMW00301801XX		HTMW16L03001XX		HTMW16U02201XX		HTGW01402501XX	
Field Sample Date	10/3/2006		10/3/2006		10/4/2006		10/4/2006		10/9/2006	
Qc Code	FS		FS		FS		FS		FS	
Parameter	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**	**Result**	**Qualifier**
Methyl cyclohexane	10	U	10	U	10	U	10	U	10	U
Methyl Tertbutyl Ether	10	U	10	U	10	U	10	U	10	U
Methylene chloride	10	U	10	U	10	U	10	U	10	U
o-Xylene	10	U	10	U	10	U	10	U	10	U
Styrene	10	U	10	U	10	U	10	U	10	U
Tetrachloroethene	10	U	10	U	10	UJ	10	UJ	10	U
Toluene	10	U	10	U	10	U	10	U	10	U
trans-1,2-Dichloroethene	10	U	10	U	10	U	10	U	10	U
trans-1,3-Dichloropropene	10	U	10	U	10	U	10	U	10	U
Trichloroethene	15		25		10		11		9.1	J
Trichlorofluoromethane	10	UJ	10	UJ	10	U	10	U	10	U
Vinyl chloride	10	U	10	U	5.5	J	0.97	J	10	U
Xylene, m/p	10	U	10	U	10	U	10	U	10	U

Notes:
Results in micrograms per liter (µg/L)
Samples analyzed for VOCs by EPA Method OLM04.2
QC Code:
FS = Field Sample
FD = Field Duplicate
TB = Trip Blank
Qualifiers:
U = Not detected at a concentration greater than the RL
J = Estimated Value
D = Analyte was reported from a dilited analytical run.
B = Analyte was detected in the method blank

9.0 INTERNAL QUALITY CONTROL

9.1 FIELD QUALITY CONTROL

QC procedures have been established for MACTEC field activities. Field QC activities include the use of calibration standards for pH, specific conductance, temperature, and PIDs as described in Section 6.

A routine process of collecting field QC samples will be incorporated into all field programs unless otherwise directed by the NYSDEC PM. Field QC samples to be submitted to the laboratory include:

trip blanks
equipment blanks
field duplicates
matrix spikes

These samples provide a quantitative basis for evaluating the data reported. The site-specific Work Plan will specify the number and type of QC samples to be obtained during field activities.

Trip Blanks. Trip blanks are required for assessing the potential for contaminating aqueous VOC samples during sample shipment. The trip blank consists of a VOC sample container filled by the laboratory with reagent water and is shipped to the site with other VOC sample containers. A trip blank is included with each shipment of water samples scheduled for VOC analysis and will be analyzed with the other VOC samples.

Soil samples that are collected as unpreserved samples will utilize a water trip blank. Soil samples that are preserved in the field will utilize a trip blank that is prepared with the preservation fluid used in the actual samples (sodium bisulfate or methanol).

Field Duplicates. Field duplicates of soil and water samples will be submitted for analysis of all site-specific parameters at a rate of 5 percent of the samples collected. These duplicates are intended to assess the homogeneity of the sampled media and the precision of the sampling protocol.

Equipment Blanks. Equipment blanks (i.e., rinsate blanks) for the bailer, sampling pump, and/or tubing assembly are scheduled during monitoring well sampling at a rate of 5 percent of the samples collected. VOCs and SVOCs or inorganics present within the bailer, pump apparatus, or discharge tubing are assessed by collecting a sample of reagent water passed through the sampling apparatus after washing with the decontamination solution followed by at least one rinse with reagent water. If dedicated equipment is used at a site, the need for equipment blanks may be dropped from the sampling program.

Soil equipment blanks are collected during each field event at a rate of 5 percent of the samples collected. VOC, SVOC, or inorganics present within or on the sampling apparatus where intimate contact with the sample occurs (i.e., split-spoon, trowel), are assessed by rinsing the sampling apparatus with deionized water following decontamination. Rinsate blanks are collected directly into the appropriate water container.

Matrix Spike/Matrix Spike Duplicates (MS/MSD). The NYSDEC ASP requires the laboratory to analyze MS/MSDs for organic analyses at a frequency of 5 percent. To meet this requirement the MACTEC field operation leader (FOL) will select samples for MS/MSD analyses and will provide additional sample volume to the laboratory.

9.2 QUALITY REVIEW OF STUDIES AND REPORT PREPARATION

Quality reviews are performed during the course of a project to ensure that all project deliverables meet currently accepted professional standards. The level of effort for each assignment will vary depending on type of assignment, project objectives and goals, duration, and size. Review of the project will entail periodic discussions between technical staff, Task Leaders, Site Managers, QAO, QRB, PM, and Program Manager.

To enhance the professional quality of the company's studies and reports, the PM and Program Manager will:

- require that reports refer to and are consistent in scope with the project proposal and contract; and
- require that the report be organized and written so that (1) NYSDEC understands the risks and uncertainties associated with the report and (2) facts are distinguished from opinion, and risks and limitations are identified.

Implementation of QC for reports involves the use of a technical review routing and sign-off forms. Figure 9-1 illustrates the Deliverable Review Tracking Form. The PM and Program Manager provide final review and release for all deliverables.

DELIVERABLE REVIEW TRACKING FORM

Project Title: **Project No.:**

Client: **New York State Department of Environmental Conservation (NYSDEC)**

Deliverable Title:

Author(s):

Date to be Shipped: **Due Date to Client:**

	DRAFT REPORT	
ASPECTS REVIEWED	**REVIEWED BY**	**DATE**
Format/Organization (PM)		
Conforms to Scope (PM)		
Technical Approach (TR)		
Computations Checked (TR)		
Figures Checked (TR)		
Tables Checked (TR)		
Conclusions/Recommendations (TR)		
Two Signatures/Sealed (PM)		
Budget (if applicable) (PM)		
All Comments Addressed (PM/TL)		

FINAL REVIEW RELEASE SIGNATURES:

Project Manager: Date:

Principal Reviewer: Date:

NOTES:

1. Retain this form in Project File
2. All blocks are not applicable to all deliverables
3. TL = Technical Lead
   TR = Technical Reviewer
   PM = Project Manager

Figure 9.1

10.0 AUDITS

QA audits may be performed to document that QC measures are being utilized to provide data of acceptable quality and that subsequent calculations, interpretation and other project outputs are checked and validated. Both scheduled and unscheduled audits are provided for in the QA program.

The QAO may conduct project audits of calculations, interpretations and reports which are based on the measurement system outputs, and system and performance audits. Scheduled audits will be identified in the project Work Plan as a project-specific task. Unscheduled audits may also be performed following a request from the NYSDEC PM, the MACTEC Program Manager, or QAO.

10.1 PROJECT SYSTEMS AUDIT

A project systems audit may be conducted on all components of measurement systems to determine proper selection of procedures and utilization of resources. The systems audit includes evaluation of both field and laboratory procedures.

Organization and Personnel. The project organization is reviewed for compliance with the proposed organization and for clarity of assigned responsibility. Personnel assigned to the project will be reviewed to determine that assigned responsibility, skill, and training of the personnel are properly matched. The PM maintains firsthand knowledge of the project-team's capabilities and will discuss the organization's efficacy with the QRB. Assigned personnel may be interviewed by the QRB during an audit.

Facilities and Equipment. The audit will address whether field equipment and analytical instruments are selected and used to meet requirements specified by the project objectives stated in the site-specific Work Plan. Equipment and facilities provided for personnel health and safety may also be evaluated.

Calibration and documentation procedures for instruments used in the field are also reviewed.

Analytical Methodology. A review of analytical methodology relative to data requirements for the project will be performed. An on-site observation of analyst technique, data reduction, and record keeping may be performed, if necessary. Periodic review of precision and accuracy of data will be performed.

Sampling and Sample Handling Procedure. A field audit of sampling activities may be performed by the MACTEC QAO. Field documentation may be reviewed. The site visit will be documented in an audit report.

Data Handling. During a system audit, the QAO will review data handling procedures with the Task Leaders and Site Managers. Accuracy, consistency, documentation, and appropriate selection of methodologies will be discussed.

10.2 PROJECT REVIEW

Project reviews are scheduled and conducted periodically by the Program Manager. The intent of project review is to assess scope and contractual compliance and overall technical quality of the contracted services.

10.3 QUALITY ASSURANCE AUDIT REPORT

A written report of the QA project/system audit is prepared to include:

- an assessment of project team status in each of the major project areas;
- clear statements of areas requiring improvement or problems to be corrected;
- recommendations and assistance will be provided regarding proposed corrective actions or system improvements. (If no action is required, the report will state that the QA audit was satisfactorily completed); and

- a timetable for any corrective action required.

11.0 PREVENTIVE MAINTENANCE

11.1 ANALYTICAL INSTRUMENTATION

Preventive maintenance of analytical instrumentation is addressed by the subcontract laboratories SOPs that are presented in the Laboratory QA documents.

11.2 FIELD INSTRUMENTS

Preventive maintenance of field equipment is performed by field chemists and field operations support staff and routinely precedes each sampling event. More extensive maintenance is performed on the basis of hours in use. Sampling crews report on the performance of the equipment after each sampling event. Critical spare parts are kept in stock.

12.0 DATA ASSESSMENT

12.1 GENERAL

The purpose of data quality assessment is to document that data generated under the program are accurate and consistent with project objectives. The quality of data will be assessed based on the precision, accuracy, representativeness, comparability, and completeness of the data that are generated. Data quality assessment will be conducted in three phases:

Phase 1. Prior to data collection, sampling and analysis procedures are evaluated in regard to their ability to generate the appropriate, technically acceptable information required to achieve project objectives. This QAPP meets this requirement by establishing project objectives defined in terms of parameters, analytical methods, and required sampling protocols.

Phase 2. During data collection, results will be reviewed to assess whether procedures are efficient and effective and that the data generated provide sufficient information to achieve project objectives. The precision and accuracy of selected measurement systems will be evaluated. In general, evaluation of data will be based on performance audits, results of duplicate and spiked sample analyses, and review of completeness objectives.

Documentation may include:

- number and identity of duplicate samples collected;
- number and identity of duplicate, spike, and field blank samples analyzed;
- identification of statistical techniques, if used, to measure central tendency, dispersion, or testing for outliers;
- use of historical data and its reference;
- identification of analytical method; and

- data validation results.

Phase 3. Following completion of data collection activities, an assessment of the adequacy of the database generated in regard to completing project objectives will be undertaken by the QRB and PM. Recommendations for improved QC will be developed, if appropriate. In the event that data gaps are identified, the auditor may recommend the collection of additional raw data to fully support the project's findings and recommendations.

Each phase of the assessment will be conducted in conjunction with appropriate project staff.

13.0 CORRECTIVE ACTION

Corrective or preventive action is required when potential or existing conditions are identified that may have an adverse impact on data quantity or quality. Corrective action can be immediate or long-term. In general, any member of the program staff who identifies a condition adversely affecting quality can initiate corrective action by notifying in writing his or her supervisor, the QAO, or the QRB. The written communication will identify the condition and explain how it may affect data quality or quantity.

13.1 IMMEDIATE CORRECTIVE ACTION

Immediate corrective action is usually applied to spontaneous, non-recurring problems, such as an instrument malfunction. The individual who detects or suspects nonconformance to previously established criteria or protocol in equipment, instruments, data, methods, etc., will immediately notify their supervisor. The supervisor and the appropriate Task Leader, Site Manager, or PM will then investigate the extent of the problem and take the necessary corrective steps. If a large quantity of data is affected, the Task Leader must prepare a memorandum to the PM, QAO, and the QRB. These individuals will collectively decide how to proceed. If the problem is limited in scope, the Task Leader or Site Manager will decide on the corrective action measure, document the solution and notify the PM, QRB, and the QAO in memorandum form.

13.2 LONG-TERM CORRECTIVE ACTION

Long-term corrective action procedures are devised and implemented to prevent the recurrence of a potentially serious problem. The QRB will be notified of the problem and will conduct an investigation to determine the severity and extent of the problem. They will then file a corrective action request with the PM and QAO.

In case of dispute between the QRB and the PM, the Company Officer will make a final determination for the company.

Corrective actions may also be initiated as a result of other activities, including:

- performance audits;
- systems audits;
- laboratory/field comparison studies; and
- QA project audits conducted by the QRB.

The QAO will be responsible for documenting all notifications, recommendations, and final decisions. The PM and the QRB will be jointly responsible for notifying program staff and implementing the agreed upon course of action. The QRB will be responsible for verifying the efficacy of the implemented actions. The development and implementation of preventive and corrective actions will be timed, to the extent possible, so as not to adversely impact either project schedules or subsequent data generation/processing activities. The QRB will also be responsible for developing or identifying and implementing routine program controls to minimize the need for corrective action.

14.0 REPORTS TO MANAGEMENT

Management personnel at all levels receive QA reports appropriate to their level of responsibility. The PM receives copies of all QA documentation. QC documentation is retained within the department which generated the product or service (e.g., field data documentation) except where this documentation is a deliverable for a specific contract. QC documentation is also submitted to the QAO for review and approval. Previous sections detailed the QA activities which are integral to MACTEC QA Program and the reports which they generate. A final audit report for each project may also be prepared. The reports would include:

- periodic assessment of measurement data accuracy, precision and completeness;
- results of performance audits and/or systems audits;
- significant QA problems and recommended solutions for future projects; and
- status of solutions to any problems previously identified.

Additionally, any incidents requiring corrective action will be fully documented. Procedurally, the PM will prepare the reports to management. These reports will be addressed to the Task Leader, or Site Manager, QAM, and the QRB. The summary of findings shall be factual, concise, and complete. Any required supporting information will be appended to the report.

15.0 REFERENCES

American Public Health Association (APHA), 1998. "Standard Methods for Examination of Water and Wastewater"; APHA, 1015 Fifteenth St., NW., Washington, D.C. 20005.

American Society of Testing and Materials (ASTM), 1990a. *1990 Annual Book of ASTM Standards - Section 4 - Construction*; Vol. 4.08; "Standard Method for Penetration Test and Split-Barrel Sampling of Soils"; ASTM-D-1586-84.

American Society of Testing and Materials (ASTM), 1990b. *1990 Annual Book of ASTM Standards - Section 4 - Construction*; Vol. 4.08; "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)"; ASTM-D-2488-84.

Bouwer, H. and R.C. Rice, 1976. "A Slug Test Method for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells"; *Water Resource Research*, Vol. 12, No. 3; pp.423-428.

Cooper, H.H., J.D. Bredehoeft, and S.S. Papadopulos, 1976. "Response of a Finite Diameter Well to an Instantaneous Charge of Water"; *Water Resources Research* Vol. 3, No. 1; pp. 263-269.

Driscoll, F.G., 1989. *Groundwater and Wells*; Second Edition; Johnson Filtration Systems, Inc.; St. Paul, Minnesota.

Geraghty & Miller, 1991. "AQTESOLV - Aquifer Test Solver"; Version 1.1, 1991. Geraghty & Miller Modeling Group; Reston, Virginia.

New York State Department of Environmental Conservation (NYSDEC), no date. "Proposed Division Technical and Administrative Guidance Memorandum -Disposal of Contaminated Groundwater Generated During Remedial Investigations"; Division of Hazardous Waste Remediation, Albany, New York; no date (Draft).

New York State Department of Environmental Conservation (NYSDEC), 1988. "Division Technical and Administrative Guidance Memorandum - Phase II Investigation Generic Work Plan"; Division of Hazardous Waste Remediation; HWR-88-4007; Albany, New York; May 8, 1988.

New York State Department of Environmental Conservation (NYSDEC), 1989. "Division Technical and Administrative Guidance Memorandum - Disposal of Drill Cuttings." Division of Hazardous Waste Remediation; HWR-89-4032; Albany, New York; November 21, 1989.

New York State Department of Environmental Conservation (NYSDEC), 1990a. "Division Technical and Administrative Guidance Memorandum - Phase II Investigation Oversight Guidance"; Division of Hazardous Waste Remediation; HWR-90-4008; Albany, New York; November 21, 1990.

New York State Department of Environmental Conservation (NYSDEC), 1990b. Division Technical and Administrative Guidance Memorandum - Phase II Investigation Oversight Note Taking." Division of Hazardous Waste Remediation; HWR-90-4019; Albany, New York; November 21, 1990.

New York State Department of Environmental Conservation (NYSDEC), 1994. "Division Technical and Administrative Guidance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels"; New York Department of Environmental Conservation; Division of Hazardous Waste Remediation; January 1994.

New York State Department of Environmental Conservation (NYSDEC), 1998. Technical and Operational Guidance Series (TOGs) 1.1.1. "Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations"; New York Department of Environmental Conservation; Division of Water; June 1998.

New York State Department of Environmental Conservation (NYSDEC), 1999. "Water Quality Regulations Surface Water and Groundwater Classifications and Standards"; Title 6, Part 700-705; New York Codes, Rules, and Regulations; August 1999.

New York State Department of Environmental Conservation (NYSDEC), 2000. "Analytical Services Protocol." June 2000 - revised July 2005.

New York State Department of Environmental Conservation (NYSDEC), 2002a. "Technical

Guidance for Site Investigation and Remediation"; Draft DER-10; December 2002.

New York State Department of Environmental Conservation (NYSDEC), 2002b. "Draft Procedures for Collection and Preparation of Aquatic Biota for Contaminant Analysis"; Division of Fish, Wildlife, and Marine Resources; Bureau of Habitat; October 2002.

New York State Department of Environmental Conservation (NYSDEC), 2005. Draft 6 NYCRR PART 375 "Environmental Remediation Program"; New York Department of Environmental Conservation; Division of Environmental Remediation; November 2005.

New York State Department of Environmental Conservation (NYSDEC), 2006. "Identification and Listing of Hazardous Wastes"; Title 6, Part 371; New York Codes, Rules, and Regulations; September 2006.

New York State Department of Health (NYSDOH), 2006. *Guidance For Evaluating Soil Vapor Intrusion In The State Of New York.* October, 2006.

Palmer, C.D. and D.G. Paul, 1987. "Focus Conference on Northwest Groundwater Issues": p. 6.

Trimble Navigation (Trimble), 1994. *GPS Pathfinder System*. pp. 134.

U.S. Bureau of Reclamation, 1968. *Earth Manual* 1st edition. Denver, CO. pp. 541-546.

U.S. Bureau of Reclamation, 1977. *Ground Water Manual*, 1st edition. Denver, CO., pp. 549-565.

United States Environmental Protection Agency (USEPA), 1980. "*Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*" (QAMS-005/80).

United States Environmental Protection Agency (USEPA), 1983. "Methods for the Chemical Analysis of Water and Wastes"; Environmental Monitoring and Support Laboratory; USEPA 600-4-79-020; Cincinnati OH; March 1983.

United States Environmental Protection Agency (USEPA), 1987. *Data Quality Objectives for Remedial Response Activities Development Process*. (USEPA/540/G-87/003).

United States Environmental Protection Agency (USEPA), 1992. *Specifications and Guidance for Contaminant-Free Sample Containers*. December 1992. (USEPA/540/R-93/051).

United States Environmental Protection Agency (USEPA), 1993. "Data Quality Objectives Process for Superfund"; Office of Solid Waste and Emergency Response; USEPA540-R-93-071; September 1993.

United States Environmental Protection Agency (USEPA), 1996. "Test Methods for Evaluating Solid Waste"; Laboratory Manual Physical/Chemical Methods; Office of Solid Waste and Emergency Response; Washington, DC; SW-846; November 1986; Revision 4 -December 1996 through Revision 6 - November 2004.

United States Environmental Protection Agency (USEPA), 1996. *USEPA Region 1 - New England Low Stress (low-flow) Purging and Sampling Procedures for the Collection of Ground Water Samples from Monitoring Wells.* Revision 2, July 30, 1996.

United States Environmental Protection Agency (USEPA), 1999. *National Functional Guidelines for Organics Review*; EPA540/R-99/008; October 1999.

United States Environmental Protection Agency (USEPA), 2004. *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*; USEPA 540-R-04-004; October 2004.

Vroblesky, D. 2001. "User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells".

APPENDIX A

INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY FORM (FROM NYSDOH FINAL VAPOR INTRUSION GUIDANCE – OCTOBER 2006)

NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH

This form must be completed for each residence involved in indoor air testing.

Preparer's Name ______________________________ Date/Time Prepared ____________

Preparer's Affiliation ___________________________ Phone No.__________________

Purpose of Investigation____

1. OCCUPANT:

Interviewed: Y / N

Last Name: _____________________ First Name: _____________________

Address: ____

County: ______________

Home Phone: _________________ Office Phone: _________________

Number of Occupants/persons at this location ______ Age of Occupants ___________________

2. OWNER OR LANDLORD: (Check if same as occupant ___)

Interviewed: Y / N

Last Name: _____________________First Name: _____________________

Address: ____

County: ______________

Home Phone: _________________ Office Phone: _________________

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: _______________

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_______________

If multiple units, how many? ________

If the property is commercial, type?

Business Type(s) ____

Does it include residences (i.e., multi-use)? Y / N   If yes, how many? ______

Other characteristics:

Number of floors______   Building age______

Is the building insulated? Y / N   How air tight? Tight / Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

____

____

____

Airflow near source

____

____

____

Outdoor air infiltration

____

____

____

Infiltration into air ducts

____

____

____

5. BASEMENT AND CONSTRUCTION CHARACTERISTICS (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other ________
c. Basement floor:	concrete	dirt	stone	other ________
d. Basement floor:	uncovered	covered	covered with ______________	
e. Concrete floor:	unsealed	sealed	sealed with ________________	
f. Foundation walls:	poured	block	stone	other ________
g. Foundation walls:	unsealed	sealed	sealed with ________________	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	
j. Sump present?	Y / N			

k. Water in sump? Y / N / not applicable

Basement/Lowest level depth below grade: ________(feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

____

____

6. HEATING, VENTING and AIR CONDITIONING (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation	Heat pump	Hot water baseboard	
Space Heaters	Stream radiation	Radiant floor	
Electric baseboard	Wood stove	Outdoor wood boiler	Other __________

The primary type of fuel used is:

Natural Gas	Fuel Oil	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: ____________________________

Boiler/furnace located in:	Basement	Outdoors	Main Floor	Other__________
Air conditioning:	Central Air	Window units	Open Windows	None

Are there air distribution ducts present? Y / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

____

____

____

____

7. OCCUPANCY

Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

Level	**General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)**
Basement	________________________
1st Floor	________________________
2nd Floor	________________________
3rd Floor	________________________
4th Floor	________________________

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Y / N

b. Does the garage have a separate heating unit? Y / N / NA

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car) Y / N / NA Please specify________________

d. Has the building ever had a fire? Y / N When?________________

e. Is a kerosene or unvented gas space heater present? Y / N Where? ________________

f. Is there a workshop or hobby/craft area? Y / N Where & Type? ________________

g. Is there smoking in the building? Y / N How frequently? ________________

h. Have cleaning products been used recently? Y / N When & Type? ________________

i. Have cosmetic products been used recently? Y / N When & Type? ________________

j. Has painting/staining been done in the last 6 months? Y / N Where & When? ______________

k. Is there new carpet, drapes or other textiles? Y / N Where & When? ______________

l. Have air fresheners been used recently? Y / N When & Type? ______________

m. Is there a kitchen exhaust fan? Y / N If yes, where vented?____________

n. Is there a bathroom exhaust fan? Y / N If yes, where vented?____________

o. Is there a clothes dryer? Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type?________________

Are there odors in the building? Y / N
If yes, please describe: ____

Do any of the building occupants use solvents at work? Y / N
(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? ____

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, use dry-cleaning regularly (weekly)
Yes, use dry-cleaning infrequently (monthly or less)
Yes, work at a dry-cleaning service
No
Unknown

Is there a radon mitigation system for the building/structure? Y / N Date of Installation: ___________
Is the system active or passive? Active/Passive

9. WATER AND SEWAGE

Water Supply:	Public Water	Drilled Well	Driven Well	Dug Well	Other: _______
Sewage Disposal:	Public Sewer	Septic Tank	Leach Field	Dry Well	Other: _______

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: ____________________________________

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided and explained to residents? Y / N

11. FLOOR PLANS

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:

First Floor:

12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.

13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: ________________________________

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo ** Y / N

* Describe the condition of the product containers as **Unopened (UO), Used (U)**, or **Deteriorated (D)**
** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

NYSDEC
PROJECT HEALTH AND SAFETY PLAN

NYSDEC SUPERFUND STANDBY CONTRACT
NYSDEC CONTRACT NO. D003826

Submitted to:

New York State Department of Environmental Conservation
Albany, New York

Submitted by:

MACTEC Engineering and Consulting
Portland, Maine

JULY 2005

NYSDEC
PROJECT HEALTH AND SAFETY PLAN

NYSDEC SUPERFUND STANDBY CONTRACT
NYSDEC CONTRACT NO. D003826

Submitted to:

New York State Department of Environmental Conservation
Albany, New York

Submitted by:

MACTEC Engineering and Consulting
Portland, Maine

JULY 2005

Kendra Bavor
EH&S Specialist, RSHO

William Weber, P.E.
Program Manager

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF APPENDICES

The following appendices are applicable for the work anticipated at NYSDEC Superfund sites. Site Specific Health and Safety Plans will be included with each work assignment. Addendums will be added to the Site Specific Health and Safety Plans to address further defined activities as the Sampling and Analysis Plans are developed.

1.0 GENERAL

1.1 SCOPE AND PURPOSE

This Health and Safety Plan (HASP) has been prepared in conformance with the MACTEC Engineering and Consulting (MACTEC E&C) Health and Safety Program and is intended to meet the requirements of 29 CFR 1910.120. This HASP addresses those activities associated with field operations for the NYSDEC Standby Superfund Contract. Compliance with this HASP is required for all MACTEC E&C personnel, contractor personnel, and other parties entering the New York State Department of Environmental Conservation (NYSDEC) Superfund sites.

1.2 PROJECT PERSONNEL

1.2.1 Project Manager

The Project Manager (PM) is the individual with overall project management responsibilities. Those responsibilities as they relate to health and safety include the development of a Site Specific HASP; the provision of the necessary resources to meet requirements of this HASP; the coordination of staff assignments to ensure that personnel assigned to the project meet medical and training requirements; and the means and materials necessary to resolve health and safety issues identified on the project.

1.2.2 Regional Safety and Health Officer

The Regional Safety and Health Officer (RSHO), of MACTEC E&C, can be reached by telephone at (207) 775-5401 in Portland, Maine. The RSHO has final authority over health and safety issues. The RSHO will be responsible for (1) approval of the individual chosen to serve as the SSHO for the field operations; (2) review and approval of Site Specific HASPs developed by the Site Safety and Health Officer (SSHO), as well as any significant changes made over time to the site HASP; (3) resolution of site disputes involving health and safety issues that are not resolved at the site through the SSHO; and (4) ensuring that the policies and procedures of this HASP are implemented by the SSHO.

1.2.3 Site Safety and Health Officer

The SSHO for this project has been designated by the PM with concurrence of the RSHO. The SSHO will have at least an indirect line of reporting to the RSHO for the duration of his/her assignment as project SSHO. The SSHO is responsible for developing and implementing the Site Specific HASPs in accordance with the MACTEC E&C Health and Safety Program. The SSHO will investigate accidents, illnesses, and incidents occurring on-site. The SSHO will also conduct safety briefings and Site specific training for on-site personnel. As necessary, the SSHO will accompany all NYSDEC, Occupational Safety and Health Administration (OSHA), or other governmental agency personnel visiting a site in response to health and safety issues. The SSHO, in consultation with the RSHO, is responsible for updating and modifying this HASP if site or environmental conditions change. In addition, the SSHO will notify the RSHO of any Stop Work Orders issued.

1.2.4 Other Functional Titles

Other personnel who may be involved in the NYSDEC projects and their general responsibilities will be defined as each work assignment work plan is prepared.

1.3 TRAINING

Training is defined under the MACTEC E&C Health and Safety Program, and all personnel entering potentially contaminated areas of the NYSDEC sites must meet the requirements of 29 CFR 1910.120. Personnel without the required training will not be permitted in any area with potential for exposure to toxic substances or harmful physical agents (i.e., exclusion zone).

All personnel working on a MACTEC E&C site who potentially may be exposed to toxic substances or hazardous materials will participate in an initial and an annual refresher and/or supervisory training (as appropriate), as well as site specific training before commencement of the on-site assignment. The initial Health and Safety Training Program consists of the 40-hour training program required and designated by the OSHA standard 29 CFR 1910.120. In addition to the initial training, MACTEC E&C uses 8-hour annual refresher and supervisory training elements, which are augmented by site specific training regarding site hazards and specialized problems or protocols.

1.3.1 Initial Training

All site-assigned personnel who are potentially exposed to toxic substances or hazardous materials will be required to participate in a training course on hazardous waste site operations. This training is required under provisions of the OSHA standard, and must consist of 40 hours covering the following areas:

- familiarity with the regulations and implications of OSHA regulations in 29 CFR 1910.120
- familiarity with the organizational structure responsible for site health and safety
- explanation of the medial surveillance requirements, including recognition of health hazards

- instruction in the use and maintenance of personal protective equipment
- identification and analysis of site chemical and physical hazards
- instruction regarding monitoring equipment, including personnel and environmental sampling instruments
- site control and decontamination procedures
- contingency planning
- confined-space entry procedures (if applicable)

1.3.2 Annual Refresher/Supervisory Training

Annually, all personnel required to participate in the initial training will take an 8-hour refresher training course. Those personnel with either site supervisory or health and safety responsibilities will also have an additional 8 hours of training beyond the initial 40 hours. The 8-hour supervisory training meets requirements of the annual refresher.

1.3.3 Site Specific Training

All personnel assigned to a MACTEC E&C site must participate in the site specific training presentation, which will cover major elements of the site HASP, as well as health and safety procedures regarding an individual's specific job responsibilities and tasks. The SSHO or health and safety designee will provide this training before an individual is permitted to work on a field site. Site Safety Orientation Appendix C, Form H.

1.3.4 Other Training

Additional training will be provided as determined by the RSHO or the SSHO, and may include additional refreshers on personal protective equipment, instrumentation, CPR, first aid, or any other pertinent health- or safety-related subject. Daily Safety meetings will be held at the start of each shift to ensure personnel understand site conditions and operations procedures including personal protective equipment requirements for the tasks. The daily meetings will be documented in the field log book including participants, topic(s) covered, date & time.

1.4 MEDICAL SURVEILLANCE

Personnel entering potentially contaminated areas of this site will be medically qualified for site assignment through a medical surveillance program outlined in the MACTEC E&C Health and Safety Program. Personnel who have not received medical clearance will not be permitted in any area with potential for exposure to toxic substances or harmful physical agents (i.e., downrange).

1.4.1 Health Monitoring Program

All on-site MACTEC E&C personnel and laboratory staff must be enrolled in the Health Monitoring Program. The program is implemented through the company health care carrier. The health monitoring program consists of an initial medical examination to establish the employee's general health profile, which provides important baseline laboratory data for later comparative study and annual examinations. Follow-up examinations are completed annually for all personnel enrolled in the health monitoring program, or more frequently if project assignments warrant testing following specific field activities.

1.4.2 Review of Exposure Symptoms

Symptoms of exposure to hazardous materials will be reviewed for each site by the RSHO and SSHO to indicate to personnel the recognized signs of possible exposure to those materials. This information will be supplemented with a discussion of the need for objectivity in the personal health assessment to account for normal reaction to stressful situations. The SSHO will watch for outward evidence of changes in worker health. Symptoms may include skin irritations, skin discoloration, eye irritation, muscular soreness, fatigue, nervousness or irritability, intolerance to heat or cold, or loss of appetite. Employees will routinely be asked to assess their general state of health during the project. Special medical monitoring may be identified for certain sites.

1.5 HAZARD COMMUNICATION

In 1986, OSHA began enforcing the Hazard Communication Standard (HCS) (29 CFR 1910.1200). This standard requires employers to make their associates aware of the hazards to which they may be exposed. This standard does not apply to exposures to hazardous waste. Therefore, on hazardous waste sites, the only chemicals covered by the HCS are those MACTEC E&C or their subcontractors bring onto the site, such as for decontamination and sample preservation purposes. In 1987 when the Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) was first promulgated, most of the components of the HCS were incorporated into the new standard. Because of this, the only components of the HCS that need to be addressed separately at a hazardous waste site are labeling and Material Safety Data Sheets (MSDS)s; the rest of the standard has been included in 1910.120 or is part of the overall MACTEC E&C Health and Safety Program.

MSDSs for chemicals brought to the site will be added to the MSDS section of the Site Specific Health and Safety Plan and will be reviewed by all employees and subcontractors working at the site. Health and safety information about contaminant chemicals of concern historically known or suspected to be on site will be provided in CHEMICAL CONTAMINANT FACT SHEET(s) provided in the Site Specific HASP. A blank form is provided in the site specific HASP to be used if other chemical information is obtained. These forms will remain in the site specific HASP and retained with the program documents and records.

MACTEC E&C's policy has been to minimize chemical storage by purchasing small sized containers that are shipped directly to the site, so as to avoid the need to transfer bulk chemicals to smaller containers (Note: The sample jars have been purchased with the preservative already added). The original label will be kept on all containers. If the chemical is transferred to a smaller container, the new container will be labeled with the name of the contents and appropriate hazard warnings (e.g., any combination of words, pictures, or symbols that conveys the chemical hazard; for example the word "flammable" with a picture of a flame).

Note: If the chemical has been transferred to a secondary container that is to be used that day by the person doing the transferring (e.g., TSP added to water for decontamination or methyl alcohol added to a squeeze bottle), labeling is not required. Labeling may be used to distinguish a container's contents if similar containers are used (e.g., "methyl alcohol" or "alcohol" written on the squeeze bottle to distinguish its contents from Deionized (DI) water).

2.0 SITE CHARACTERIZATION AND ANALYSIS

2.1 SITE NAME, LOCATION, HISTORY, AND SCOPE OF WORK

This document serves as the Program HASP for MACTEC E&C work under the NYSDEC Standby Superfund Contract. As work projects are assigned by the NYSDEC, site specific work plans will be developed, including site name, location, and Scope of Work. Site Specific HASPs will be developed for each site, to identify concerns associated with that individual site that are not addressed in this Program HASP.

3.0 TASK ANALYSIS

3.1 GENERAL FIELD INVESTIGATIONS

Site specific tasks will be described in the Site Specific Sampling and Analysis Plans (SAP)s. The Site Specific HASPs will describe the task specific controls or special requirements. The following sections provide general project information regarding the chemical and physical hazards associated with the NYSDEC Superfund Sites. The sections below provide information on the most common and significant substances or hazards likely to be present at the Sites. Specifically, toxicological information, exposure limits, symptoms of exposure, and physical properties associated will be discussed in the Site Specific HASPs.

3.2 RISK ASSESSMENT

Analytical results and site conditions encountered during historical field investigations will be presented in Site Specific HASPs. This information will be used to determine chemicals of concern, appropriate monitoring procedures, work practices and action limits to be implemented to control risks that may be encountered during the site investigations. The highest chemical concentrations reported, above state exposure criteria, will be used to evaluate anticipated exposures. The *Contaminant Fact Sheets* for each of these chemicals will be provided in the Site Specific HASPs. Site specific risk assessments will also be included in the Site Specific HASPs. Physical hazards will be identified in the Site Specific HASP based upon the potential or known site conditions and proposed activities or site reconnaissance prior to field tasks.

3.2.1 Hazardous Substances

To determine the contaminates of concern for the specific site field tasks, the materials known or suspected to be present will be identified from review of Site records of chemicals used, records of disposal and previous sampling data (e.g. groundwater, soil, sediment) to determine the contaminants of concern for site field tasks.

3.2.2 Site Risks

The potential hazards associated with the field activities include chemical (health - inhalation, ingestion, and dermal contact of various contaminants, fire, and reactive), physical, and ecological hazards that are known to be or may be potentially present on-site. The contaminants may be encountered in soil gas, air, soils, sediments, surface water and/or groundwater. Site specific hazard analysis will be conducted for each work site per

29 CFR 1910.120(c) and will be presented in the Site Specific HASPs. Site Specific HASPs will be updated as necessary.

Chemical Hazards. Action levels and exposure limits for known or suspected chemical hazards as related to the proposed field tasks will be presented in Site Specific HASPs.

Potential Safety Hazards:

Heavy Equipment
Buried Utilities
Noise
Slips, Trips, Falls
Heat Stress
Cold Stress
Materials Handling
Ecological Hazards

Expected decontamination chemicals include:
Liquinox®
Isopropyl Alcohol
Potable Water
Deionized (or Distilled) Water

3.2.3 Health Hazards

Workers may encounter the following health hazards while working at the NYSDEC Hazardous Waste Sites.

3.2.3.1 Aromatic Hydrocarbons

Exposure to aromatic hydrocarbons can cause depression of the central nervous system, decreased alertness, headache, sleepiness and loss of consciousness. If a dermal exposure exists, they can also deface the skin causing dermatitis. Benzene is the most toxic of the aromatic hydrocarbons in that it suppresses bone marrow function, causing blood changes. Chronic exposures can lead to leukemia. Breathing zone will be monitored for potential volatile contaminants. Workers will work up wind, as possible, from contaminants in addition, workers will wash prior to eating, drinking, smoking or leaving the site.

3.2.3.2 Halogenated Aliphatic Hydrocarbons

Exposure to halogenated hydrocarbons causes depression of the central nervous system, decreased alertness, headache, sleepiness and loss of consciousness. In addition, halogenated hydrocarbons can affect the kidneys, resulting in decreased urine flow, swelling - especially around the eye area and anemia, and the liver causing fatigue, malaise, dark urine, liver enlargement, and jaundice. Vinyl chloride is one of the more toxic of the halogenated aliphatic hydrocarbons and is know to cause cancer in humans. Other hydrocarbons in this group are also potential carcinogens. Breathing zone will be monitored for potential volatile contaminants. Workers will work up wind, as possible, from contaminants in addition, workers will wash prior to eating, drinking, smoking or leaving the site.

3.2.3.3 Heavy Metals

Heavy metals are toxic to the kidneys, however, each heavy metal has its own characteristic symptom cluster. Lead causes decreased metal ability, weakness (especially in the hands), headaches, abdominal cramps, diarrhea, and anemia. Workers will change protective cloths and/or remove coveralls before leaving the work site. Site protective clothing will be laundered or disposed to avoid transporting contaminants. Workers will wash hands and face before eating, smoking, drinking and leaving the site.

3.2.3.4 Pesticides

Pesticides have been used commonly for sterilization, and insect control. The common routes of entry are skin absorptions, inhalation and ingestion. The organs affected include the stomach, intestines, heart, blood vessels, kidneys, nervous system, lymphatic system, reproductive system, endocrine system, and skin. In addition to carcinogenic effects and reproductive effects other long term effects are kidney and liver dysfunction, general weakening of the immune system and endocrine disrupters.

Handle materials contaminated with pesticides and chemicals as little as possible. Wear gloves, respirator and if accidentally ingested seek poison control or medical center. Workers who encounter pesticides should be aware of the signs and symptoms including nausea, vomiting, headache, neurological changes (tremor or exaggeration of reflexes), facial numbness, partial paralysis, convulsions, loss of perception and vibratory sensation, moderately rapid respiration, slow to normal pulse. Workers will refer to MSDS or Chemical Contaminant Fact Sheets in Site Specific HASPs.

3.2.4 Potential Safety Hazards

Workers may encounter the following safety hazards while working at the NYSDEC Hazardous Waste Sites.

3.2.4.1 Heavy Equipment

When working around heavy equipment, there is a potential for physical injury resulting from contact with any equipment that may be operating in the project area. Elevated noise levels are a potential when working with heavy equipment. Communications may be limited to noise levels and obstructed view. In addition, access to the site will require clearance for overhead utilities and obstructions.

Workers must be made aware of the presence of these hazards and take steps to avoid them. Workers will remain clear of heavy equipment and their loads and will also remain outside the radius of reach for articulated equipment such as backhoes, track hoes, and cranes.

Workers will also take extra precautions when working around heavy equipment when wearing respiratory protection. This is due to the limited ability to communicate while respirators are being worn. Workers and equipment operators shall determine suitable hand signals for use in communicating with each other and these hand signals will be communicated to all site personnel during the initial site safety briefing and during the daily tool box meetings. Workers who operate the heavy equipment must be well trained in the use of their particular equipment.

3.2.4.2 Buried Utilities

As work operations typically involve intrusive activities, a potential for disturbance of underground utilities exists. To minimize the potential for accidents or interruption of utility service, underground utilities will be identified prior to the start-up of intrusive activities.

At least two working days prior to the start-up of intrusive activities, Dig Safely New York will be contacted in order to obtain clearance. The areas where intrusive activities will occur will be identified. The locator service will respond and mark the ground surface using the following general guidelines:

Water	Blue outline
Natural Gas	Yellow outline
Electric	Red outline
Telephone	Initials of Telephone Company or “YES” or “NO”
Cable	Notation

MACTEC E&C personnel will get written verification that utilities have been identified prior to commencing intrusive activities.

3.2.4.3 Noise

Work will be conducted in areas with a potential for elevated noise levels. Hearing protection will be worn if noise levels exceed 85 decibels on a time-weighted-average. Potential noise sources at the site include drill rigs, excavation machinery, etc.

3.2.4.4 Slips, Trips, and Falls

Workers at the site may be exposed to slip, trip, and fall hazards due to uneven terrain, presence of debris, or slippery surfaces. Workers will ensure that the site is maintained in a neat orderly manner to minimize tripping hazards. Worker will take proper care when walking on uneven surfaces. Proper footwear with adequate traction will be worn by all personnel when walking on slippery surfaces.

3.2.4.5 Heat Stress

Heat stress is a potential hazard at the site due to warm or hot summer weather and the use of PPE. PPE places an added strain on the worker due to the impermeable nature of the protective clothing that reduces the body's ability to cool down and well as the added weight to be carried. See Appendix A of HASP for further information on Temperature Extremes.

3.2.4.6 Cold Stress

Cold stress is a potential at the site due to the cold winter weather anticipated during site operations. Fatal exposures have almost always resulted from accidental exposures immersion in low temperature water or failure to escape from low air temperatures. Appendix A of the HASP addresses the procedures that will be followed to protect workers from cold related injuries and Temperature Extremes.

3.2.4.7 Materials Handling

Workers may be exposed to materials handling related injuries (i.e., back injuries) due to the handling of heavy items at the site. These items include: *(e.g., coolers, drums, cylinders of gas, heavy equipment, etc*). Employees materials will use mechanical aids *(e.g. hand truck, forklift, front end loader, back hoe, etc.),* wherever possible to handle the heavy items. If the use of mechanical aids is not possible, two persons, will be required to lift the object, or the load will be divided into smaller amounts to reduce the weight.

3.2.4.8 Ecological Hazards

Poisonous Insects, Snakes, and Plants. Workers may encounter poisonous insects, snakes, and plants while working in the field. Stings from ants, bees, wasps, hornets, and yellow jackets usually cause localized pain, however, they may, on occasion, cause death. Death is usually due to the worker experiencing an acute allergic reaction to the poisons in the sting.

Workers may encounter ticks while working at the site. Ticks can transmit germs of several diseases including Rocky Mountain Spotted fever, and Lyme Disease. Ticks adhere tenaciously to the skin or scalp and evidence shows that the longer an infected tick remains attached, the greater is the chance that it will transmit disease (it usually has to be attached for 24 hours to transmit Lyme Disease). Refer to the section below for further information on Lyme Disease.

Spiders in the US are generally harmless with two notable exceptions: the black widow spider and the brown recluse or violin spider. There is a potential for workers to encounter Black Widow/Recluse spiders at the site. Equipment, clothing, brush, etc. should be checked for spiders prior to handling them.

In the US, there are many types of poisonous snakes. Pit vipers (such as rattlesnakes, copperheads, and water moccasins) typically have elliptical pupils and a pit between the eye and nostril on each side of the head. The venom of the pit vipers affects the circulatory system. Non-poisonous snakes typically have round pupils and no fangs or pits. Workers have a potential to encounter the following snakes at the site: timber rattlers, or non-venomous snakes such as garter snakes, green snakes, etc.

Poisonous plants in the eastern US and potentially on NYSDEC sites include poison ivy and poison sumac. Poison ivy is a small plant, vine or a shrub with leaves consisting of three glossy leaflets. Poison sumac grows as a woody shrub or small tree usually located in wet areas and grows between 5 to 25 feet tall. If contact with poison ivy or poison sumac is suspected, remove contaminated clothing and wash all exposed areas thoroughly with soap and water.

Precautions will be taken to avoid poisonous insects, snakes, and plants if at all possible. If working in an area known to contain poisonous plants, workers will be instructed on how to identify the local variety. If the plants cannot be avoided, modified Level D PPE (uncoated, white tyveks are acceptable if no chemical contamination is present) will be used. Workers will be instructed to wash exposed skin with soap and water as soon as possible after work is completed and/or during breaks.

If working in areas with poisonous insects or snakes, workers will wear at least ankle high or calf high rubber or leather boots, tyveks or long sleeved shirts, buttoned at the wrist, and long pants, tucked into socks or boots. In addition, insect repellent, such as DEET should also be used to deter the insects.

In addition to poisonous plants, insects, and snakes, workers may encounter warm blooded animals, such as dogs, cats, raccoons, etc., that can transmit rabies and/or hantavirus.

Rabies: Rabies is a disease that is transmitted to man through the bite of rabid domestic or wild animals. Exposure can also occur through contact with the saliva of an infected animal should it encounter broken skin or the eyes, nose, or mouth. In the US, the principal animals that present a threat to man consist of the skunk, the fox, the bat, and the raccoon. Rabies is caused by a virus that requires an incubation period from a few weeks to several months. Prevention of the disease is through avoidance of animal bites and caves containing infected bats. Workers will avoid contact with wild life if at all possible. If a person is attacked and bitten by a wild animal that is suspected to be rabid, the individual will seek medical attention immediately. If it can be done safety, the animal in question will be collected and sent to the health department to determine if actually infected.

Hantavirus: Hantavirus is a viral disease that is transmitted to man from exposure to rodents. Hantavirus does not cause illness in their reservoir host. Infected rodents shed the virus in their saliva, urine, and feces. Human infection may occur when infected saliva or excreta are inhaled as aerosols produced directly from the animal after only a few minutes of exposure to the animal. Transmission may also occur when dried material, contaminated by rodent excreta, is disturbed and directly introduced into broken skin, the eyes, or possibly ingested in contaminated food or water. Workers in potentially high-risk settings should avoid contact with rodents and rodent burrows or disturbing dens. Workers should wear chemical protective gloves if there is a potential for contact with nesting material or excreta. Gloves should be washed and disinfected before their removal. Wash hands and face with soap and water. Do not use cabins or enclosed shelters that are rodent infected. After working in such an area, workers should monitor their health for 45 days after last possible exposure. If a temperature or respiratory illness occurs within that time frame, they should seek medical attention immediately and inform the attending physician of potential exposure.

Lyme Disease: Lyme Disease is an illness caused by corkscrew-shaped bacteria which is transmitted to humans, dogs, horses, and other animals by the bite of an infected deer tick (ixodes dammini). The disease tends to occur largely in wooded coastal portions of New York, Pennsylvania, New Jersey, and New England. The ticks cling to vegetation in brushy, wooded, or grassy areas. Lyme Disease is most commonly acquired in the summer months (June and July are peak), less often in early spring or late fall, and only rarely during the winter. The bite of the infected tick can then transmit the bacteria to the new host if the tick is attached for at least 24 hours.

While rarely life-threatening, if not treated, Lyme Disease may lead to arthritis, neurological or cardiac problems, and possibly birth defects. The first symptom of Lyme Disease is usually a skin rash of a small red area, 3 to 32 days after the bite. The rash often resembles a red doughnut or bull's eye with a white center. The rash may be accompanied by flu-like symptoms such as fever (100°-103°F), headache, stiff neck, sore and aching muscles and joints, nausea and vomiting, fatigue, sore throat, and swollen glands. Three major organ systems (the joints, nervous system and heart), can be affected weeks to months after the initial tick bite, although symptoms usually appear within four to six weeks. Complications may include Bell's Palsy (facial muscle droop), pain and weakness, usually in the shoulder and upper arms; and poor concentration, depression seizures, and temporary paralysis (resembling Cuillian-Barre disease).

To limit exposure wear a long-sleeved shirt, long pants, high socks (with pants tucked into socks), and closed shoes or boots. Light colors will help you spot ticks on clothing. Apply a commercial tick repellent on clothing, shoes, and socks after reading label instructions carefully. Lastly, conduct daily "tick checks" on yourself and your companions when you get in from the field.

Prompt removal of a tick will greatly decrease the risk of disease transmission. Treatment with appropriate antibiotics early in the illness clears up the rash within days and may prevent complications. Treatment of joint and nervous system complications if often accomplished with antibiotics given intravenously.

4.0 PROTECTIVE MEASURES

Protective measures are implemented to limit worker and public risk. There are three alternative methods that may be used. The primary measures considered for practicality and feasibility are engineering controls such as physical barriers or a change in equipment. The controls consider alternative methods that would limit access or exposures to risks. Next, work practices or procedures are established that require directions that caution the worker in their actions. The last protective method is the use of personal protective equipment (PPE). This is equipment worn by the employee. Specific protective measures to be implemented are presented by task in Site Specific HASPs. The sections below define the alternative methods and protective measures to be considered during the field work of this project.

4.1 ENGINEERING CONTROLS

Based upon the task, engineering controls to be implemented as practical to reduce risk and hazards are defined in Site Specific HASPs.

Whenever feasible, engineering controls will be used at the site to reduce employee exposure to hazardous substances. Feasible engineering controls include the following:

- the use of pressurized cabs or control booths
- the use of remotely operated materials-handling equipment
- the use of industrial-sized fans to blow hazardous vapors from the breathing zone when exposure is from a point source and a power source is available

4.2 WORK PRACTICES

General work practices to be used during MACTEC E&C projects are described below. Specific work practices necessary for this project or those that are of significant concern will be included in the Site Specific HASPs and further described in addendum, if necessary.

4.2.1 General

Workers will be expected to adhere to the established safe work practices for their respective specialties (e.g., drilling, laboratory analysis, and construction). The need to exercise caution in the performance of specific work tasks is made more acute due to (1) weather conditions; (2) restricted mobility and reduced peripheral vision caused by the protective gear; (3) the need to maintain integrity of the protective gear; and (4) the increased difficulty in communicating caused by respirators or elevated noise levels. Work at the site will be conducted according to established protocol and guidelines for the safety and health of all involved. The following highlight principles for working at a hazardous waste site:

- In any unknown situation, always assume the worst conditions and plan responses accordingly.

- Use the buddy system. Under no conditions will any person be permitted to enter the Exclusion Zone alone. Establish and maintain communications. In addition to radio communications, it is advisable to develop a set of hand signals, because conditions may greatly impair verbal communications.

- Because no personal protective equipment is 100 percent effective, all personnel must minimize contact with excavated or contaminated materials. Plan work areas, decontamination areas, and procedures accordingly. Do not place equipment or drums on the ground. Do not sit on drums or other materials. Do not sit or kneel on the ground in the Exclusion Zone or Contamination Reduction Zone (CRZ). Avoid standing in or walking through puddles or stained soil.

- Disposable items will be used, when possible, to minimize risks during decontamination and possible cross-contamination during sample-handling.

- Smoking, eating, or drinking in the work area and before decontamination will not be allowed. Oral ingestion of contaminants is a likely means of introducing toxic substances into the body.

- Avoid heat and other work stresses related to wearing protective gear. Work breaks should be planned to prevent stress-related accidents or fatigue.

- Maintain monitoring systems. Conditions can change quickly if subsurface areas of contamination are penetrated.

- Conflicting situations that may arise concerning safety requirements and working conditions must be addressed and resolved rapidly by the SSHO to avoid any motivation or pressure to circumvent established safety policy.

- To the extent feasible, handling of contaminated materials should be done in a remote area, particularly when drummed or other containerized hazardous waste materials are found on-site. Every effort should be made to identify the contents of containers found on-site before they are moved or subject to material-handling applications.

- Personnel must be observant of not only their own immediate surroundings but also that of others. Everyone will be working under constraints; therefore, a team effort is needed to notice and warn of impending dangerous situations. Extra precautions are necessary when working near heavy equipment while using personnel protective gear because vision, hearing, and communication can be restricted.

- Contact lenses are not allowed to be worn on-site; if corrosive or lachrymose substances enter the eyes, proper flushing is impeded.

- All facial hair that interferes with the face piece fit must be removed before donning a respirator at all sites requiring Level C or Level B protection.

- Rigorous contingency planning and dissemination of plans to all personnel minimizes the impact of rapidly changing safety protocols in response to changing site conditions.

- Personnel must be aware that chemical contaminants may mimic or enhance symptoms of other illnesses or intoxication. Avoid excess use of alcohol or working while ill during field investigation assignments.

- The site leader, SSHO, and sampling personnel will maintain project records in a bound notebook (e.g., daily activities, meetings, incidents, and data). Notebooks will remain on-site for the project duration so that replacement personnel may add information, thereby maintaining continuity. The notebooks and daily records will become part of the permanent project file.

4.2.2 Site Entry Procedures

In most cases, MACTEC E&C teams are not the first on-site investigators. Considerable knowledge of site history and current status allows preparation of a HASP with reasonable assurance that personnel are adequately protected. In the event that sufficient site information is not available to perform a summary risk assessment and assign the appropriate level of personal protective equipment, the following procedures should be followed. It must be understood that verification of the level of contamination (even with background information) will always require some of the following steps.

1. Recognize that MACTEC E&C's presence on-site implies a perceived contamination potential by the client.

2. Assume that the site is contaminated and conduct a site safety reconnaissance, consisting of the following activities:

    - Establish a CRZ (decontamination area).

    - Survey the site at the highest level of protection practicable, beginning with a perimeter survey and gradually covering all areas of proposed activity with the following (as appropriate):

- HNU PI meter or equivalent
- OVA
- radiation survey meter (if applicable)
- personal air sampling pumps
- chemically reactive indicator tubes
- oxygen-deficiency meter
- explosive mixture meter

· Establish a "hot zone."

· Review data, assess risk, and select the appropriate level of protection.

3. Prepare a summary site HASP and document all data acquired.

4.3 PERSONAL PROTECTION EQUIPMENT

4.3.1 Personal Protection Level Determination

The level of PPE required will be determined by the type and levels of waste or spill material present at the site where project personnel may be exposed. In situations where the types of waste or spill material on-site are unknown, the hazards are not clearly established, or the situation changes during on-site activities, the SSHO must make a reasonable determination of the level of protection that will ensure the safety of investigators and response personnel until potential hazards have been determined through monitoring, sampling, informational assessment, laboratory analyses, or other reliable methods. Once the hazards have been determined, protective levels commensurate with the hazards will be used. Protection requirements will be evaluated on a continuous basis to reflect new information as it is acquired.

4.3.2 Levels of Protection

The following subsections describe the basic composition of the generally recognized protective ensembles to be used for site operations. Specific components for any level of protection will be selected based on hazard assessment; additional elements will be added as necessary. Disposable protective clothing, gloves, and other equipment, exclusive of respirators, should be used when feasible to minimize risks during decontamination and possible cross-contamination during sample handling. It is anticipated that personnel completing the activities at the NYSEC sites will use modified Level D PPE. Action levels and upgrades in PPE levels are based upon air monitoring and can be found in the Site Specific HASPs. The following Level D PPE may be required during site activities and must be present at the site, as described below:

Hard Hat
Safety Glasses
Steel-toed boots
Insulated work coveralls (if required)
Polycoated Tyvek coveralls
Nitrile inner gloves
Nitrile outer gloves
Leather gloves (if required)
Over the shoe booties

Hearing protection will also be required if working within the vicinity of operating heavy equipment.

4.3.2.1 Level A

Level A protection provides the highest level of protection for skin, eyes, and the respiratory system. It is appropriate for conditions where there are potential or actual high concentrations of atmospheric vapors, gases, or particulates. Level A should be used if site operations or work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to the skin or capable of being absorbed through the intact skin. Level A is used primarily for emergency situations or when the following conditions exist: (1) vapors or mists of strong acids; (2) known or probable immediately dangerous to life and health (IDLH) atmospheres with dermally active compounds; (3) high atmospheric concentrations of compounds that can be absorbed through the skin; and (4) operations that must be conducted in a confined, poorly ventilated area, where conditions requiring Level A have not yet been eliminated. The fully encapsulating suit and the pressure-demand self-contained breathing apparatus (SCBA) or hose line respirator are the key elements in Level A PPE.

Level A equipment includes the following items:

- SCBA (pressure demand) OR supplied air respirator (pressure demand with escape mask)
- total encapsulating suit
- coveralls (optional)
- long underwear
- gloves (outer, chemical-resistant)
- gloves (inner, chemical-resistant)
- boots (chemical-resistant, steel-toed, steel shank)
- hardhat (optional)

- disposable protective suit, gloves, and boots (to be worn over or under encapsulating suit)

- two-way radios

4.3.2.2 Level B

Level B protection should be used when the type and atmospheric concentration of substances have been identified and require a high level of respiratory protection; however, the atmospheric contaminant, splashing liquid, or other direct contact will not adversely affect or be absorbed through any exposed skin. This includes atmospheres with IDLH concentrations of specific substances that do not (1) represent a severe skin hazard, or (2) meet the criteria for use of air-purifying respirators. Level B has the same respiratory protection criteria as Level A; however, dermal exposure is not as severe.

Level B equipment includes the following items:

- SCBA (pressure demand) OR supplied air respirator (pressure demand with escape SCBA)

- hooded chemical-resistant clothing (coated Tyvek)

- coveralls (optional)

- gloves (outer, chemical-resistant)

- gloves (inner, chemical-resistant)

- boots (chemical-resistant, steel-toed, steel shank)

- boot covers (chemical-resistant) (optional)

- hardhat (optional)

- two-way radio (to be worn under outside protective clothing)

- face shield (optional)

4.3.2.3 Level C

Level C protection should be used when the atmospheric contaminant, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin. In addition, the types of air contaminants must have been identified, the concentration measured, and an air-purifying respirator must be available that can remove the contaminants. An air-purifying respirator can only be used if the oxygen content in the air is at least 19.5 percent, the contaminant has adequate warning properties (e.g., odor, taste, and irritating effect thresholds within two times the Threshold Limit Value), the concentration of the contaminant does not exceed the IDLH, and the worker has been fit-tested. Level C has the same splash protection as Level B; however, cartridge respirators are used instead of SCBAs.

Level C equipment includes the following items:

- full-face respirator (cartridge)
- hooded chemical-resistant clothing (coated Tyvek)
- coveralls (optional)
- gloves (inner, chemical-resistant)
- gloves (outer, chemical-resistant)
- boots (chemical-resistant, steel-toed, steel shank)
- boot covers (chemical-resistant) (optional)
- hardhat (optional)
- escape mask (optional)
- two-way radios (worn under outside protective clothing)
- face shield (optional)

4.3.2.4 Level D

Level D is a work uniform affording minimal protection and is used for nuisance contaminants only. Level D protection should only be used when the atmosphere contains no known hazard, all potential airborne contaminants can be monitored for, and work functions preclude splash, immersion, or the potential for unexpected inhalation or contact with hazardous levels of any chemical.

Level D equipment includes the following items:

- coveralls
- gloves (optional)
- boots (chemical-resistant, steel-toed, steel shank)
- boot covers (chemical-resistant) (optional)
- safety glasses or chemical splash goggles (optional)
- hardhat (optional)
- escape mask (optional)
- face shield (optional)

5.0 MONITORING

In addition to the PPE described above, monitoring of the breathing zone with a photo ionization detector (PID) equipped with a 10.6 electron volts (eV) lamp will be conducted in the exclusion zone (EZ), as task appropriate. If sustained readings in the breathing zone exceed background or exposure limits workers will back off and reassess according to the Site Specific HASP. The Air Monitoring Equipment/Frequency of Readings/Action Guidelines are discussed in the Site Specific HASPs.

5.1 MONITORING EQUIPMENT

The work environment will be monitored to ensure that IDLH or other dangerous conditions are identified. Depending on site activities, monitoring may include evaluations for combustible atmospheres, oxygen-deficient environments, and hazardous concentrations of airborne contaminants.

5.1.1 Air Sampling: Equipment, Calibration, And Maintenance

To the extent feasible, the presence of airborne contaminants will be evaluated through the use of direct-reading instrumentation. Information gathered will be used to ensure the adequacy of the levels of protection being used at the site, and may be used as the basis for upgrading or downgrading levels of protection, at the discretion of the SSHO. The following monitoring equipment may be used at the NYSDEC sites.

ISC MX-241 Dual Detector

This meter monitors for combustible gases and oxygen. It can be used to determine (1) if an area contains concentrations of combustible gases with readings in percentage of the lower explosive limit (LEL); and (2) the percentage of oxygen. This equipment will be calibrated in accordance with the manufacturer's instructions and calibration records maintained in the project files.

This instrument also is calibrated to methane and monitors combustible gases in the percentage of the LEL. It will be calibrated in accordance with the manufacturer's instructions and calibration records maintained in the project files.

ISD HS267

This instrument monitors for the presence of hydrogen sulfide in parts per million (ppm). It will be calibrated in accordance with the manufacturer's instructions and calibration records maintained in the project files.

Photovac Organic Vapor Analyzer 10S50

The Organic Vapor Analyzer (OVA) is a total organic vapor analyzer capable of detecting volatile organic compounds (VOCs) that can be ionized by ultraviolet (UV) light. Model 10S50 is commonly used on-site to estimate the presence of VOCs for purposes of crew protection, well screen placement, and selection of samples for further analysis. The principle of operation is twofold: (1) the ambient temperature gas chromatograph, which breaks down mixtures of VOCs into individual components identified by retention time; and (2) detection accomplished by ionization in UV light. The charged component then moves to an electrode which, in turn, results in a meter deflection proportional to the concentration of the contaminant. This instrument does not read out directly in ppm unless calibrated against the material being measured; therefore, results must be interpreted conservatively and with care. Calibration and maintenance will be performed in accordance with the manufacturer's instructions and calibration records maintained in the project files.

HNU IS101, Thermo Electron Instrument (TEI) 580B, MiniRae, and Photovac TIP Photo ionization Detector

Like the OVA, the PID operates on the basis of ionization of the contaminant, which results in a meter deflection proportional to the concentration of the contaminant. In the PID, ionization is caused by a UV light source. The strength of the UV, measured in electron volts (eV), determines which contaminants can be ionized. The HNU can use three different-strength UV sources, including 9.6, 10.2, and 11.7 eV; only the 10.2- and 11.7-eV probes are currently available for field use. The TEI can use either the 10.6, or 11.7 eV. The TIP operates using a UV light source of 10.6 eV. Calibration and maintenance will be performed in accordance with the manufacturer's instructions and calibration records maintained in the project files .

Detector Tubes (MSA and Draeger)

A colorimetric detector tube is a direct-reading instrument consisting of a glass tube impregnated with an indicating chemical, which is connected to a piston cylinder or bellows-type pump. A known volume of air is drawn through the glass tube. The contaminant in the air reacts with the indicator chemical, producing a stain the length of which is proportional to the contaminant's concentration. Care must be taken when using the detector tubes because reliability of the results depends on the proper pump calibration, the degree of stability of the reacting chemical, and the ambient temperature. Interfering gases or vapors can also positively or negatively affect measured results. Calibration and maintenance will be performed in accordance with the manufacturer's instructions and calibration records maintained in the project files.

5.1.2 Explosivity

If there is a potential for flammable vapors to be present at the site, workers will monitor the area using a combustible gas meter. If combustible gas readings indicate levels between 10 and 20 percent LEL, operations will be temporarily suspended and the situation will be reassessed by the SSHO to determine the source and the course of action. If the levels cannot be reduced by some means, operations can continue at levels above 10 percent only if appropriate precautions are taken *(e.g., non-sparking tools, bonding, spark arrests).* If at any time the LEL exceeds 20 percent, operations shall be immediately suspended.

5.1.3 Oxygen Deficiency

If there is a potential for oxygen deficient atmospheres to be present at the site. Oxygen levels will be monitored using a LEL/O_2 meter. If oxygen levels are below at or 19.5%, operations will stop and workers will back off and reassess/upgrade to Level B PPE. Normal oxygen levels in the atmosphere are 20.9%. Any downward defection from this level is cause for further evaluation as the defection could be due to the presence of other contaminants in the air diluting the oxygen concentration.

5.1.4 Particulates

Dry, dusty conditions may be a potential at the site. Worker exposure may occur due to nuisance levels of dust, chemicals sorbed to dust or the presence of contaminated particulates such as asbestos, lead, or cadmium. The work area may be monitored with a respirable dust meter. Site Specific HASPs will include chemicals of concern and engineering practices necessary to control risks and hazards. Dust suppression methods (water spray) may need to be used if conditions warrant. If levels are still above the action limit, then workers will upgrade to Level C PPE or back off and reassess. The presence of metals in the soils will require additional medical surveillance, protective equipment, work practices, or monitoring, in order to comply with the specific regulation

5.1.5 Air Sampling

To the extent feasible, the presence of airborne contaminants will be evaluated through the use of direct reading instrumentation (DRI). Information gathered will be used to ensure the adequacy of the levels of protection being used at the site, and may be used as the basis for upgrading or downgrading the levels of protection in conformance with action levels provided in this HASP and at the direction of the SSHO.

In addition to the potential explosivity, oxygen deficiency, and airborne particulates described above, a PID may be used to monitor potential source areas and to screen source areas and breathing zones of employees during sampling and other intrusive activities. The PID has been selected because it is capable of detecting organic gases and vapors and some inorganic gases and vapors. Prior to the commencement of any field activities, the background level of the Site must be determined and noted. A daily background reading must be taken away from areas of potential contamination to obtain accurate results. These readings, any influencing conditions (i.e., weather, temperature, humidity), and the location will also be documented in the field logbook as a matter of reference. Specific air monitoring measures and action level requirements are presented in the Site Specific HASP.

5.1.6 Personal Monitoring

It is not anticipated that personal monitoring will be conducted during the task covered by this HASP. If necessary, personal monitoring will be addressed in the Site Specific HASP.

6.0 SITE CONTROL

6.1 ZONATION

To prevent both exposure of unprotected personnel and migration of contamination due to tracking by personnel or equipment, work areas and associated personal protective equipment requirements will be clearly identified. Designated work areas or zones are required as suggested in the "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," NIOSH/OSHA/USCG/EPA, November, 1985. Areas surrounding each of the work areas shall be divided into three zones:

Exclusion Zone (EZ)
Contamination Reduction Zone (CRZ)
Support Zone

The general zonation protocols that should be employed at hazardous waste sites are described below.

6.1.1 Exclusion Zone

The EZ isolates the area of contaminant generation and restricts (to the extent possible) the spread of contamination from active areas of the site to support areas and off-site locations. The EZ is demarcated by the Hot Line (i.e., a tape line or physical barrier). Personnel entering the EZ must (1) enter through the CRZ; (2) wear the prescribed level of protection; and (3) be otherwise authorized and trained to enter the EZ. Any personnel, equipment, or materials exiting the Exclusion Zone will be considered contaminated. Personnel will be subject to decontamination; equipment and materials will either be subject to decontamination or containerized in uncontaminated devices.

Within the EZ, specific locations or restricted areas (clearly marked or identified) will be established (as necessary) for particular locations or around specific site operations. In the case of well drilling or excavation operations, a restricted area will be established that includes a minimum 30-foot radius from the drill rig or excavation operation, if possible. Other restricted areas may include drum areas, active site areas, sources of combustible gases or air contaminants, or other dangerous areas as they are identified. Access for emergency services to areas of specific site operations will be established.

6.1.2 Contamination Reduction Zone

Moving out from the EZ, starting at the Hot Line and continuing to the Contamination Control Line, is the CRZ. The CRZ is a transition zone between contaminated and uncontaminated areas of the site. When "hot" or contaminated personnel, equipment, or materials cross the Hot Line, they are assumed to be as hot or contaminated as they are going to be from site operations. Being subjected to the decontamination process, they become less contaminated; when they reach the Contamination Control Line, they are clean and can exit the CRZ without spreading contamination.

Within the CRZ is the Contamination Reduction Corridor, where materials necessary for full personnel and portable equipment decontamination are kept. A separate facility will be established for heavy equipment decontamination. In addition, certain safety equipment (e.g., emergency eye wash, fire extinguisher, stretcher, and first aid kit) is staged in this zone.

6.1.3 Support Zone

The Support Zone is the outermost zone of the site, separated from the CRZ by the Contamination Control Line; it is considered a clean area. Movement of personnel and materials from the Support Zone into the CRZ is generally unrestricted, except as required through access points controlled for administrative purposes. However, only uncontaminated/decontaminated personnel or materials may enter the Support Zone from the CRZ.

The Support Zone contains the necessary support facilities (including personal hygiene facilities) for site operations. It also serves as the communications center and source of emergency assistance for operations in the EZ and CRZ. A log of all persons entering the site will be maintained by the SSHO, the field operations leader, or the site designee. The zone shall be set up in an area of the site that is known to be or is likely to be free of contamination.

<u>Interim Zones</u>

Where activities at subsurface investigation points are expected to be of short duration (less than one day) with surrounding areas readily within visual observation, interim delineation of zones may be developed and maintained. Generally, caution tape or an equivalent visual reminder should be used to indicate areas where access is restricted.

6.2 COMMUNICATIONS

When radio communication is not used, the following air horn signals will be employed:

HELP	three short blasts	(. . .)
EVACUATION	three long blasts	(_ _ _)
ALL CLEAR	alternating long and short blasts	(_ . _ .)

Hand signals may be necessary in areas where exposure noise is expected. Work crews will be instructed and trained to use the hand signals.

7.0 DECONTAMINATION/DISPOSAL

All personnel and/or equipment leaving contaminated areas of the site will be subject to decontamination, which will take place in the contamination reduction zone. The Site Sampling and Analysis Plans provide details to be implemented.

7.1 DECONTAMINATION

The following sections provide general information and guidelines about decontamination.

7.1.1 Personnel Decontamination

Decontamination procedures are followed by all personnel leaving hazardous waste sites. Under no circumstances (except emergency evacuation) will personnel be allowed to leave the EZ and CRZ prior to decontamination. A typical personnel decontamination station is shown in Figure B-1. Generalized procedures for removal of protective clothing are as follows:

1. Drop tools, monitors, samples, and trash at designated drop stations (i.e., plastic containers or drop sheets).

2. Step into the designated shuffle pit area and scuff feet to remove gross amounts of dirt from outer boots.

3. Scrub outer boots and outer gloves with decontamination solution or detergent and water. Rinse with water.

4. Remove tape from outer boots and remove boots; discard tape and boots in disposal container.

5. Remove tape from outer gloves and remove gloves; discard tape and gloves in disposal container.

6. If the worker has left the EZ to change the air tank on the SCBA or the canister on the air-purifying respirator, this will be the last step in the decontamination procedure. The tank or cartridge should be exchanged, new outer gloves and boot covers donned, and the joints taped; the worker then returns to duty.

7. Remove outer garments and discard in disposal container.

8. Remove respirator and store in the designated area.

9. Remove inner gloves and discard in disposal container.

10. If the site requires use of a decontamination trailer, all personnel must shower before leaving the site at the end of the work day.

NOTE: Disposable items (i.e., Tyvek coveralls, inner gloves, and latex over boots) will be changed daily unless there is reason to change sooner. Dual respirator canisters will be changed daily, unless more frequent changes are deemed appropriate by site surveillance data or personnel assessment.

Maximum and minimum decontamination layouts for PPE Levels A through C are shown in Figures B-2 through B-5.

Pressurized sprayers or other designated equipment will be available in the decontamination area for wash down and cleaning of personnel, samples, and equipment.

Respirators will be decontaminated daily and taken from the drop area. The masks will be disassembled, the cartridges set aside, and all other parts placed in a cleansing solution. Parts will be pre-coded (e.g., #1 on all parts of Mask #1). After an appropriate time in the solution, the parts will be removed and rinsed with tap water. Old cartridges will be marked to indicate length of use (i.e., if it is possible to evaluate the remaining utility of the cartridge), or discarded in the contaminated trash container for disposal. In the morning, the masks will be reassembled and new cartridges installed, if appropriate. Personnel will inspect their own masks and readjust the straps for proper fit.

7.1.2 Small Equipment Decontamination

Small equipment will be protected from contamination as much as possible by draping, masking, or otherwise covering the instruments with plastic (to the extent feasible), without hindering operation of the unit. For example, the PID meter can be placed in a clear plastic bag to allow for reading the scale and operating the knobs. The PID meter can be partially wrapped, keeping the sensor tip and discharge port clear.

The contaminated equipment will be taken from the drop area and the protective coverings will be removed and disposed of in appropriate containers. Any dirt or obvious contamination will be brushed or wiped with a disposable paper wipe. The units can then be taken inside in a clean plastic tub, wiped off with damp disposable wipes, and dried. The units will be checked, standardized, and recharged as necessary for the next day's operation, and then prepared with new protective coverings.

Small equipment decontamination will then proceed as necessary, as follows:

Potable water rinse

Liquinox wash (if applicable)/potable water rinse
Deionized water rinse

If there is visual, olfactory, or field screening evidence of petroleum hydrocarbon contamination, a methanol rinse will be added prior to the final DI water rinse.

7.1.3 Heavy Equipment Decontamination

It is anticipated that drilling rigs and backhoes may become contaminated during borehole and test-pitting activities. They will be cleaned with high-pressure water or steam in designated areas. Loose material will be removed with a brush. The person performing this activity will usually be at least at the level of protection used during the personnel and monitoring equipment decontamination.

7.1.4 Collection and Disposal of Decontamination Products

Investigative derived waste (IDW) including PPE and other disposable items, purge and decontamination fluids and soils that are generated during the investigation will be handled, stored and disposed of following the methodology and requirements detailed in the Site Specific Sampling and Analysis Plan (SAP) and the work plan.

8.0 EMERGENCY/CONTINGENCY PLAN

This section identifies emergency/contingency planning that has been undertaken for operations at this site. Most sections of the HASP provide information that would be used under emergency conditions. The following subsections present specific emergency/contingency planning information.

8.1 POTENTIAL HAZARDS

The most common hazards associated with hazardous waste site investigation that may require emergency contingency responses include (1) accidents; (2) inhalation, contact, or ingestion of hazardous materials; (3) explosion; and (4) fire.

8.1.1 Accidents

Accidents must be handled on a case-by-case basis. Minor cuts, bruises, muscle pulls, and the like will still allow the injured person to undergo reasonably normal decontamination procedures before receiving direct first aid. More serious injuries may not permit complete decontamination procedures to be undertaken, particularly if the nature of the injury is such that the victim should not be moved. In these cases, arrangements will be made with the medical facility and transporter to allow them to take proper precautions. The nature and degree of surface contamination at a site is generally low enough that emergency vehicles could reach the victim on-site without undue hazard. However, if on-site access is limited, accident victims may be transported by MACTEC E&C personnel trained for this response to a point accessible by an ambulance. No injured worker shall transport themselves to off-site medical clinics.

8.1.2 Contact and/or Ingestion of Hazardous Materials

Properly prescribed and maintained protective clothing and adherence to established safety procedures are designed to minimize this hazard. However, it is still possible that contact or ingestion of materials may occur. For example, puncture of a buried drum of liquid during drilling operations might cause the drum contents to contact personnel. Standard first-aid procedures should be followed. The drilling rig may have a tank of water that may be useful in some circumstances, particularly to flush contaminants from any exposed skin areas. Eye-wash bottles will also be maintained at the site for emergencies. In cases of ingestion or anything other than minor contact with known substances, the local Poison Control Center and hospital should be notified and the victim taken there immediately for further treatment and observation.

8.1.3 Explosion

The drilling crew should be keenly aware of combustible gas meter readings and should withdraw at any indication of imminently hazardous conditions (i.e., greater than 20 percent LEL). The detection of such conditions will be reported to local agencies for potential execution of the evacuation plan, if the situation is assessed to warrant such response.

8.1.4 Fire

The combustible gas meter also warns of imminent fire hazards at borings. The greatest fire hazard at the site should be recognized as handling the fluids (e.g., methanol and acetone) used for certain decontamination procedures. No smoking or open flames are allowed on-site. Carbon dioxide fire extinguishers will be kept at the drilling rig and in the decontamination area/field office. The fire department, previously informed of site activities, will be called as needed.

8.2 PERSONNEL ROLES, LINES OF AUTHORITY, AND COMMUNICATION

The SSHO or the Health and Safety designee is the primary authority for directing operations at the site under emergency conditions. Prior to commencement of on-site activities, the SSHO will review safety considerations with the field crew. The SSHO has overall responsibility for adherence to the designated safety precautions and assumes the role of on-site coordinator in an emergency response situation. All communications both on- and off-site will be directed through the SSHO or designee.

Emergency communication will be required to ensure positive preplanned notification of emergency authorities in the event of episodes requiring initiation of contingency plans. Emergency communication will include all or parts of the following:

- Coordinate with local agencies, fire and police departments, the ambulance service, and the hospital emergency room.

- Establish two-way communication and a site alarm capable of warning site personnel and summoning assistance (i.e., air horn).

- Investigate possible routes of evacuation prior to any activity.

- If an accident occurs, a copy of an accident report form, provided in Appendix C Form J should be filled out by the SSHO and filed with the individual's supervisor, the RSHO, and MACTEC E&C Human Resources. A copy should also be retained in the project records.

8.3 EVACUATION

In the event of an emergency requiring evacuation, the SSHO assumes the role of on-site coordinator. For work areas where line of sight and voice or electronic communication cannot be relied upon for rapid communication, a system of audible communication using air horns will be implemented. In this case, the following system shall be used: five short blasts (indicating that a warning message is pending) followed by one, two, or three long blasts corresponding to the required responses below.

(1) stop work and withdraw from the immediate work area (100+ feet upwind);
(2) evacuation of the EZ to the support area; and
(3) evacuation of site to the surrounding area.

This may be repeated as needed until evacuation response actions are completed.

If residences or commercial properties are potentially affected by the emergency conditions, the local agencies will be immediately notified and assistance requested. Designated on-site personnel will initiate evacuation of the immediate off-site area without delay.

8.3.1 Withdrawal Upwind (100 Feet or More)

Withdrawing upwind (100 feet or more) will be required when (1) ambient air conditions contain greater contaminant concentrations than guidelines allow for the type of respiratory protection being worn (the work crew may return after donning greater respiratory protection and/or assessing the situation as transient and past); (2) a breach in protective clothing or minor accident occurs (the work crew may return when the tear or other malfunction is repaired and first aid or decontamination has been administered); or (3) the respirator malfunctions requiring replacement.

The work crew will continually observe general wind directions while on-site. (A simple wind sock may be set up near the work site for visual determinations.) Upon observing conditions that warrant moving away from the work site, the crew will relocate upwind a distance of approximately 100 feet or farther, as indicated by the site monitoring instruments. Donning SCBA and a safety harness and line, the SSHO and a member of the crew may return to the work site to determine whether the conditions noted were transient or persistent. If persistent, an alarm should be raised to notify on-site personnel of the situation and the need to leave the site or don SCBA. An attempt should be made to decrease emissions only if greater respiratory protection is donned. The RSHO, and client will be notified of conditions. When access to the site is restricted and escape is thereby hindered, the crew may be instructed to evacuate the site rather than move upwind, especially if withdrawal upwind moves the crew away from escape routes.

8.3.2 Site Evacuation

Evacuation of the site will be required when (1) ambient air conditions contain explosive and persistent levels of combustible gas or excessive levels of toxic gases; (2) a fire or major accident occurs; or (3) explosion is imminent or has occurred.

After determining that site evacuation is warranted, the work crew will proceed upwind of the work site and notify the security force, SSHO, and field office of site conditions. If the decontamination area is upwind and more than 500 feet from the work site, the crew will pass quickly through decontamination to remove contaminated outer suits. If the hazard is toxic gas, respirators will be retained. The crew will proceed to the field office to assess the situation, where the respirators may be removed (if instrumentation indicates an acceptable condition). As more facts are determined from the field crew, they will be relayed to the appropriate agencies. The advisability and type of further response action will be coordinated and implemented by the SSHO.

8.3.3 Surrounding Area Evacuation

The area surrounding the site will be evacuated when persistent, insuppressible toxic or explosive vapors from test pits or borings (e.g., pressure release from punctured drum) are released, or air quality monitored at several points downwind assess danger to the surrounding area. When the SSHO determines that conditions warrant evacuation of downwind residences and commercial operations, the local agencies will be notified and assistance requested. Designated on-site personnel will initiate evacuation of the immediate off-site area without delay.

Any Site Specific Evacuation Plans containing special instructions and rally points will be included in the Site Specific HASP addendum developed when the site specific work plans are further defined.

8.4 EMERGENCY MEDICAL TREATMENT/FIRST AID

On-site first aid will include an industrial first-aid kit at the work site; contents of the kit will be checked weekly and restocked as necessary. Other equipment may include oxygen, backboard and straps, splints, and a cervical collar.

At least one person qualified to perform first aid will be present on-site at all times during work activity. This person will have earned a certificate in first-aid training or will have received equivalent training. Designated first aides will receive regular review training from the American Red Cross or the equivalent.

An eye-wash station will be provided at the work site, as well as flushing water for decontamination of boots, gloves, clothing, and tools.

Prior to site investigation or activity on hazardous sites, nearby health facilities will be evaluated to determine their ability to provide for the needs of on-site project staff. Criteria such as emergency department physician coverage, decontamination capabilities, and available medical specialists will be evaluated. The local hospital and emergency response team will be advised in advance of the work to be performed. Local medial facilities contact information, maps and directions from the sites to the medical facilities are located in the Site Specific HASPs.

All on-site personnel will be familiarized with both the primary and secondary route to the nearest hospital (which may be shown on a figure or a local map), as well as the location of the nearest working telephone or radio communication device. A list of emergency telephone numbers will be posted in the trailer and in vehicles as necessary.

Any personnel injured on-site will be rendered first aid as appropriate and transported to competent medical facilities for further examination and/or treatment. The preferred method of transport would be through professional emergency transportation means; however, when this is not readily available or would result in excessive delay, other transport will be authorized. Under no circumstances will injured persons transport themselves to a medical facility for emergency treatment.

8.5 SPILL CONTROL PLAN

It is not anticipated that work will be conducted around containers of bulk chemicals (e.g., drums or tanks) during the NYSDEC Superfund Site field programs. If this type of work is anticipated during a work assignment, then a then a Spill Control Plan will be developed based on site contaminants and conditions and included in the Site Specific HASP. In addition, personnel will be trained and have adequate equipment to be able to contain or control a spill, plus be able to decontaminate previously uncontaminated structures, equipment, or material. If such conditions occur, spilled materials and contaminated soils and/or water will be collected, containerized, and disposed of properly. Every effort will be made to avoid damaging the containers which would discharge the contents and further contaminate the area.

Some equipment that may be needed in addition to PPE include: sand, "kitty litter," or some other absorbent material; sandbags; a front-end loader; Department of Defense (DOT) approved 55-gallon drums or salvage drums; shovels; drum repair kit; chemicals to neutralize acids or bases; or decontamination equipment. The choice of equipment needed for the site is based on the amount and type of contaminants known or suspected to be at the site, as well as the work to be conducted. Subcontractors with equipment that has the potential to leak contaminants (e.g., fuel, hydraulic oil), will be responsible for their own Spill Control Plan.

8.5.1 Personal Protective Equipment

In the event of a spill or leak, the work crew must back off until adequate PPE can be donned. In most cases, Level B PPE will be required; however, there may be incidences where Level C or D is acceptable. The SSHO will determine the level of protection based on the contaminant, amount spilled, and levels monitored in the air.

8.5.2 Control Measures

Once the work crew is adequately protected, immediate measures should be taken to control and contain the spill within site boundaries. The hazardous area should be isolated and all unnecessary personnel kept away and upwind of the spill. Do not allow any flares, smoking, or open flames into the area and, if possible, avoid allowing combustible materials to come in contact with the spill.

Small Spills. If the spilled material is a solid, shovel contaminated material directly into a container, then cover, label, and dispose of it properly. If the spilled material is a liquid, absorb with sand, "kitty litter," or some other noncombustible absorbent material first, and then shovel it into a container, and cover, label and dispose of it properly.

Large Spills. For large liquid spills, install a dike using sandbags, absorbent pillows, soil, or any other available, noncombustible material. Ensure that the dike is large enough to contain the spill. Pump off and containerize any standing liquid. Recycle it if possible, or solidify it with an absorbent material, then cover, label and dispose of it properly. Collect and containerize all contaminated soil, then cover, label, and dispose of it properly. For large solid spills, collect, containerize, cover, label, and dispose of it properly.

8.5.3 Reporting

If the amount spilled is reportable under Resource Conservation and Recovery Act (RCRA) requirements and goes off-site, or if there is a threat to human health or the environment, the proper authorities must be notified. Notification will be made by the Site Lead or designee.

9.0 SANITARY FACILITIES AND LIGHTING REQUIREMENTS

9.1 SANITATION

Provisions must be made for sanitation facilities for the site work force. At a minimum, the provision of toilet facilities must meet the requirements of 29 CFR 1910.120(n), which includes one facility for less than 20 employees, or one toilet and one urinal for every 40 employees, up to 200; then one of each for every 50 employees. If it is a mobile crew and they have transport readily available, the requirements do not apply.

9.2 ILLUMINATION

Site operations will not be permitted without adequate lighting. Therefore, unless provisions are made for artificial light, downrange operations must halt in time to permit personnel and equipment to exit the EZ and proceed through decontamination before dusk. Conversely, operations will not be permitted to begin until lighting is adequate.

10.0 HEALTH AND SAFETY AUDIT

10.1 HEALTH AND SAFETY AUDIT PROCEDURES

Regular health and safety audits may be conducted to ensure compliance with health and safety policy and procedures. The SSHO may perform periodic audits, using the health and safety audit form (see Appendix C Form A). Auditing may also be performed on any MACTEC E&C site by the RSHO, and will include health and safety evaluations of all work activities. The audits will be an unannounced evaluation of sites selected at the discretion of the RSHO.

Results of each site health and safety audit will be summarized in an audit report provided to the site RSHO, the Project Manager, and the Operational Group Manager charged with responsibility for the project. Where the audit report identifies deficiencies, it will be the Project Manager's responsibility to promptly implement corrective action. The corrective action undertaken will be outlined in a written report submitted to the RSHO. The RSHO will retain the original audit report that has been signed by the Project Manager and the RSHO to acknowledge receipt of the audit's findings. Any mitigating comments submitted to the RSHO will be appended to the original report.

LIST OF ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
APR	Air Purifying Respirator
CAS	Chemical Abstracts Service
CDC	Center for Disease Control
CO	Carbon Monoxide
CPR	Cardio Pulmonary Resuscitation
CRZ	Contamination Reduction Zone
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DI	Deionized
DOT	Department of Transportation
DRI	Direct Reading Instrumentation
ES&H	Environmental Safety and Health
eV	Electron Volts
EZ	Exclusion Zone
F	Fahrenheit
HASP	Health and Safety Plan
HAZWOPPER	Hazardous Waste
HCS	Hazard Communication Standard
HR	Heart Rate
IARC	International Agency for Research on Cancer
IDLH	Immediately Dangerous to Life and Health
IDW	Investigative Derived Waste
IP	Ionization Potential
LEL	Lower Explosive Limit
LTM	Long Term Monitoring
MACTEC E&C	MACTEC Engineering and Consulting, PC
MSDS	Material Safety Data Sheet
NIOSH	National Institute for Occupational Health and Safety
NTP	National Toxicology Program

OSHA	Occupational Safety and Health Administration
OVA	Organic Vapor Analyzer
PAH	Polycyclic Aromatic Hydrocarbon
PCB	polychlorinated byphenyls
PEL	Permissible Exposure Limit
PID	Photo Ionization Detector
PM	Project Manager
ppb	Parts Per Billion
PPE	Personal Protective Equipment
ppm	Parts Per Million
RCRA	Resource Conservation and Recovery
REL	Recommended exposure Level
RSHO	Regional Safety and Health Officer
SAP	Sample and Analysis Plan
SCBA	Self Contained Breathing Apparatus
SSHO	Site Health and Safety Officer
STEL	Short Term Exposure Limit
SVOC	Semi Volatile Organic Carbon
TLV	Threshold Limit Value
TPH	Total Petroleum Hydrocarbon
TWA	Time-Weighted Average
UEL	Upper Explosive Limit
USACHPPM	U. S. Center for Health Promotion and Preventative Medicine
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
UV	Ultraviolet
VOC	Volatile Organic Carbon
WC	Workers Compensation
XRF	X-Ray Fluorescence Spectroscopy

APPENDIX A

TEMPERATURE EXTREMES

A. TEMPERATURE EXTREMES

A.1 HEAT STRESS

Due to the increase in ambient air temperatures and the effects of protective outer wear decreasing body ventilation, there is increased potential for injury, specifically heat casualties. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim, and the prevention of heat stress casualties.

A.1.1 Identification and Treatment

A.1.1.1 Heat Exhaustion

Symptoms. Heat exhaustion usually begins with muscular weakness, dizziness, nausea, and a staggering gait. Vomiting is frequent. The bowels may move involuntarily. The victim is very pale, the skin is clammy, and he or she may perspire profusely. The pulse is weak and fast; breathing is shallow. The victim may faint unless he or she lies down. This may pass; however, sometimes it persists and, while heat exhaustion is generally not considered life threatening, death could occur.

First Aid. Immediately remove the victim to the CRZ in a shady or cool area with good air circulation. Remove all protective outer wear. Call a physician. Treat the victim for shock (i.e., have the victim lie down, raise the feet 6 to 12 inches, and maintain body temperature but loosen all clothing). If the victim is conscious, it may be helpful to give sips of water. Transport the victim to a medical facility.

A.1.1.2 Heat Stroke

Symptoms. This is the most serious of heat casualties because the body excessively overheats. Body temperatures often are between 107 and 110°F. The victim will have a red face and will not be sweating. First there is often pain in the head, dizziness, nausea, oppression, and dryness of the skin and mouth. Unconsciousness follows quickly and death is imminent if exposure continues. The attack will usually occur suddenly. Heat stroke is always serious.

First Aid. Immediately evacuate the victim to a cool and shady area in the CRZ. Remove all protective outer wear and all personal clothing. Lay the victim on his or her back with the head and shoulders slightly elevated. It is imperative that the body temperature be lowered immediately. This can be accomplished by applying cold wet towels or ice bags to the head and groin. Sponge off the bare skin with cool water or rubbing alcohol, if available, or even place the victim in a tub of cool water. The main objective is to cool without chilling. Do not give stimulants. Transport the victim to a medical facility as soon as possible.

A.1.2 Prevention of Heat Stress

One of the major causes of heat casualties is the depletion of body fluids and salts through sweating. Fluids should be maintained in the Support Zone. Salts can be replaced by either a 0.1 percent salt solution, more heavily salted foods, or commercial mixes such as Gatorade™. The commercial mixes are advised for personnel on low-sodium diets.

During warm weather, a work schedule will be established that allows most work to be conducted during the morning hours, before ambient air temperature levels reach highs.

A work/rest schedule will be implemented for personnel required to wear Level B or C protection (i.e., an impervious outer garment) with sufficient time allowed for personnel to "cool down" (this may require working in shifts). Two hours is the maximum time between breaks at Level B or C, regardless of temperature. At elevated temperatures, breaks should be scheduled as follows:

Ambient Temperatures	Maximum Time Between Cool Down Breaks
Above 90°F	¼ hour
85° to 90°F	½ hour
80° to 85°F	1 hour
70° to 80°F	1½ hours

A.1.3 Heat Stress Monitoring

Monitoring of personnel wearing impervious clothing should commence when the ambient temperature reaches 70°F, with increased frequency if ambient temperature increases or as slow recovery rates are indicated. When temperatures exceed 85°F, workers should be monitored for heat stress after every work period. As a screening mechanism of the body's recuperative ability to excess heat, one or more of the following techniques should be used.

1. Measure the heart rate (HR) for 30 seconds, by radial pulse, as early in the resting period as possible. At the beginning of the rest period, the HR should not exceed 110 beats per minute. If the HR is higher, the next work period should be shortened by 10 minutes (or 33 percent), with the length of the rest period staying the same. If the pulse rate is still above 110 beats per minute at the beginning of the next rest period, the following work cycle should again be shortened by 33 percent.

2. Measure oral body temperature with a clinical thermometer, as early as possible in the resting period. At the beginning of the rest period, oral temperature (OT) should not exceed 99°F. If OT exceeds 99°F, the next work period should be shortened by 10 minutes (or 33 percent), with the length of the rest period staying the same. If the OT again exceeds 99°F at the beginning of the next period, the following work cycle

should be further shortened by 33 percent. OT should also be measured at the end of the rest period to ensure that it has dropped below 99°F.

3. Maintain good hygienic standards by changing clothes frequently, showering daily, and allowing clothing to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.

A.2 COLD STRESS

Cold weather may often cause problems for personnel working outside, even at temperatures above freezing. As temperatures drop below freezing, the potential for cold weather injuries increases dramatically, as does the potential for equipment failure. Because of the considerable danger to personnel, outdoor work should be suspended if the ambient temperature drops below 0°F (-18°C) or if the wind chill factor drops below -29°F (-34°C). These levels represent guidelines that should be used as an action level unless the SSHO determines and documents otherwise. Table K-1, which shows equivalent temperatures (i.e., wind-chill) for a range of ambient conditions, should also be referred to. Snow and ice increase the risks to personnel and operations through reduced visibility, increased potential for falling injuries, reduced on-site mobility, and the increased time required to access the site (or off-site support services).

In view of these factors, it is critical that the SSHO establish site specific safety and operating protocols, and that all on-site personnel be made aware of the risks.

A.2.1 Local Cold Injuries

Local cold injuries affect specific areas of the body (e.g., fingers, ears, or toes), including the more commonly recognized injuries described in the following subsections.

A.2.1.1 Chilblains

Chilblains is a chronic condition affecting the skin and peripheral capillary circulation, resulting from prolonged exposure of the bare skin, primarily in the extremities, to temperatures at or below 60°F. The best method of preventing and treating chilblains is to cover and protect the skin, thereby avoiding prolonged exposure to the cold.

A.2.1.2 Frostbite

Frostbite is freezing of the hands, feet, ears, and exposed parts of the face as a result of exposure to very low temperatures. Frostbite occurs when ice crystals form in the fluid in cells of the skin and tissue. As long as blood circulation remains good, frostbite will not occur.

There are three stages of frostbite: incipient frost bite (frostnip), superficial frostbite, and deep frostbite. The classification depends on severity and can range from incipient frostbite (frostnip), which affects the skin; to superficial frostbite, which involves the skin and the tissues immediately beneath it; to deep frostbite, which is much more serious with damage that may affect deeper tissue and even bone.

Symptoms. Symptoms for each of the three stages of frostbite are described as follows.

- Frostnip. Skin first turns red and then later becomes pale or waxy white. There may be tingling, stinging, aching, an uncomfortable sensation of coldness or numbness, or no noticeable symptoms.

- Superficial Frostbite. The skin turns white or gray-white and is waxy in appearance. It is firm to touch (i.e., does not move easily) and the tissue beneath the skin is soft and resilient. There is a lack of sensation in the area.

- Deep Frostbite. The tissue is pale, cold, and solid with possible blisters and swelling. The hands and feet are especially susceptible to deep frostbite.

TABLE A-1
COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS AN EQUIVALENT TEMPERATURE

Wind Chill Chart

Wind (mph)	Temperature (°F)																	
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes; 10 minutes; 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Emergency Treatment of Frostbite. Frostnip is easily treated in the field by the application of body heat, which should be applied before the affected area becomes numb. If frostnip affects your fingers and hands, place them against the skin of your chest or in your armpits. To warm your face, hold a mitten or scarf over the lower part of your face and breathe into it. Thaw frozen spots immediately. Do not rub affected areas.

Superficial frostbite usually responds to the application of body heat, as described previously. If the skin does not respond to body heat or if it resembles the early stages of deep frostbite, follow the emergency treatments listed in the following paragraphs. DO NOT rub affected areas.

For deep frostbite, if possible, the injured person should be taken to a heated shelter to avoid further frostbite. If it can be done without the danger of further frostbite, remove all constricting items (e.g., boots, gloves, and socks) from the injured area. RAPID REWARMING WILL MINIMIZE TISSUE LOSS. If possible, warm the extremities in a carefully controlled water bath (104 to 106°F) until tips of the fingers or toes turn pink and feeling is restored. If a water bath is not available, either apply wet packs (100 to 112°F) to the person's body, or gently wrap frostbitten area in blankets or some other warm material.

DO NOT attempt to thaw the affected parts by exercising them or heating them in front of an open fire, heat lamp, radiator, or stove. The person could receive a heat injury as a result of sensation loss.

DO NOT use snow to thaw frostbite. DO NOT rub, massage, or use pressure on the affected areas. Keep the frostbitten parts elevated if possible. Watch to see if CPR is necessary. Give the victim warm drinks such as tea, coffee, or soup. DO NOT GIVE ALCOHOLIC BEVERAGES. Have the victim exercise fingers or toes as soon as possible, but only after they are warmed. DO NOT allow a person with frostbitten feet to walk; walking may cause additional damage.

Medical Treatment of Frostbite.

- Frostnip. Usually does not require medical care.
- Superficial Frostbite. Blisters may require medical care.
- Deep Frostbite. EARLY MEDICAL TREATMENT IS URGENT! Transport the victim to medical care facilities at once.

Prevention of Frostbite. It is far easier to prevent or stop frostbite in earlier stages than to thaw and take care of badly frozen flesh. To protect the body against frostbite, the following precautions should be taken:

- Wear enough clothing to protect against the cold and wind.

- Wear warm gloves and boots.

- Pull a scarf or jacket flap over the lower part of the face or pull a hood tightly around the face.

- Occasionally exercise the face, fingers, and toes to keep them warm and to detect any areas that may have become numb.

- Crew members should watch each other closely, especially the face, for signs of frostbite.

A.2.1.3 Immersion Foot

Immersion foot (formerly called trench foot) is a cold injury resulting from prolonged exposure to near-freezing temperatures when standing or walking on wet or swampy ground.

Symptoms. In the early stages, the feet and toes are pale, cold, numb, and stiff, and walking is difficult. If preventive action is not taken, the feet will swell and ache; in extreme cases, this may result in irreversible damage to the tissues of the foot or leg.

Emergency Treatment of Immersion Foot. Handle feet very gently. DO NOT rub or massage. If necessary, clean feet carefully with soap and warm water, then dry, elevate, and expose to warm but not hot air.

Prevention of Immersion Foot. Because the early stages of immersion foot are not painful, crew members must be constantly on the alert and check feet often when working in cold, wet conditions. Keep feet dry by wearing waterproof footgear and changing socks frequently because perspiration, trapped inside waterproof boots or heavy footgear, can contribute to immersion foot symptoms. Avoid standing in wet areas. If feet get wet, dry them as soon as possible, warm them with your hands, then use foot powder, and change to dry socks. If you cannot change wet boots and socks, exercise your feet frequently by wriggling your toes and moving your ankles. Never wear tight boots.

A.2.2 Systemic Cold Injuries

Systemic injuries are those that affect the entire body system. Severe body cooling, known as systemic hypothermia, can occur at temperatures well above freezing. Hypothermia, which can be fatal, is the progressive lowering of body temperature accompanied by rapid, progressive mental and physical collapse. A large percentage of wilderness deaths are the result of hypothermia.

Hypothermia is caused by exposure to cold, and is aggravated by moisture, cold winds, fatigue, hunger, inadequate clothing or shelter, and excessive perspiration from strenuous exercise followed by too rapid cooling.

Hypothermia often occurs between temperatures of 30 to 50°F, which most people believe are not dangerous. Crew members should be alert for symptoms of hypothermia, especially when temperatures are dropping rapidly or when they must work in rain, snow, or ice.

Hypothermia may occur on land or following submersion in even moderately cold water (i.e., 65°F or lower). On land, hypothermia may take a full day or more of exposure to develop; however, if the conditions are extremely severe, death may occur within a few hours of initial symptoms.

In cold water, death may seem to be from drowning; in reality, it is usually the result of hypothermia. In water, skin and nearby tissues chill very fast; in 10 to 15 minutes, the temperature of the heart and brain may drop. When the core (i.e., internal body) temperature reaches 90°F, unconsciousness may occur; when body temperature drops to 80°F, heart failure is possible.

A.2.2.1 Symptoms

In the early stages of hypothermia, the body begins to lose heat faster than it can be produced, making an effort to stay warm by shivering. When the body can no longer generate enough heat to overcome heat loss and the energy reserves of the body become exhausted, body temperature begins to drop. This affects the ability of the brain to make judgments and also results in loss of muscular control. As the body temperature drops, hypothermia symptoms become increasingly severe, as shown in the following table:

SYMPTOMS OF HYPOTHERMIA	APPROXIMATE CORE TEMPERATURE
Person is conscious, alert with increased respiration. Shivering may become uncontrollable as core temperature nears 95°F.	Above 95°
Person is conscious but disoriented and apathetic. Shivering is present but diminishes as temperature drops. Below 92°F, respiratory rate gradually diminishes and pupils being to dilate.	95° to 90°F
Person is semiconscious. Shivering is replaced by muscular rigidity. Pupils are fully dilated at about 86°F.	90° to 86°F
Unconscious; diminished respiration.	Below 86°F
Barely detectable or nondetectable respiration.	Below 80°F

A.2.2.2 Emergency Treatment of Hypothermia

Move hypothermia victim to shelter and warmth as rapidly as possible. In very mild cases, dry clothing and shelter may be all that is needed. Gently remove all of the victim's wet clothing (so energy is not expended by warming and drying wet clothing) and replace it with a dry set. Give the person something warm to drink. DO NOT GIVE ALCOHOLIC BEVERAGES.

ALL OTHER HYPOTHERMIA CASES SHOULD BE CONSIDERED MEDICAL EMERGENCIES. PROVIDE EXTERNAL HEAT IN ANY WAY POSSIBLE! A warm bath (with the water kept between 105° and 110°F) is the most effective way of warming a victim of hypothermia. NEVER put an UNCONSCIOUS VICTIM in a bathtub.

If it is not possible to give the person a warm bath, use one of the following ALTERNATE METHODS:

- Wrap warm moist towels (or other fabric) around the victim's head, neck, sides, and groin. As the packs cool, re-warm them by adding warm water (approximately 105°F). Check the temperature of the water with your elbow or the inside of your arm; it should be warm but not hot.

- If you are at a remote outdoor location and cannot use the other method, make a "human sandwich" by placing the unclothed victim in a sleeping bag (or between blankets) with two other undressed persons to provide body-to-body heat transfer. THIS WILL SAVE LIVES. Additional sleeping bags or blankets can be placed over and under the victim.

DO NOT wrap a hypothermia victim in a blanket without an auxiliary source of heat unless it is to protect against any further heat loss before treatment can begin, or you need to go for help and there is no other alternative.

Continue treatment once the victim has stabilized. Give warm liquids and nourishing food if the person is conscious. Check the person for symptoms of frostbite and if necessary, give treatment.

Handle the patient gently and do not allow him or her to walk. Exertion can circulate cold stagnant blood from extremities to the central body and cause "after-drop," in which the patient's core temperature drops below the level that will sustain life. ALCOHOL CONTRIBUTES TO AFTER-DROP.

A.2.2.3 Medical Care for Hypothermia

HYPOTHERMIA IS A SEVERE EMERGENCY. GET MEDICAL TREATMENT AS SOON AS POSSIBLE. Even persons with mild hypothermia should see a doctor.

A.2.2.4 Prevention of Hypothermia

In cold weather, never go into the field without wearing adequate clothing. Take a complete change of warm clothes and one or two extra pairs of socks (in plastic bags). Wear or carry a windproof, water-resistant outer jacket and, in rain or snow, wear adequate raingear.

Stay dry. If your clothing becomes wet from perspiration, rain, snow, or immersion in water, change it as soon as possible. If you start to shiver in a prolonged or violent way, seek shelter at once. Shivering may produce heat but it also uses up energy. Violent shivering may be an early sign of hypothermia.

Avoid accidental immersion in water. Practice boat safety and learn cold water survival techniques. If you fall into water and you are not very close to shore, remain quiet. Keep your head out of water, climb onto the boat, or hold or climb onto any other object that will support you and keep you up out of the water.

A.2.3 Safety/First Aid Equipment

In view of the causes, results, and appropriate treatment of cold weather injuries discussed previously, as a minimum, the following safety equipment should be included during cold weather operations:

- extra clothing for all personnel
- blankets and/or sleeping bag
- high-energy food and drinking water supply
- toboggan
- tow ropes

In extreme cold conditions, add the following safety items:

- electric blanket (if an electrical source is available)
- portable emergency generator (with fuel, oil, and cords)
- space heater and fuel

A.2.4 General Winter Operations

Cold weather conditions can severely affect winter operations. The Site Manager and SSHO must plan work schedules and project tasks accordingly.

A.2.4.1 Preliminary Assessment

If you will be working outdoors in cold weather, assess the local weather conditions through the news media (i.e., radio, television, and newspapers) to determine whether work should progress and/or the amount of preparation needed. Carefully consider questions such as the following:

- What are the typical wind and weather conditions for the period in which you will be working?
- Are the areas in which you will work sheltered or open to the wind?
- Is there a place nearby for periodic warming breaks? Can you obtain or heat warm food and beverages there? Is there a source of drinking water?
- Are there ways to minimize the length of time that crew members will have to work outdoors in the cold?
- If you use a vehicle for a warming area or will use a heater in a closed room, how can you ensure there is adequate ventilation to prevent carbon monoxide poisoning?

A.2.4.2 Scheduling

Wherever possible, try to schedule work during the least severe weather. Rotate crew members to keep cold exposures short and allow sufficient time for frequent warming breaks. Remember that workers in heavy clothing often need more time to complete the tasks and may become fatigued more easily. Be aware that operations may have to be discontinued if winds increase or the temperature drops.

Because winter days are short, scheduling should allow time for taking care of equipment and supplies before nightfall. Once it becomes dark, it is more difficult to gauge terrain, and temperatures are likely to drop.

A.2.4.3 Site Access

Snow and ice could make travel on site access roads impossible or treacherous at best. Personnel should not be allowed to work on-site if conditions could severely hamper the arrival or departure of emergency vehicles. If the route to off-site medical facilities is blocked by snow or ice, an otherwise minor injury could result in a major medical emergency. If conditions warrant, the following provisions should be made:

- snow removal/plowing services for site access roads
- a dependable, four-wheel-drive vehicle available to on-site personnel for transporting an injured person to an off-site medical facility
- sleeping bags, blankets, a food supply, and water kept on-site in the event a sudden storm requires personnel to remain overnight

The SSHO is responsible for deciding when weather conditions make site access unsafe, thereby requiring work to stop until conditions improve.

A.2.4.4 Equipment and Supplies

Obtain equipment and supplies that will help prevent cold stress and will help in the treatment of cold stress disorders. Required equipment includes a reliable ambient temperature thermometer, a wind gauge, and a wind chill chart. If the site is potentially windy due to a lack of natural or manmade windbreaks (e.g., trees, valleys, and structures), try to provide means of shielding workers from the wind. If working at a remote location, carry extra food and water because hunger and dehydration contribute to cold stress. If possible, make provisions for hot food and beverages. Ensure that emergency communication equipment is available and operational for crew members working in the cold, at heights, or in remote locations.

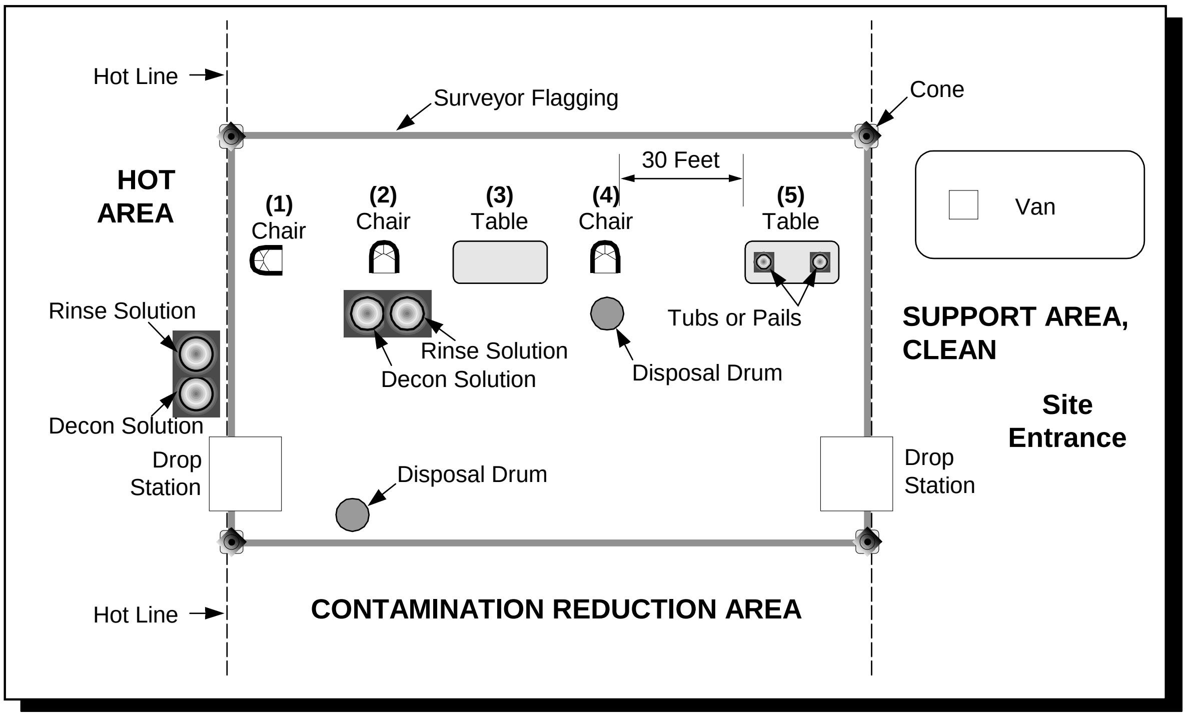
Close attention must be given to the effects of cold weather on field equipment. Batteries can be severely affected by cold resulting in disabled radios, air monitoring equipment, sampling pumps, and vehicles. A supply of fresh batteries, a sufficient number of charging units, and a set of automotive jumper cables should be maintained on-site. In addition, the electronics in many field instruments such as PI, LEL, and oxygen meters, as well as the chemical reactions in detector tubes (e.g., Draeger tubes) can also be adversely affected by the cold. The manufacturers' literature must be consulted for minimum operating temperatures.

If at all possible, monitoring well sampling tasks should not be scheduled during cold weather. These tasks generally require the use of relatively delicate pumps; long, uninsulated stretches of tubing; and significant quantities of decontamination solutions. Unless considerable effort is expended to prevent pumps, hoses, decontamination solutions, and sample containers from freezing, attempting to sample monitoring wells in cold weather may be counter- productive. Portable shelters should be considered if cold weather sampling is necessary.

APPENDIX B

DECONTAMINATION FIGURES

FIGURE B-1 TYPICAL PERSONNEL DECONTAMINATION STATION



Not To Scale

Task Key

(1) Wash Outer Boots - Rinse Boots - Dispose
(2) Wash Outer Gloves - Rinse Boots - Dispose
(3) SCBA Tank Change Over Table W/Spare
(4) Remove SCBA, Wash Mask in Pails or Tubs
(5) Remove Inner Gloves - Dispose

FIGURE B-1
TYPICAL PERSONNEL DECONTAMINATION STATION
MACTEC E&C INC

FIGURE B-2 MAXIMUM DECONTAMINATION LAYOUT-LEVEL A PROTECTION

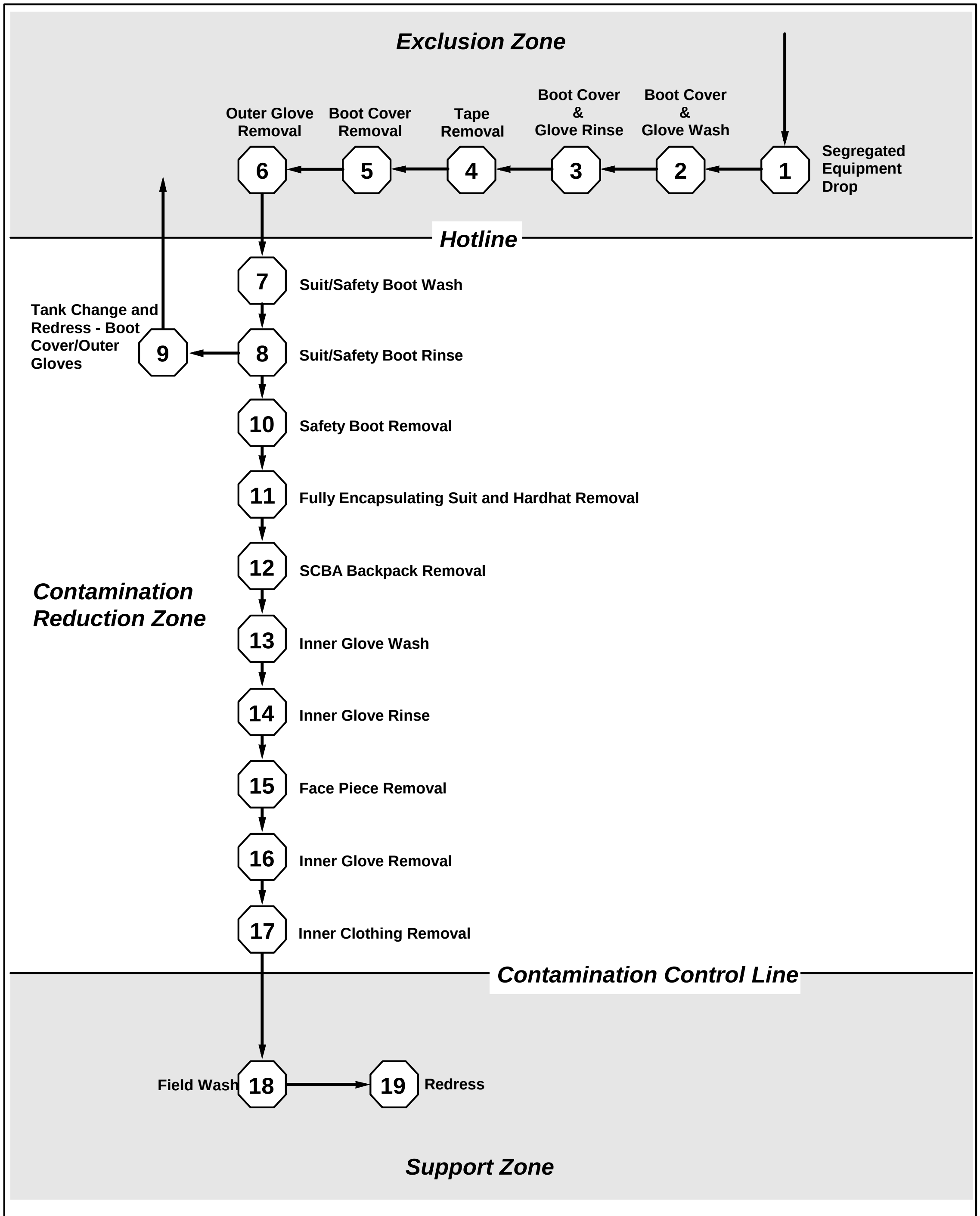


FIGURE B-2
MAXIMUM DECONTAMINATION LAYOUT
LEVEL A PROTECTION
MACTEC E&C, Inc.

FIGURE B-3 MAXIMUM DECONTAMINATION LAYOUT-LEVEL B PROTECTION

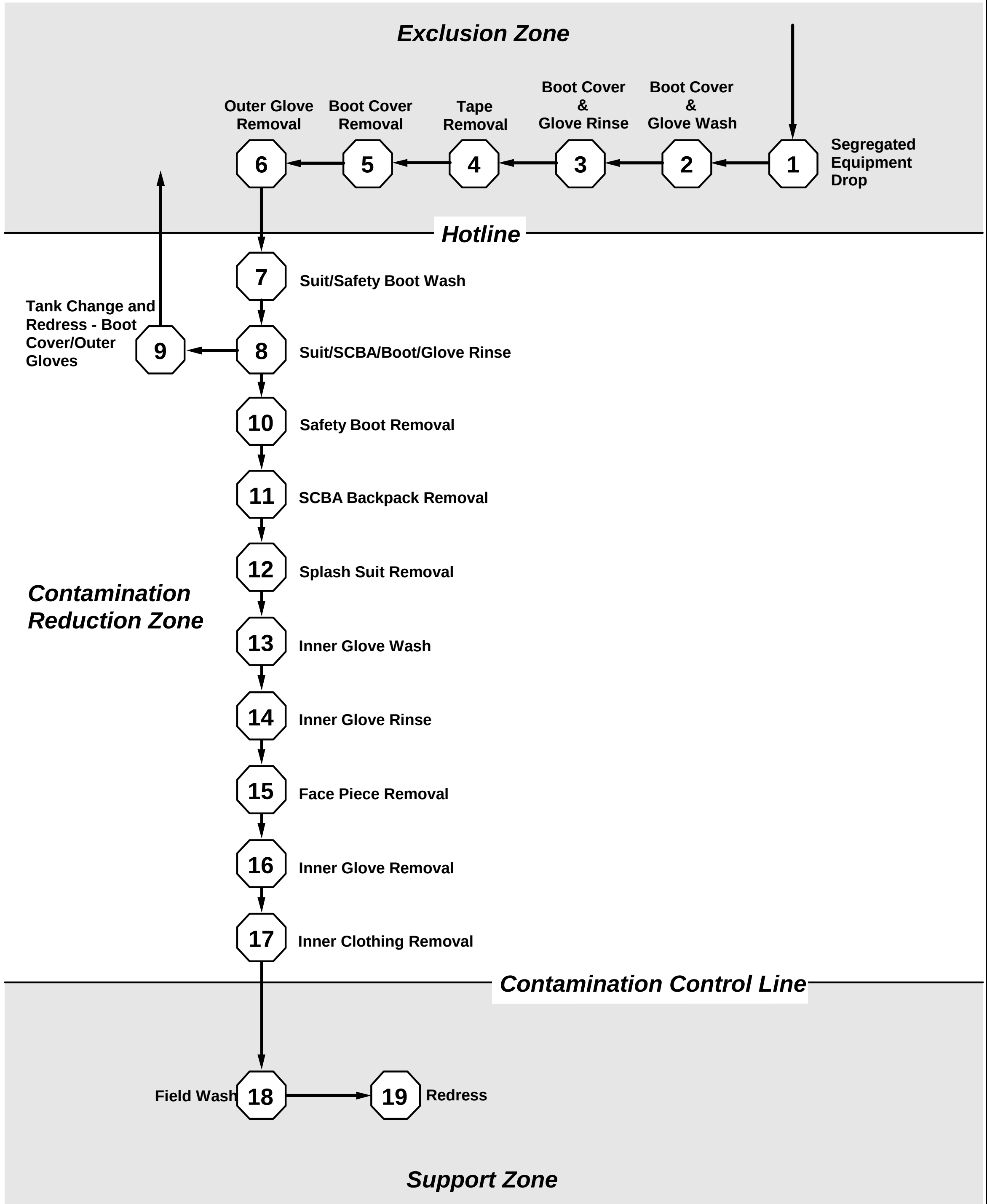


FIGURE B-3
MAXIMUM DECONTAMINATION LAYOUT
LEVEL B PROTECTION
MACTEC E&C, INC.

FIGURE B-4 MAXIMUM DECONTAMINATION LAYOUT-LEVEL C PROTECTION

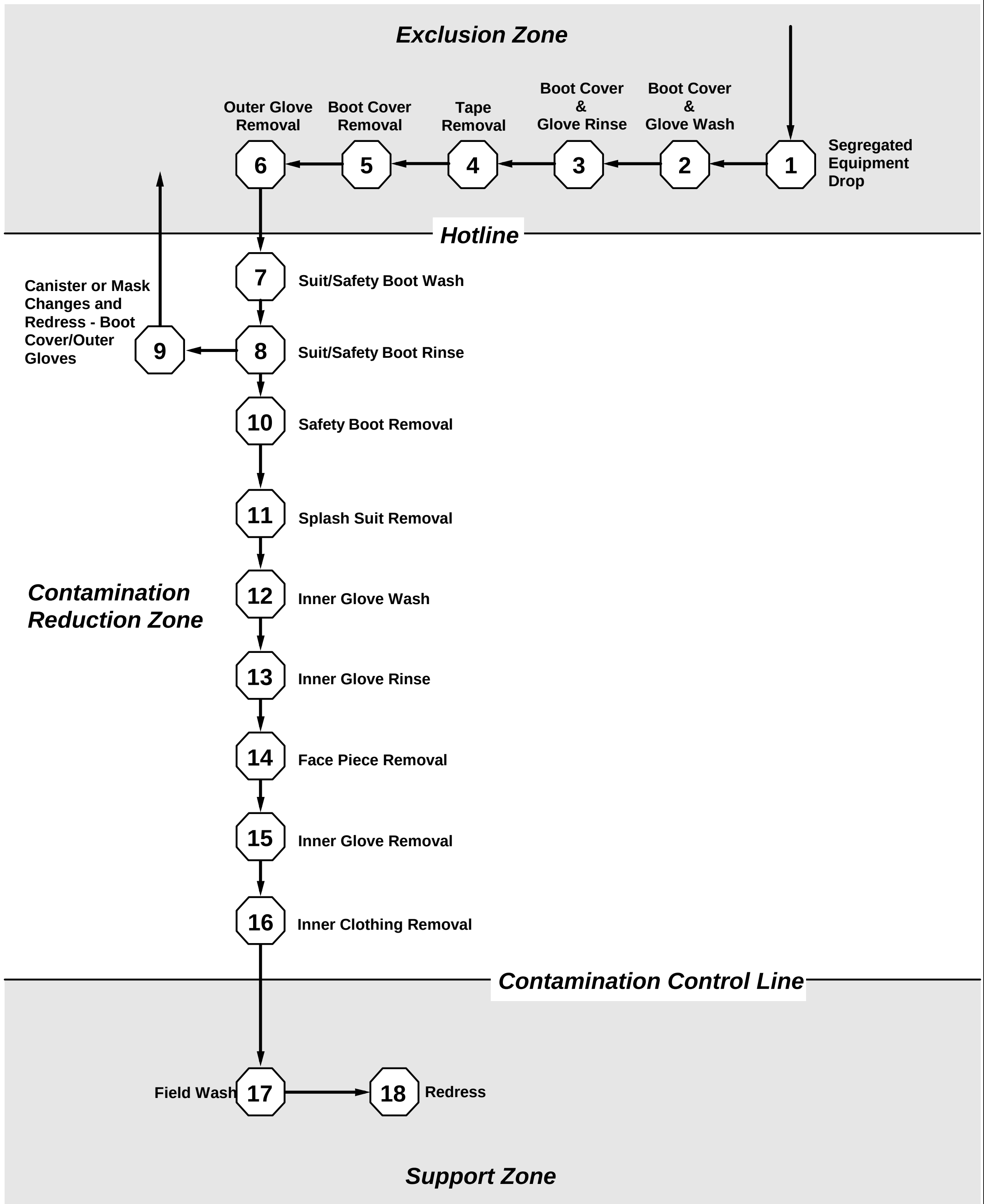


FIGURE B-4
MAXIMUM DECONTAMINATION LAYOUT
LEVEL C PROTECTION

MACTEC E&C, Inc.

FIGURE B-5 MINIMUM DECONTAMINATION LAYOUT-LEVELS OF A AND B PROTECTION

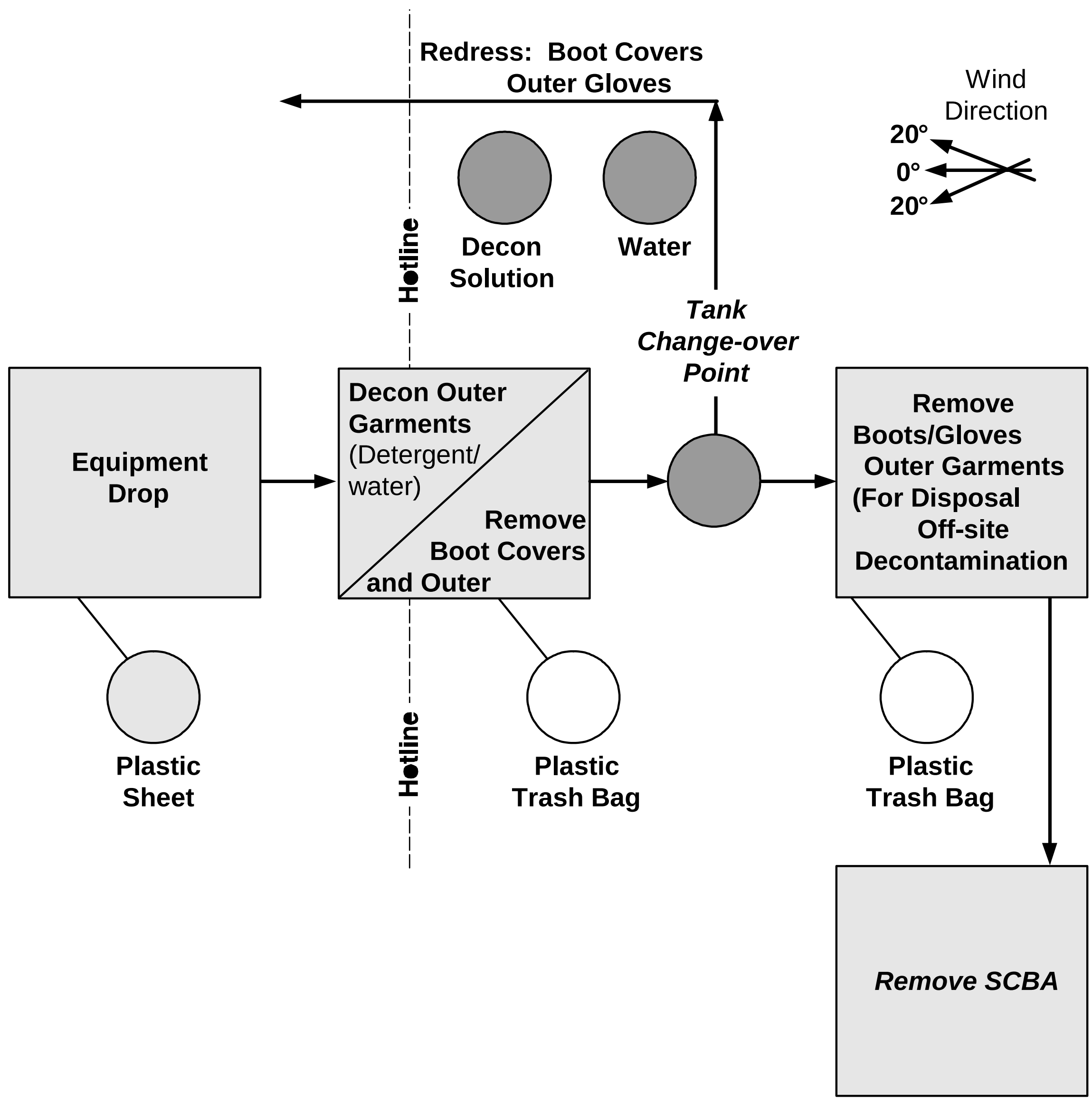


FIGURE B-5
MINIMUM DECONTAMINATION LAYOUT
LEVELS A AND B PROTECTION
MACTEC E&C, Inc.

APPENDIX C

HEALTH AND SAFETY FORMS AND DATA SHEETS

FORM A - HEALTH AND SAFETY AUDIT

Site Name: Date:

Auditor:

SEND A COPY OF COMPLETED FORM TO THE HEALTH AND SAFETY MANAGER.

GENERAL YES/NO COMMENTS

HASP on-site?

HASP completely signed off and approved?

OSHA poster posted in trailer?

Emergency telephone numbers posted in trailer?

Emergency eyewash on-site?

Emergency shower on-site?

Stretcher on-site?

First-aid kit on-site?

Adequately stocked?

Proper sanitation facilities? YES/NO/COMMENTS

DOCUMENTATION AND RECORDKEEPING

Only personnel listed and approved in HASP on-site?

All personnel properly trained?

All personnel in health monitoring program?

Daily field records kept by the Site

Manager?

Levels of PPE recorded?

Contaminant levels recorded?

Site surveillance records kept by HSO?

Calibration records maintained?

Accident/incident forms on-site?

Field team review sheets signed?

Medical data sheets completed?

Spare hospital directions available?

Visitor's logbook completed?

MSDSs for chemicals on-site?

HASP revisions recorded?

First-aid kit inspected weekly? YES/NO/COMMENTS

Are daily safety meetings held?

Emergency procedures discussed during safety meetings?

EMERGENCY RESPONSES

Vehicle available on-site for transportation to the hospital?

Fire extinguishers on-site?

At least two persons trained in CPR and first-aid on-site at all times?

All personnel know who is trained?

PERSONNEL PROTECTIVE EQUIPMENT

Proper PPE being worn as specified in the HASP?

Level of PPE being worn:

PPE adequate for work conditions?

If not, give reason:

Upgrade/downgrade to PPE level:

Has facial hair that would interfere with fit of respirators been removed?

If not, willing to shave if necessary?

Fit-tested within the last year? YES/NO/COMMENTS

If Level B, back-up/emergency person suited up (except for air)?

HSO periodically inspects PPE and
equipment?

PPE not in use properly stored?

MONITORING EQUIPMENT

All equipment listed in HASP on-site?

Properly calibrated?

In good condition?

Used properly?

Other equipment needed?

List:

Monitoring equipment covered with plastic to minimize contamination?

DECONTAMINATION

Decon line set up properly?

Proper cleaning fluid used for known or suspected contaminants?

Proper decon procedures used?

Decon personnel wearing proper PPE? YES/NO/COMMENTS

Equipment decontaminated?

Samples decontaminated?

Disposable items changed twice a day or more often if needed?

WORK PRACTICES

Proper collection and disposal of contaminated PPE?

Proper collection and disposal of decon fluid?

Water available for decon?

Buddy system used?

Equipment kept off drums and ground?

Kneeling or sitting on drums or ground not allowed?

Personnel avoid standing or walking through puddles or stained soil?

Zones established?

If night work to be conducted, adequate illumination?

Smoking, eating, or drinking in the Exclusion Zone or CRZ not allowed?
YES/NO/COMMENTS

To the extent feasible, contaminated materials handled remotely?

Contact lenses not allowed on-site?

Entry into excavations not allowed unless properly shored or sloped?

All unusual situations on-site listed in HASP?

If not, what?

Action taken?

HASP revised?

CONFINED SPACE ENTRY

All confined spaces identified?

If not, list:

All appropriate equipment available and in good working order?

Equipment properly calibrated?

Confined Space Checklists used?

Checklists completely and correctly filled out?

FORM B - OSHA Poster

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation.

Requirements of the Act include the following:

- All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm or employees. Employers must comply with occupational safety and health standards issued under the Act.

- Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

- The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

- The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

- Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

- Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

- The Act provides the employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act. Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discriminatory action.

- If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

- The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

- The Act provides for mandatory civil penalties against employers of up to $7,000 for each serious violation and for optional penalties of up to $7,000 for each nonserious violation. Penalties of up to $7,000 per day may be proposed for failure to correct violations within the proposed time period and for each day the violation continues beyond the prescribed abatement date. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to $70,000 for each such violation. A violation of posting requirements can bring a penalty of up to $7,000.

- There are also provisions for criminal penalties. Any willful violation resulting in the death of any employee, upon conviction, is punishable by a fine of up to $250,000 (or $500,000 if the employer is a corporation), or by imprisonment for up to six months, or both. A second conviction of an employer doubles the possible term of imprisonment. Falsifying records, reports, or applications is punishable by a fine of $10,000 or up to six months in jail or both.

- While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

- OSHA has published Safety and Health Program Management Guidelines to assist employers in establishing or perfecting programs to prevent or control employee exposure to workplace hazards. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for health such as training.

- Free assistance in identifying and correcting hazards and in improving safety and health management is available to employers, without citation or penalty, through OSHA-supported programs in each State. These programs are usually administered by the State labor or Health department or a State university.

POSTING INSTRUCTIONS

Employees in States operating OSHA approved State Plans should obtain and post the State's equivalent poster.

Under provisions of Title 29, Code of Federal Regulations, Part 1903.2(a)(1) employers must post this notice (or facsimile) in a conspicuous place where notices to employees are customarily posted.

MORE INFORMATION

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:

Atlanta, Georgia (404) 347-3573

Boston, Massachusetts (617) 565-7164

Chicago, Illinois (312) 353-2220

Dallas, Texas (214) 767-4731

Denver, Colorado (303) 844-3061

Kansas City, Missouri (816) 426-5861

New York, New York (212) 337-2378

Philadelphia, Pennsylvania (215) 596-1201

San Francisco, California (415) 744-6670

Seattle, WA (206) 442-5930

Washington, D.C.
1991 (Reprinted)
OSHA 2203

Lynn Martin, Secretary of Labor
U.S. Department of Labor

Occupational Safety and Health Administration to report suspected fire hazards, imminent danger safety and health hazards in the workplace, or other job safety and health emergencies, such as toxic waste in the workplace, call OSHA's 24-hour hotline: 1-800-321-OSHA.

FORM – C CHEMICAL CONTAMINANT FACT SHEET

CONTAMINANT FACT SHEET

Chemical Name:

CAS Number:

Synonyms:

____

____

____

HEALTH HAZARD DATA

Color: colorless____________________

Physical State: Solid ______________

Liquid ______________

Gas ______________

Odor: ________________________

Odor Threshold ________________

Vapor Density: ________________

Ionization Potential (IP):______________

IDLH: __________

Carcinogen: OSHA ______________

IARC ______________

NTP ______________

ACGIH ______________

NIOSH ______________

Skin absorbable: ______________

Skin corrosive: ______________

Signs/Symptoms of Acute Exposure:

Inhalation :

Source	TWA (units)	STEL (units)	C (units)
OSHA PELs			
ACGIH TLVs			
NIOSH RELs			

AIR MONITORING

Type	Brand/Model No.	Calibrations Method/ Media	Relative Response or Conversion Factor	Meter Specific Action Level
SCBA				

Checked by: Date:

PERSONAL PROTECTIVE EQUIPMENT

Recommended Protective Clothing Materials:

Suits ______________

Gloves______________

Boots ______________

Service Limit Concentration (ppm):______________

MUC 1/2 Mask APR = TWA x 10 = ______________

MUC Full-Face APR = TWA x 50 = ______________

FIRE/REACTIVITY DATA

Flash Point: ______________

LEL/UEL____________

Fire Extinguishing Media:

Dry Chemical ________ Foam ________

Water Spray _____ CO_2 ________

FORM – D AUTHORIZED PERSONNEL

Personnel authorized to participate in exclusion zone activities at this site have been reviewed and certified for site operations by the Project Manager and the RSHO. Certification involves the completion of appropriate training, a medical examination, and a review of this Site Specific HASP. All persons entering the site must use the buddy system, and check in with the Site Manager and/or SSHO before entering the exclusion zone.

CERTIFIED MACTEC ENGINEERING AND CONSULTING, INC. TEAM PERSONNEL:

____

____

____

____

____

____

OTHER CERTIFIED PERSONNEL:

____

____

____

*	FIRST-AID-TRAINED
+	CPR-TRAINED

FORM E - FIELD TEAM REVIEW

HASP ACKNOWLEDGEMENT

Project Name:	Site Name:
Project #:	Site Location:

I acknowledge that I understand the requirements of this HASP, and agree to abide by the procedures and limitations specified herein. I also acknowledge that I have been given an opportunity to have my questions regarding the HASP and its requirements answered prior to performing field activities. Health and safety training and medical surveillance requirements applicable to my field activities at this site are current and will not expire during on-site activities.

Name (print)	Signature	Date

I acknowledge that I have verified that the employees listed above have fulfilled the health and safety training requirements for this site. I have also verified that the above employees have fulfilled the medical surveillance requirements and any client requirements to participate in a substance abuse screening program for this site and do not have any medical restrictions that would prohibit them from performing tasks that they are assigned to at this site. I also hereby attest that the personal protective equipment described in this HASP was selected based on an appropriate assessment of the hazards of the site and work covered by this HASP.

Project Manager’s Signature:	Date:

TO BE SIGNED BY ON-SITE PERSONNEL AND KEPT IN PROJECT FILE.

FORM F - HASP APPROVAL

Scheduled Start-up Date:	Scheduled Start-up Time:
Project Name:	Site Name:
Project #:	Site Location:

We have reviewed the attached HASP for the above referenced site. We recognize that when this form is completed, the attached HASP is approved for the field activities on the above referenced site. The signatures below also act as certification of the personal protective equipment hazard assessment(s) performed for the work activities addressed by this HASP. Changes to this HASP shall be documented in writing and approved.

Name of HASP Author:	
Signature:	Date:
Name of HASP Reviewer:	
Signature:	Date:
Project Manager Name:	
Signature:	Date:
General Supervisor Name:	
Signature:	Date:
Site Safety and Health Supervisor Name:	
Signature:	Date:
Health and Safety Professional Name:	
Signature:	Date:

FORM G - MEDICAL DATA SHEETS

This Medical Data Sheet will be completed by all on-site personnel and kept in the Support Zone during site operations. It is not a substitute for the Medical Surveillance Program requirements consistent with the MACTEC E&C Corporate Health and Safety Program for Hazardous Waste Sites. This data sheet will accompany any personnel when medical assistance or transport to hospital facilities is required. If more space is required, use the back of this sheet.

Project:_________________

Name: _________________

Address:________________

Home Telephone: Area Code ( )______________

Age: ______ Height: _____ Weight: _____

In case of emergency, contact: ________________________

Address: ____

Telephone: Area Code ( )________________________

Do you wear contact lenses? Yes ( ) No ( )

Allergies: ___________________________

List medication(s) taken regularly: ______________________

Particular sensitivities: __________________________________

Previous/current medical conditions or exposures to hazardous chemicals:

Name of Personal Physician:

Telephone: Area Code ( ) ____________________________________

FORM H - SITE SAFETY ORIENTATION

A pre-investigation orientation/kick-off meeting will be conducted with project team members.

Project:______________________________________ Site:______________________

Project Number:_________________________ Date:______________________

All applicable items listed below are to be reviewed on the first day of site activities and when new workers arrive on site. Training provider, please initial each item covered in the training, or note "NA" as applicable.

General Supervisor: ______

Site Health and Safety Officer (SHSO): ______

Employees' direct supervisor: ______

Location of HASP and MSDS on site: ______

HazCom labeling system if different from Local Operation: ______

Site specific medical surveillance requirements: ______

Site control measures (location of exclusion zone, etc.): ______

Safety and health hazards on site: ______

The Level of Protection and specific PPE to be used: ______

Work practices to be used on site to minimize exposure: ______

Decontamination procedures: ______

How to effectively use site/task engineering controls: ______

Applicable elements of the site emergency response plan: ______

Any other site specific health and safety related requirements: ______

Participating employees must print and sign their name in the spaces provided below:

FORM I - DAILY BRIEFING FORM

RECORD OF SITE SAFETY MEETING

Project:___________________________________ Site:_______________________________

Project Number:____________________________ Date:_______________________________

Safety Meeting Conducted by (print name):____

Safety Meeting Conducted by (signature): ____

List of topics discussed this meeting

____

____

____

Participating employees must print and sign their name in the spaces provided below:

___________________________________ ____

___________________________________ ____

___________________________________ ____

___________________________________ ____

___________________________________ ____

___________________________________ ____

___________________________________ ____

___________________________________ ____

___________________________________ ____

___________________________________ ____

___________________________________ ____

___________________________________ ____

FORM J - INCIDENT INVESTIGATION FORM

Below is a summary of the steps to be taken and form for the timely reporting of incidents. An incident is a work related injury, illness, property damage or fiscal loss. An incident is also a near miss; a narrowly avoided mishap that could have caused bodily harm or property damage. The employee has the responsibility to report all incidents to the proper contacts. Employee is to report any incident immediately to their Supervisor/Project Manager.

Supervisor/Project Manager is to immediately notify the MACTEC E&C Health and Safety Representative (HSR), the Office Manager and the Division's ES&H Manager. The Supervisor/Project Manager provides the HSR with the information to complete the Incident Analysis Report within 8 hours of the incident.

Incident investigations are to be conducted by the employee's Supervisor and/or HSR using the Incident Analysis Report and the MACTEC E&C Root Cause Analysis Flow Chart.

Results of the accident investigation and corrective actions taken are to be documented as soon as it reasonable and reported to the Director of Risk Management and the applicable Division ES&H Manager (MACTEC E&C or the MDC ES&H Manager). The HSR should document and communicate applicable corrective actions to all applicable office personnel.

MACTEC, Inc.

OSHA Log Case Number:

INCIDENT ANALYSIS REPORT

Class 1 ☐ Class II ☐ Class III ☐ Near Miss ☐ (Place an "X" after the Class)

(Review Flow Chart in Appendix A, Incident Reporting Procedure to Determine Class) Report Date: ☐

I.GENERAL DATA Incident Date: _______________

Employee Name:_______________ Social Security No.:__________________ Sex: ☐ M ☐ F Time of incident: _______

Job Title: ____________________ Birth date: __________ Hire Date: _____________ Time employee began work: ______

Department:____________________ Job #:_______________ Client: _________________

Office Address: _____________________ Immediate Supervisor: ________________ Hours worked last 7 days:______Day of incident:_____

_________hrs: ☐S ☐M ☐T ☐W ☐T ☐F ☐S

Home Address: Street: ___________________ City:___________________ State:________ ZIP: ___________

Place of accident or exposure: Company Controlled Work Site: ☐ Yes ☐ No

II.INJURY/ILLNESS DATA

Type of injury/illness (check one only) ☐ None – near miss (skip to III) ☐ First aid only ☐ Medical treatment only

☐ Days Restricted ☐Days Away ☐Fatality Name Physician or Other Health Care

Professional:____

If treatment was given away from the worksite, where was it given: Facility Name: ____

Street: ____________City:____________________ State: _____ ZIP____________

Was employee treated in an emergency room? ☐ Yes ☐ No Was employee hospitalized overnight as an in-patient? ☐ Yes ☐ No

Describe Any Treatment or Medication Given or Prescribed:____

What was the injury or illness? (Tell us the part of the body that was affected and how it was affected; be more specific than "hurt", "pain," or

"sore". *Examples:* "strained back"; "chemical burn, hand"; "carpal tunnel syndrome." ____

____

____

III. INCIDENT DESCRIPTION

List the names of all persons involved in the incident, and employer information: ____

____

List the names of any witnesses, their employer, and a local/company telephone number or address: _________________________________

____

What was the employee doing just before the incident occurred? (Describe the activity, as well as the tools, equipment, or material the employee was using. Be specific. *Example:* "climbing a ladder while carrying roofing material; "spraying chlorine from hand sprayer"; "daily computer key-entry"
____

____

____

What happened? (Tell us how the injury occurred. *Example:* "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time". _________________________________

____

What object or substance directly harmed the employee: (*Examples:* "concrete floor"; "chlorine"; "radial arm saw") *If this question does not apply to the incident leave it blank.*
____

List any damaged equipment or property, model and serial no. <u>and</u> estimated costs to repair/replace damaged equipment or property: __________

____

____

IV.INCIDENT ANALYSIS

What job specific safety training has the person(s) involved in the incident received to enable them to perform their job safely? Describe:

What safety training has the person(s) involved in the incident received?

#	Root Cause and Contributing Factors: Conclusion (Describe in Detail Why Incident/Near Miss Occurred)
1	
2	
3	
4	
5	

Root Cause(s) Analysis (RCA):

Lack of skill or knowledge Lack of or inadequate operational procedures or work standards Inadequate communications of expectations regarding procedures or work standards Inadequate tools or equipment	Correct way takes more time and/or requires more effort Short-cutting standard procedures is positively reinforced or tolerated Person thinks there is no personal benefit to always doing the job according to standards Person was distracted and not focused on the work activity Uncontrollable factor

#	RCA#	Solution(s): How to Prevent Loss/Near Miss from Recurring	Person Responsible	Due Date	Completion Date	Date Verified & Validated

Results of Solution, Verification and Validation

Analysis Team Members

Printed Name	Signature	Date

Reviewed By:

Supervisor Date:		LHSM	Date:
Local Operations Manager	Date:	HSM	Date:
Senior Operations Manager	Date:	MHSM	Date:

Date of report: Prepared by: Official position: