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FINAL

Master Project Plans

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Prepared for

Department of the Navy

Naval Facilities Engineering Command
Atlantic Division
Norfolk, Virginia

Contract No.
N62470-02-D-3052
CTO-041
Clean III Program

June 2008

Prepared by

CH2MHILL

1. Introduction

1.1 Preface

This document presents the Master Project Plans (MPs) for the activities to be performed for environmental investigations at Marine Corps Base, Camp Lejeune (MCB Camp Lejeune). One set of MPs will provide the approach to be used for investigations and general types of activities to be completed.

The MPs include three separate but related documents: the Master Sampling and Analysis Plan (SAP), the Master Quality Assurance Project Plan (QAPP), and the Master Health and Safety Plan (HASP). The MPs will be updated by CH2M HILL as necessary, and reviewed at least once every three years to ensure that the information contained therein is accurate and reflects current procedures and guidance. Any updates or necessary changes will be incorporated through addenda to the MPs.

Site-specific details, such as sampling locations, numbers of samples, and analytical parameters will be provided in separate site-specific plans. The site-specific plans will supplement the MP and will present information specific to each new area of investigation. Details, such as results of previous site investigations and site-specific maps, will be provided in the site-specific work plans. General information will not have to be reproduced for each report or for each investigation. Attachment 1 presents a checklist for the project-specific work plan.

1.2 Document Organization

The MP includes the Master SAP, the Master QAPP, and the Master HASP.

The Master SAP includes the following sections:

- Introduction – Describes the document (Section 1).
- Site Background – Describes the location, topography, geology, hydrogeology, and activities at MCB Camp Lejeune (Section 2).
- Field Activities – Generally describes analytical/quality control protocol, field activities, and field sampling methods (Section 3).
- Sample Handling Quality Control – Describes sample tracking and shipping procedures (Section 4).

The Master QAPP describes general project organization and responsibilities, quality assurance and quality control procedures for collecting samples at sites to be investigated at the Base. Specifically, a variety of these sampling activities will be conducted at sites selected as part of future site investigation (SI), RI, or FS actions. These Master Plans may also be used for investigations under other regulatory programs at MCB Camp Lejeune.

The Master HASP includes the following sections:

- Introduction – Describes the document, how the document should be used, information regarding CH2M HILL's health and safety policy, and general site pre-entry requirements.
- Project Information and Description (Section 1.0) – Provides general information about MCB Camp Lejeune, such as accessibility, size, and history.
- Tasks to Be Performed (Section 2.0) – Lists potential tasks (both HAZWOPER-Regulated and Non-HAZWOPER-Regulated) to be performed at MCB Camp Lejeune.
- Hazard Evaluation and Control (Section 3.0) – Discusses the evaluation and control of some hazards typically associated with MCB Camp Lejeune.
- Personnel (Section 4.0) – Describes the CH2M HILL's medical surveillance and training program and lists employees who may potentially perform field work on MCB Camp Lejeune. Also discusses the policy and procedures for covering subcontractors and other contractors under the HASP.
- Personal Protective Equipment (Section 5.0) – Lists general personal protective equipment required for each level of personal protection and discusses reasons for upgrading or downgrading to a different level.
- Air Monitoring Specifications (Section 6.0) – Lists the air monitoring equipment needed for some common field activities, frequency of use, frequency of calibration, and calibration specifications.
- Decontamination (Section 7.0) – Discusses general specifications for personnel, sampling equipment, and heavy equipment.
- Spill-Containment (Section 8.0) – Describes general spill containment procedures.
- Confined-Space Entry (Section 9.0) – Discusses confined-space entry policy.
- Site-Control Plan (Section 10.0) - Outlines site control procedures and HAZWOPER compliance plan.
- Emergency Action Plan (Section 11.0) – Discusses various aspects of the emergency procedures.
- Emergency Contacts (Section 12.0) – Lists emergency contacts for MCB Camp Lejeune, CH2M HILL, and other relevant contacts.
- Site Specific Health and Safety Plan Template (Attachment 1)
- Material Safety Data Sheets (MSDSs) (Attachment 3)
- Health and Safety Self Assessment Checklists (Attachment 4)
- CH2M HILL's Health and Safety SOPs and Procedures for Transporting Dangerous Goods, as referenced (Attachment 5)

Attachment 1
Project-Specific Work Plan Checklist

Project-Specific Checklist - Quality Assurance

This checklist supplements the QAPP with project-specific quality assurance information for each investigation. It is to be taken into the field with the Project-Specific QAPP.

Site: _____

1. List sampling tasks:

2. List data quality objectives:

3. Organization:

   NAVFAC Mid-Atlantic IR Section Head _____

   NAVFAC Mid-Atlantic Technical Representative _____

   USEPA Remedial Project Manager _____

   NCDENR Federal Facilities Project Manager_____

   CH2M HILL Activity Manager _____

   Quality Control Senior Review _____

   Technical Project Manager _____

   Field Team Leader _____

4. Table of samples with analyses to be performed and associated QC samples (attached):

5. Analytical Quantitation Limits (attached):

6. QA/QC Acceptance Criteria, e.g., precision, accuracy (attached):

7. Data reduction, validation, and reporting:

   _____As per Section 9 of Master QAPP _____Other (attached)

8. Internal QC Procedures (field and laboratory):

   _____As per Sections 10 and 11 of Master QAPP _____Other (attached)

9. Corrective Action:

   _____As per Section 14 of Master QAPP _____Other (attached)

10. Other deviations from QAPP _____

Project-Specific Checklist - Field Sampling

This checklist supplements the SAP with project-specific field sampling information for each investigation. It is to be taken into the field with the Project-Specific SAP.

Site:_____

1. Tasks to be performed:

_____Geophysical surveys
_____Soil gas surveys
_____Surface water and sediment sampling
_____Surface soil sampling
_____Soil boring installation
_____Subsurface soil sampling
_____Monitoring well installation and development
_____Monitoring well abandonment
_____Groundwater sampling
_____In-situ groundwater sampling
_____Aquifer testing
_____Hydrogeologic measurements
_____Biota sampling
_____Trenching
_____Land surveying
_____Investigation derived waste sampling
_____Decontamination
_____Other_____

2. Field measurements to be taken:

_____temperature
_____pH
_____dissolved oxygen
_____turbidity
_____specific conductance
_____organic vapor monitoring
_____geophysical parameters (list):
_____electromagnetic induction
_____ground-penetrating radar
_____surveying
_____magnetometry
_____global positioning system
_____soil gas parameters (list):
_____combustible gases
_____water-level measurements
_____pumping rate
_____other_____

3. Sampling program (nomenclature, etc.):

4. Map of boring and sampling locations (attach to checklist):

5. Table of field samples to be collected:

6. Applicable SOPs (attach to checklist) or references to specific pages in Master SAP:

7. Site-specific procedures or updates to protocols established in the Master Project Plans:

Project-Specific Checklist - Health and Safety Plan

A Project-Specific checklist must be used in conjunction with a Health and Safety Plan (HASP). The contractor specific HASP and Project-Specific Checklist are provided in the Master Health and Safety Plan.

FINAL

Master Sampling and Analysis Plan

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Preface

This document presents the Master Sampling and Analysis Plan (SAP) for the activities to be performed under contract with the Department of Navy, Atlantic Division, Naval Facilities Engineering Command (NAVFAC) for Marine Corps Base, Camp Lejeune, North Carolina. This SAP has been developed to encompass the anticipated sampling and analysis activities at all RI/FS sites and other environmental investigation sites, as defined in the Federal Facilities Agreement (FFA).

This SAP will be updated by NAVFAC or CH2M HILL as necessary, and reviewed at least once every three years to ensure that the information contained therein is accurate and reflects current procedures and guidance. Any updates or necessary changes will be incorporated through addenda to the SAP.

Site-specific details, such as sampling locations, numbers of samples, and analytical parameters, will be provided in separate site-specific plans. The site-specific plans will supplement the Master Plans and will present information specific to each new area of investigation. Environmental contractors performing field investigations on MCB Camp Lejeune will be able reference general material, such as sampling and analytical methodologies, from one master set of documents. General information will not have to be reproduced for every RI/FS and other environmental investigation SAPs.

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Abbreviations and Acronyms

ASTM	American Society for Testing and Materials
bgs	Below Ground Surface
^{o}C	Degrees Celsius
CFR	Code of Federal Regulations
COC	Chain-of-Custody
DENR	Department of Environment and Natural Resources
DOT	Department of Transportation
DPT	Direct Push Technology
EC	Electronic Conductivity
ECD	Electron Capture Detector
EM	Electromagnetic Induction
EPA	Environmental Protection Agency
^{o}F	Degrees Fahrenheit
FFA	Federal Facilities Agreement
FID	Flame Ionization Detector
FTL	Field Team Leader
GPR	Ground Penetrating Radar
GPS	Global Positioning Satellite
HASP	Health and Safety Plan
IDW	Investigation-Derived Waste
MCB	Marine Corps Base
MHz	Megahertz
MIP	Membrane Interface Probe
mL	Milliliter
MS/MSD	Matrix Spike/Matrix Spike Duplicate
msl	Mean Sea Level
NAPL	Non-Aqueous Phase Liquid
NGVD	National Geodetic Vertical Datum
NTU	Nephelometric Turbidity Unit
PAH	Polycyclic Aromatic Hydrocarbon
PDB	Passive Diffusion Bag
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride

QAPP	Quality Assurance Project Plan
QC	Quality Control
RAC	Remedial Action Contractor
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SI	Site Investigation
SU	Standard Unit
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency
VOA	Volatile Organic Analyte
VOC	Volatile Organic Compound
WMP	Waste Management Plan
WP	Work Plan
XRF	X-ray Fluorescence

DRAFT

1. Introduction

This Master Sampling and Analysis Plan (SAP) is a compilation of the anticipated field activities that may be performed to support Site Investigation (SI), Remedial Investigation/Feasibility Study (RI/FS), remedial action, and site-screening activities at one or more of the sites at Marine Corps Base (MCB), Camp Lejeune in Onslow County, North Carolina. The purpose of the Master SAP is to describe the types of field procedures that may be performed during the course of field activities, and how these procedures will be completed. This Master SAP does not include site-specific information regarding past activities, nor does it include potential sample locations or the number of samples to be collected. The specific information regarding field activities at any environmental investigation sites will be provided in separate site-specific Work Plans (WPs). The WPs will reference this Master SAP, rather than repeat the information contained in this plan. The potential field activities that may be conducted at MCB, Camp Lejeune include:

- Geophysical surveys
- Soil gas surveys
- Land Surveys
- Monitoring well installation
- Monitoring well development
- Surface water and sediment sampling
- Surface soil sampling
- Soil boring installation
- Subsurface soil sampling
- Groundwater sampling
- Monitoring well abandonment
- In-situ groundwater sampling
- Aquifer testing
- Hydrogeologic measurements
- Trenching
- Investigation derived waste sampling
- Decontamination

2. Site Background

2.1 Location

MCB Camp Lejeune is located within the Atlantic Coastal Plain Physiographic Province in Onslow County, North Carolina, approximately 45 miles south of New Bern and 47 miles north of Wilmington. The Base covers approximately 236 square miles. The Base is bisected by the New River, which flows in a southeasterly direction and forms a large estuary before entering the Atlantic Ocean.

The Base is bordered by the City of Jacksonville, North Carolina and State Route 24 to the north; the Atlantic shoreline to the south and east; and U.S. Route 17 to the west (not including the Greater Sandy Run Area of the Base west of U.S. Route 17).

2.2 Topography

The topography of the Base is generally flat and typical of the North Carolina Coastal Plain. Elevations on the Base range from sea level to approximately 72 feet above mean sea level (msl). However, elevations on the majority of the base range from approximately 20 to 40 feet above msl.

Drainage at the Base generally is toward the New River, except in areas near the coast, which drain through the Intracoastal Waterway. In developed areas, the natural drainage has been altered by asphalt cover, storm sewers, and drainage ditches. Approximately 70 percent of the Base is situated in broad, flat interstream areas. Drainage is poor in these areas and the soils are often wet (Water and Air Research [WAR], 1983). The U.S. Army Corps of Engineers has mapped the limits of the 100-year floodplain at the Base at 7 feet above msl in the upper reaches of the New River increasing downstream to 11 feet above msl near the coastal area (WAR, 1983).

2.3 Climate

The climate at MCB, Camp Lejeune is characterized by mild winters and hot humid summers. Winters are usually short and mild with occasional and short duration cold periods. Summers are long, hot, and humid. Average annual net precipitation is approximately 50 inches. Ambient air temperatures generally range from 33 to 53 degrees Fahrenheit (°F) in the winter months, and 71 °F to 88 °F during the summer months. Winds are generally south-southwesterly in the summer, and north-northwesterly in the winter (WAR, 1983).

2.4 Geology

According to Cardinell, et al. (1993), three of the upper Tertiary formations (Yorktown, Eastover, and Pungo River) are not present in the vicinity of MCB, Camp Lejeune. Cardinell, et al (1993) postulated that the New River may have eroded the Belgrade formation locally at MCB, Camp Lejeune.

The uppermost undifferentiated formation of Holocene and Pleistocene age sediments consist of mostly fine, loose to medium dense sands, with a lesser amount of silt and clay and is present from land surface to depths of 20 to 30 feet below ground surface (bgs). Thin, discontinuous lenses of silt and clay may be regionally associated with the Belgrade formation. The Belgrade formation generally consists of mostly fine sands, silts and clays, with lesser amounts of shell fragments.

The upper portion of the River Bend Formation, which underlies the Quaternary age sediments, is composed of sands, silts, shell and fossil fragments, and trace amounts of clay. The River Bend Formation overlies the Eocene Castle Hayne Formation. The Castle Hayne formation consists of both poorly indurated and well indurated biomicrite and biomicrudite limestone (Harris, et al., 1991). Thickness of the Castle Hayne Formation ranges between 150 feet and over 450 feet locally at MCB Camp Lejeune (Cardinell, et al., 1993) Site-specific geologic information will be discussed in the site-specific WPs.

2.5 Hydrogeology

The surficial aquifer, Upper Castle Hayne confining unit, and the Castle Hayne aquifer have all been described at MCB, Camp Lejeune (Cardinell, et al., 1993). The surficial aquifer resides within the Undifferentiated Formation, and the Caste Hayne Aquifer resides locally within the River Bend Formation. The Belgrade Formation typically acts as a confining unit between the surficial and the Castle Hayne aquifer. Site-specific hydrogeologic information will be discussed in the site-specific WPs.

2.6 Base Use

MCB Camp Lejeune is host to five major Marine Corps commands and one Navy command. In addition, MCB Camp Lejeune provides support and training for the following tenet commands: Headquarters Nucleus; Second Marine Expeditionary Force; Second Marine Division; Second Marine Force Service Support Group; Second Marine Surveillance, Reconnaissance, and Intelligence Group; Sixth Marine Expeditionary Brigade; the Naval Hospital; and the Naval Dental Clinic. All of the real estate and infrastructure are owned, operated, and maintained by the host command.

2.7 Sites Under Investigation

Site-specific background information and discussions of contamination regarding individual sites will be included in site-specific WPs. Field activities and sampling techniques will be specific to the site and contaminant present. A tabulation of potential source areas at MCB, Camp Lejeune currently under investigation or remediation is presented in Table 2-1.

TABLE 2-1
Potential Source Areas
Master Sampling and Analysis Project Plan, MCB Camp Lejeune

	Constituents of Potential Concern	Notes
Operable Unit 1		
Site 21 on Center Road	Pesticides, PCBs	Soil removed. Land use controls
Site 24 Birch and Duncan Streets	metals, cVOCs	Approaching site closure. Land use controls
Site 78 - Hadnot Point Industrial Area	VOCs, cVOCs	
Operable Unit 2		
Sites 6 and 82 - Storage Lots 201 and 203; Piney Green Road VOC Area	cVOCs, pesticides, lead	DDT, PCBs, POL and Metals removed. Land use controls
Operable Unit 4		
Site 41 -Camp Geiger Dump Near Former Trailer Park	Metals, Solvents, Pesticides, POL wastes, Chemical Training Agents, Ordnance	Approaching site closure. Land use controls
Site 74 - Mess Hall Grease Disposal Area	PCBs, Pesticides, chemical training agents	Approaching site closure. Land use controls
Operable Unit 5		
Site 2 Former Nursery/Day Care Center	Pesticides	Pesticide soil removed. Land use controls
Operable Unit 6		
Site 36 - Camp Geiger Dump Area	PCBs, VOCs,cVOCs, PAHs Pesticides	PAH and pesticide soil removed. Land Use Controls
Site 43 - Agan Street Dump	SVOCs, PAHs, pesticides	PAH soils and metallic debris removed, approaching site closure. Land use controls
Site 44 - Jones Street Dump	SVOCs, VOCs, PAHs, pesticides	Approaching site closure. Land use controls
Site 54 - Crash Crew Fire Training Burn Pit	SVOCs, VOCs	Approaching site closure. Land use controls
Operable Unit 7		
Site 1 - French Creek Liquids Disposal Area	POL, Battery Acid, cVOCs, VOCs	Approaching site closure. Land use controls
Site 28 - Hadnot Point Burn Dump	VOCs, SVOCs	Site closure. Land use controls
Operable Unit 8		
Site 16 - Former Montford Point Burn Dump	Pesticides, PCBs, SVOCs, VOCs	Land use controls
Operable Unit 10		
Site 35 - Camp Geiger Area Fuel Farm	VOCs, cVOCs, PAHs	
Operable Unit 12		
Site 3 - Old Creosote Plant	PAHs, VOCs	Soil removed, Land use controls
Operable Unit 13		
Site 63 - Verona Loop Dump	SVOCs, Pesticides, Metals	Land use controls
Operable Unit 14		
Site 69 - Rifle Range Chemical Dump	PCBs, pesticides, cVOCs, chemical training agents, calcium hypochlorite	No intrusive investigation performed, land use controls
Operable Unit 15		
Site 88 - Base Dry Cleaners	cVOCs	Soil Stabilization, ongoing activities
Operable Unit 16		
Site 89 - Former DRMO	cVOCs, PAHs	
Site 93 - TC-942	POL, cVOCs, Metals	
Operable Unit 18		
Site 94 - PCX Service Station	VOCs, cVOCs, PAHs	
Operable Unit 19		
Site 84 - Building 45 Area	PCBs, Pesticides, PAHs, Metals, VOCs	Building and soil removal, ongoing activities
Operable Unit 20		
Site 86 - Tank Area AS419-AS421	VOCs, SVOCs, cVOCs	
Operable Unit 21		
Site 73 - Courthouse Bay Liquids Disposal Area	PAHs, Battery Acid, VOCs, cVOCs	
RCRA Sites		
SWMU 43 - Pest Control Shop	Pesticides, Metals	
SWMU 46 - Montford Point Dump Site	Metals, pesticides	
SWMU 177 - UST Site 333-C	SVOCs, Pesticides, Metals	
SWMU 254 - 1408 Dumpster	SVOCs	
SWMU 258 - S1745 O/W	Metals	
SWMU 261 - 1780 UST-1	Metals	
SWMU 269 - 816 O/W	VOCs, SVOCs	
SWMU 293 - 1106/1107 O/W	Metals	
SWMU 297 - 1780 O/W-2	Metals	
SWMU 299 - AS114 AST	SVOCs, Metals	
SWMU 303 - AS515 AST-E with SWMU 318	SVOCs, Metals	
SWMU 307 - G649 Rack	Metals	
SWMU 311 - S1619 O/W	Metals	
SWMU 314 - SM187 O/W	SVOCs, Metals	
SWMU 318 - AS515 O/W	VOCS, SVOCs, Metals	
SWMU 336 - AS4106 Paint Stripper	VOCs, Metals	
SWMU 360 - Building 1817 UST	VOCs	

3. Field Activities

This section describes field activities that may be performed at MCB, Camp Lejeune. Not all of these activities will be conducted at all sites. The discussion of field activities is general; details of the procedures will be provided in the site-specific WPs as applicable. Furthermore, remediation-specific field activities, such as ozone sparging or permanganate injection will not be discussed in this Master SAP, rather they will be detailed in site-specific SAPs. Standard operating procedures for field activities may be referenced to USEPA Region 4, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*.

3.1 Geophysical Surveys

Geophysical survey methods that may be used include electromagnetic induction (EM), ground penetrating radar (GPR), magnetometry, and downhole geophysical surveys. Appropriate survey methods will be selected to delineate potential areas of buried wastes and utilities at the areas under investigation. Utilities will be marked by a professional utilities locating service prior to any soil disturbance. The results from these surveys will be used to determine the locations of subsequent soil borings and monitoring wells and to characterize the condition of the subsurface.

In general, grids will be established in the field at areas to be evaluated at an appropriate spacing (e.g., 15 to 20 feet), depending on the geophysical method being used and the size of the site. Smaller grid spacings may be used in areas where greater subsurface definition is required (e.g., locating an underground storage tank). The grid spacings will be tied to existing permanent structures (e.g., buildings, monitoring wells) so they can be referenced to later land surveys. In some areas, brush and tree clearing may be required for the geophysical surveying operations. The criteria used to determine grid spacing will be further defined in the site-specific WPs.

3.1.1 Electromagnetic Induction

EM terrain conductivity profiling is a non-invasive method used to identify lateral changes in subsurface conductivity through inductive electric measurements made at the ground surface. The EM survey is a rapid, cost effective reconnaissance tool. Areas of higher-than-background conductivity may be associated with surficial and buried wastes, contaminants, or metals objects (i.e., buried drums and storage tanks, product lines, utility lines, etc.). EM may also be used for contaminant plume mapping, locating abandoned trenches and lagoons, and locating lateral anomalies such as pockets or pits of different materials.

EM data will be digitally recorded and downloaded to a personal computer for processing and analysis. Data will be profiled and contoured over the area of investigation to determine inordinately high and low conductivity values. Areas interpreted to represent buried waste, contaminants, or metals will be delineated.

3.1.2 Ground Penetrating Radar

GPR is an active geophysical system that transmits high frequency electromagnetic waves into the ground and detects the energy reflected back to the surface. The GPR transmits electromagnetic waves of radio and microwave frequencies (e.g., 80 megahertz [MHz] to 1,000 MHz). Reflections typically occur at lithologic changes, subsurface discontinuities, and internal soil structures. GPR is useful for determining the presence of underground utilities and buried metallic objects, and for further characterizing buried wastes by producing a graphic cross section of the subsurface. Other applications include locating concrete foundations, buried archaeological artifacts, excavations, filled pits, and lagoons.

3.1.3 Magnetometry

Magnetometry measures local perturbations in the earth's magnetic field. Both naturally occurring and man-made magnetic materials can modify the ambient field. Buried ferrous objects, such as drums, tanks, and product lines usually produce a detectable magnetic anomaly.

Magnetic data will be digitally recorded and downloaded to a personal computer for processing and analysis. Data will be profiled and contoured over the area of investigation to facilitate identification of anomalous magnetic intensities. Areas interpreted to represent buried waste, contaminants, or metals will be delineated.

3.1.4 Downhole Geophysics

Downhole geophysical methods are used to characterize or log the stratigraphy, geology, morphology, and hydrology of a well or open bore hole. Methods that are commonly utilized and information recorded are summarized below:

- Caliper log - measures changes in the diameter of the borehole;
- Fluid resistivity log - records natural variations in electrical resistivity (resistance) of borehole and interstitial fluids;
- Electrical resistivity log - records natural variations in electrical resistivity (resistance) between contrasting lithologic types and interstitial fluids;
- Spontaneous potential log - records natural variations in electrical potential (voltages) between contrasting lithologic types;
- Gamma log - records natural variations in gamma radiation between contrasting lithologic types;
- Acoustic (sonic) log - records natural variations in density (porosity) between contrasting lithologic types;
- Neutron logs - records natural variations in neutron emission between contrasting lithologic types;
- Temperature log - records variations in water temperature within a borehole; and
- Fluid movement (flow) log - records variations in borehole groundwater flow.

3.2 Soil Gas Survey

Soil gas surveys are usually conducted in areas where materials containing petroleum-based compounds, volatile organic compounds (VOCs), or other hydrocarbon compounds were

used, spilled, or stored. Soil gas survey results will be used to help delineate the extent and concentration of organic vapors in the vadose zone that may be indications of soil and/or groundwater contamination. The results may also be used to determine the need for confirmatory soil borings and monitoring wells, and their locations.

Soil gas samples are typically collected in-situ and analyzed on-site. Samples may be analyzed for hydrocarbon compounds and/or selected chlorinated compounds (e.g., trichloroethylene, tetrachloroethylene, 1,1,1-trichloroethane, etc.) using gas chromatographic techniques. Samples can also be analyzed for combustible gases using a portable combustible gas indicator.

3.3 Land Surveying

A North Carolina-licensed land surveyor will survey soil and groundwater sample locations. The locations may be referenced both horizontally and vertically to permanent land monuments or a grid system. The survey controls will be tied to a benchmark and the National Geodetic Vertical Datum (NGVD) of 1929. Ground surface and top of casing vertical control will be to the nearest 0.01 foot, and the horizontal control will be to the nearest 0.10 foot. The top of the casing will be notched or otherwise marked to identify a constant measuring point for measuring depths to groundwater, which is used to determine groundwater elevations.

Portable Global Positioning Satellite (GPS) systems may also be used to determine horizontal coordinates for points, such as sampling locations and grid points. Horizontal control varies with different GPS systems.

3.4 Soil Borings

Before soil borings (or well borings) are initiated, utility clearances will be obtained from a professional utility locating service. Soil borings will be drilled using direct push technology (DPT), hollow stem augers (HSA), mud rotary, or Rotasonic drilling methods. After all of the required samples have been collected from a soil boring, the borehole will be abandoned or a permanent groundwater monitoring well will be installed in the borehole. Soil borings for permanent groundwater monitoring wells will be drilled using HSA, mud rotary, or Rotasonic drilling methods.

For HSA, DPT, mud rotary, and Rotasonic drilling methods, the entire soil core will be quickly screened for organic vapors using an FID immediately upon opening the core barrel. One-inch long portions of the soil cores will be collected at 2.5-foot intervals for VOC headspace measurements. Samples will be placed in a new re-sealable plastic bag and placed in the sun for a minimum of 15 minutes. The FID probe will be inserted into the bag for the headspace measurement, and the results will be recorded in the field logbook and on the soil boring log. Field descriptions will be recorded on boring logs (Attachment 1) and in the field logbook. Soil and rock sample descriptions will prepared as described in Section 3.10.1.

It is possible that drilling refusal will be encountered during the subsurface investigation. If so, the borehole location will be moved to a nearby alternate location (cleared for utilities) determined in the field. If physical access to areas is restricted, soil borings may also be advanced using a hand auger or a tripod-mounted sampling device. The locations and

total depth of hand-augured boreholes will be determined in the field based upon subsurface soil conditions and site-specific sampling objectives.

If a soil boring is abandoned, soil boring abandonment procedures outlined in Section 3.12 will be followed. If a groundwater monitoring well is to be installed in the soil boring, well installation procedures outlined in Section 3.6 will be followed.

All equipment will be decontaminated according to the procedures described in this SAP.

3.4.1 HSA Drilling

The HSA drilling method uses continuous flight augers to approach the desired sampling depth. A standard split-spoon soil sampler may be used to collect samples. The split-spoon sampler is driven directly into the ground through the augers to the desired depth in accordance with ASTM D-1586, *Standard Method for Penetration Test and Split Barrel Sampling of Soils*. Soil samples are obtained by retracting the soil sampler from the borehole and detaching the split spoon sampler from the rods. The split barrel is opened, soil is removed, and placed into a sample container. The split spoon samplers will be decontaminated prior to the collection of each sample. Thin walled Shelby tube samplers may be used to collect relatively undisturbed soil samples through the augers. Procedures for Shelby tube sampling are found in Section 3.10.2 of this Master SAP.

3.4.2 DPT Drilling

The DPT drilling method uses either an open core barrel or piston sampling device. The core barrel is used in much the same way as the previously described split spoon sampler, although the sample chamber contains a disposable PVC or acetate liner. The piston sampler consists of a DPT core barrel equipped with a resealable drive point that seals the sample chamber closed in the initial sampling push. Upon arrival at the desired depth, the drive point can be remotely released and the push continues. During the subsequent push, the drive point rises freely up inside the sample chamber as the soil core displaces it.

The push rods and sample chamber are retrieved from the borehole, and the liner containing the sample is removed. The liner is cut open and the soil sample is placed in a sample container. Downhole sampling equipment is decontaminated and a new liner is placed in the sample chamber to collect the next sample.

3.4.3 Rotasonic Drilling

The Rotasonic drilling method uses a telescoping system to produce a 3.5-inch diameter soil core. The telescoping system consists of an inner nominal 4-inch diameter casing and up to three successively larger outer casings (nominally six, eight, and 10 inches in diameter). The use of temporary casings may be necessary in order to seal off specific aquifer zones as the borehole is advanced.

Drill rods and core barrel with a minimum 8-inch inside diameter (ID) will be used to drill monitoring well boreholes. Continuous core soil samples (6-inches outside diameter) will be collected for lithologic classification and intervals selected for chemical analysis. The use of water and drilling fluid to assist in sonic drilling for monitoring well installation will be avoided, unless required for such conditions as running sands or drilling bedrock formations.

Temporary outer casing, drill rods, core barrels, and other downhole drilling tools will be properly decontaminated prior to the initiation of drilling activities and between each borehole location. Core barrels and other downhole soil sampling equipment will also be properly decontaminated before and after each use.

Drill cuttings and decontamination fluids generated during well drilling activities will be contained according to the procedures detailed in the Site Specific Field Sampling Plan. Drilling equipment will be decontaminated before drilling in accordance with the procedures detailed in Section 3.16.1.

3.4.4 Mud Rotary Drilling

Mud rotary drilling may be used for the installation of Type III monitoring wells.

Mud rotary drilling can be used to install deep monitoring wells through a 6-inch or greater surface casing. To collect split spoon samples, the drill bit is advanced to the depth to be sampled, the bit is removed from the borehole, and the split-spoon sample is collected from the borehole.

Drill cuttings and fluids generated during rotary drilling activities will be contained until completion of activities at the drilling location. Such material will be disposed as described in the Waste Management Plan in Attachment 2. Drilling equipment will be decontaminated before drilling in accordance with the procedures detailed in Section 3.16.1.

Thin walled Shelby tube samplers may be used to collect relatively undisturbed soil samples. Procedures for Shelby tube sampling are found in Section 3.10.2 of this Master SAP.

3.5 Membrane Interface Probe Profiling

Membrane interface probe (MIP) profiling may be conducted in order to delineate non-aqueous phase liquid (NAPL), dissolved phase impacted groundwater, or vapor phase organic contamination in the vadose zone. The MIP collects depth-continuous readings that may be used to model the horizontal and vertical extent of contamination of the subsurface.

Before membrane interface probe (MIP) profiling activities are initiated, utility clearances will be obtained from a professional utility locating service. The MIP will be advanced into the subsurface by a DPT rig. As the MIP is advanced into the subsurface, soil and groundwater within the vicinity of the probe will be heated to approximately 120°C to increase the volatility of any organic compounds that may be present. The volatilized constituents diffuse across a membrane on the side of the probe and into an inert gas line that carries volatile compounds to the surface. Once at the surface, the gas stream may be analyzed using a photoionization detector (PID), electronic conductivity (EC) meter, electron capture detector (ECD), and/or a flame ionization detector (FID). By measuring the voltage output from the detectors, a relative comparison may be made as to the concentrations of organic compounds in each boring.

3.6 Monitoring Well Installation

Groundwater monitoring wells may be installed on site. The number of wells to be installed and well locations will be discussed in the site-specific SAPs. General installation

procedures are described below. Wells will be constructed in accordance with Title 15A, North Carolina Administrative Code, Subchapter 2C. A North Carolina Certified Well Driller whom is registered with the state of North Carolina shall install Wells. Well Construction Forms (GW-1) shall be included as an appendix to the formal report. NC Registered Well Drillers are required to send in GW-1 forms to the Raleigh Central Office.

3.6.1 Shallow Monitoring Well Installation

The monitoring well borehole installation will be bored, drilled, or augured as close to vertical as possible. Slanted boreholes will not be acceptable unless specified in the site-specific work plan. The depth and volume of each borehole should be calculated and the appropriate materials procured before starting drilling activities. Field descriptions of the soil or rock encountered in the boring will be recorded on a boring log (Attachment 1) and in the field notebook.

The boreholes will be of sufficient diameter so that well construction can proceed without major difficulties. A minimum 2-inch annular space is required between the casing and the borehole wall to allow the filter pack, bentonite pellet seal, and the annular grout to be placed at the specified intervals at an acceptable thickness using a tremie tube. If the well string and casing are installed through HSAs, the augers will be slowly extracted as the filter pack, bentonite seal, and grout are tremied and/or poured into place. The gradual extraction of the augers will allow the materials being placed in the augers to flow gradually out of the bottom into the borehole without causing bridging problems.

Wells will be installed after soil and/or discrete groundwater samples are collected and the boreholes have been drilled to the depths specified in the site specific work plan. Depths may be modified by the site geologist to adjust for field conditions. In general, for shallow wells, the screened interval will be placed to intersect the seasonal water table. For intermediate and deep wells, the screened interval will be placed on the basis of lithology. Installation equipment will be decontaminated as specified in this Master SAP. Well construction details will be recorded on the Well Completion Form (Attachment 3) and in the field logbook.

3.6.2 Deep Monitoring Well Installation

A surface casing is required for Type III well installation. Rotasonic casings may be used as isolation casings during well construction. However, the outer isolation casing must be advanced to the required depth prior to advancing an intermediate casing (if required) or installing the inner casing. Temporary casings will not be grouted. A permanent surface casing will be required for all Type III wells constructed using drilling techniques other than rotasonic.

Permanent surface casing will be constructed of minimum 6-inch ID steel with a minimum wall thickness of 0.20 inches or Schedule 80 PVC. Casing lengths for permanent surface casings will be welded or connected by threaded connections sealed with Teflon tape, while casing lengths for temporary surface casings may be threaded connections of casing installed as part of the rotary-drilling method. The steel casing and threaded couplings must be free of paint, varnish, or coatings of any kind, both inside and outside. Threaded connections must be free of oils or grease. Welding of the casing is permissible provided that the welds meet the Standards of the American Welding Society.

Surface casing will be decontaminated prior to installation in accordance with the procedures outlined in Section 3.16.1. Surface casing will be installed at least 5 feet into a significant clay layer, if adequate thickness is available. Permanent surface casing will be placed in the bottom of the borehole and the surface casing will be pressed into the clay. The surface casing will be grouted in place by installing the grout through a tremie pipe from the bottom of the annulus to the ground surface.

Alternatively, the surface casing may be installed and grouted in place by a grout displacement method. The bottom of the surface casing is fitted with a tight, drillable plug. The borehole is then filled with the estimated volume of cement-bentonite grout to fill the annular space, and the casing is lowered to the bottom of the borehole (displacement method). If the weight of the casing is not sufficient to displace the grout and allow the casing to sink to the bottom of the borehole, the casing may be filled with clean water.

Well installation will proceed in the surface casing once the grout has been allowed to set up for approximately 16 to 24 hours. All water in the surface casing will be removed before drilling resumes in order to prevent carrying contamination downward into deeper intervals of the water-bearing unit. All water in the casing will be disposed as described in the Waste Management Plan in Attachment 2.

Temporary surface casing installed independently of the drilling process also will be placed in the bottom of the borehole and the surface casing will be pressed into the clay. However, it will not be grouted into place.

3.6.3 Well Casing and Well Screen Assembly

Well casings and screens will be new and unused. Well casings, screens, and end caps will be assembled and installed to prevent damage to the sections and joints. No lubricating oils, solvents, grease, or pipe dope will be used on casing threads. Teflon® tape will be used to wrap the threads to ensure a tight fit and minimize leakage. No glue of any type will be used to secure casing joints. O-rings will not be used and will be removed prior to well assembly. A temporary well cap will be placed on top of the well casing and screen assembly during installation of the annular materials.

Well casings will consist of factory-made flush-threaded 2-inch-diameter, Schedule 40 polyvinyl chloride (PVC). Well screens will consist of factory-made flush-threaded machine-slotted 2-inch-diameter, Schedule 40 PVC. A well screen slot size appropriate for the geologic formation encountered (probably 0.010-inch) will be selected. Screen length will be determined in site specific work plans. A factory-made flush-threaded 2-inch-diameter, Schedule 40 PVC end cap will be placed on the bottom of each well screen. Flush-threaded joints will be compatible for monitoring well casings, screens, and end caps.

For deep wells, stainless steel centralizers may be used. The centralizers will be fastened to the well casing three (3) feet above the well screen.

3.6.4 Sand Filter Pack Installation

A sand filter pack will be placed around the well screen using the positive displacement method, tremie method, or other approved method. Pouring of the filter pack materials is acceptable in boreholes that are less than 50 feet deep. Before the well casing and screen assembly are placed on the bottom of the borehole, at least six inches of filter pack material

will be placed at the bottom of the borehole to serve as a firm footing for the well. The well screen and casing will remain suspended and centered in the borehole until the annular materials have completely settled.

After the well casing and screen assembly are set at the appropriate depth, the sand filter pack will be placed into the borehole. The sand filter pack will consist of a thoroughly washed, sound, durable sand of an appropriate grain size, containing less than five percent silt or clay for the well screen slot size selected (probably commercially available 20/30-grain size or equivalent for 0.010-inch slot size). No organic material, anhydrite, gypsum, mica, or calcareous material will be allowed. The minimum specific gravity of the sand pack material will be 2.5. No water will be used to place the filter pack unless approved by the site geologist. The filter pack will be installed in approximate 2-foot lifts to prevent bridging. The depth to the top of the sand filter pack will be measured periodically using a weighted measuring tape. The sand filter pack will be installed to a depth of at least one foot above the top of the well screen.

3.6.5 Bentonite Seal

A bentonite seal will be placed on top of the filter pack screen using the positive displacement method, tremie method, or other approved method. If the bentonite seal is installed above the saturated zone, the bentonite will be poured in as a slurry using the tremie pipe method, and if the bentonite seal is installed below the saturated zone, then the bentonite seal will be poured in as pellets. Pouring of the pellets is acceptable in boreholes that are less than 50 feet deep. The bentonite seal will consist of 30 percent solids in the form of bentonite pellets. Approximately two feet of bentonite pellets will be placed above the sand filter pack. The depth to the top of the bentonite seal will be measured and documented to ensure that the transition seal meets design requirements. The bentonite will be allowed to hydrate for 30 to 45 minutes prior to emplacement of the cement-bentonite grout.

3.6.6 Cement-Bentonite Grout Annular Seal

A cement-bentonite grout annular seal will be placed on top of the bentonite seal using the tremie method. The grout seal will extend from the top of the bentonite seal to within two feet of the ground surface. The grout seal will consist of Portland Type I cement conforming to American Society for Testing and Materials (ASTM) C-150 standards and bentonite powder. The cement-bentonite grout will be mixed using a maximum of seven gallons of water per 94-pound bag of cement and a maximum of 2.7 pounds of bentonite per 94-pound bag of cement. The bentonite powder will either be mixed into the water prior to adding the cement or mixed into the cement powder prior to adding water. The grout will be mixed thoroughly before being placed in the borehole. The drilling subcontractor will supply a mud scale in order to demonstrate the grout was properly mixed. The grout will be allowed to cure for a minimum of 24 hours before the concrete surface pad is installed.

If used, the temporary isolation casings (beginning with the inner-most casing) will be gradually withdrawn as grout is pumped into the borehole. The rate of casing removal will not exceed the rise of the grout within the borehole. The driller will provide a mud scale to demonstrate that the cement grout return at the ground surface is within 3 percent of the weight of the cement grout being pumped into the hole. This will provide documentation that significant grout dilution by groundwater is not occurring.

Placement of the cement grout may displace volatile organic vapors. Therefore, ambient air quality will be monitored using the appropriate instrument listed in the site specific Health and Safety Plans.

3.6.7 Surface Completion

The type of surface completion will be determined in the site specific work plans. In general, both flush mounted and above-grade wells may be used at MCB Camp Lejeune. Surface pads will consist of concrete at least four inches thick and 2-feet-square centered on the well. The specific dimensions of the well pad will be determined in site specific work plans. A lockable, watertight cap or cover made specifically for the diameter of the well casing will be placed on each well. Master Lock® model number 4140KA locks with key number 4232 will be used for all wells installed at MCB Camp Lejeune.

For flush-mounted well completions in paved areas, concrete and asphalt will be removed from around the well to create a 2-foot-square opening in the pavement. The well will be centered in the opening. A concrete saw will be used to cut the opening. A jackhammer or similar tool may be required to remove the concrete pavement. Jagged-edged or out-of-square openings will not be permitted. The surface pad will be oriented with any cultural features located nearby. An 8-inch-diameter vault will be placed over the well 0.25-inch above the existing pavement surface. The surface of the concrete pad will slope gradually from the vault surface to the existing pavement surface at the edge of the pad. The vault will be centered in the 2-foot-square pavement opening. Each vault will have bolt-on traffic-bearing iron covers. The slab will be reinforced with four 20-inch-long steel reinforcing rods (#3 minimum size) placed uniformly around the vault within the concrete slab. The concrete surface will be finished smoothly, and a metal survey marker will be embedded in the fresh concrete.

3.7 Monitoring Well Development

For well completions in unpaved areas, soil will be removed and leveled around the well to create a 2-foot-square opening for a concrete form. The well will be centered in the opening and concrete form. A shovel or similar tool may be required to remove and level the soil. Jagged-edged or out-of-square openings will not be permitted. The surface pad will be oriented with any cultural features located nearby. For flush mounted wells, an 8-inch-diameter vault will be placed over the well 0.50-inch above the existing ground surface. For above-grade wells, the wells will be completed with above-grade steel locking protectors. The steel locking protectors will be approximately 48 inches above-grade. The surface of the concrete pad will slope gradually from the vault surface to the existing ground surface at the edge of the pad. The vault will be centered in the 2-foot-square concrete form and opening. Each vault will have bolt-on traffic-bearing iron covers. The slab will be reinforced with four 20-inch-long steel reinforcing rods (#3 minimum size) placed uniformly around the vault within the concrete slab. The concrete surface will be finished smoothly, and a metal survey marker will be embedded in the fresh concrete. Monitoring Well Development

A new well will be developed within 48 hours after installation depending upon scheduled field activities. A new well will not be developed for at least 24 hours after the surface pad and outer protective casing or vault are installed to allow sufficient time for the well

materials to cure before development procedures are initiated. Development equipment will be decontaminated as specified in this Master SAP. Development water will be containerized and disposed as described in the Waste Management Plan in Attachment 2.

The following procedure will be used to develop wells by surging, bailing, or pumping. If a well cannot be developed adequately with a bailer, then a submersible pump will be used.

1. Remove the well cap or cover and monitor for volatile organic vapors using the appropriate instrument listed in the Master Health and Safety Plan (HASP).
2. Measure the depth to water in the well and the total well depth with a clean electronic water level indicator. Calculate the volume of standing water in the well.
3. Lower the bailer or submersible pump into the well. If a submersible pump is used, turn the pump on as it is lowered into the water column and lower the pump slowly to develop the entire water column and avoid clogging the pump with sediment. Slowly surge the screened interval to draw sediment from the sand pack into the well. Alternately bail and surge or pump and surge the screened interval until the water is relatively clear and free of visible sediment.
4. After each well volume of water is removed, measure and record the pH, temperature, specific conductance, and turbidity of the water using the Well Development Form (Attachment 4).
5. Continue well development until the water is relatively clear and free of visible sediment. Well development will be considered complete after a minimum of three well volumes of water has been removed and the pH, specific conductance, temperature, and turbidity have stabilized. If the parameters have not stabilized within five volumes, it is at the discretion of the FTL whether or not to continue well development.

With respect to groundwater chemistry, adequate development is achieved when the pH, specific conductance, and temperature of the groundwater have stabilized and the turbidity has either stabilized or is below 10 nephelometric turbidity units (NTUs). Ten NTUs is twice the primary drinking water standard and is the goal for most groundwater sampling objectives. Stabilization occurs when pH measurements remain constant within 0.1 standard unit (SU), specific conductance varies no more than 10 percent, and the temperature is constant for three consecutive readings.

3.8 Surface Water and Sediment Sampling

Surface water and sediment samples may be collected from drainage ditches, wetlands areas, creeks, lagoons, ponds, and estuaries across the site. Sampling will proceed from downstream to upstream locations to reduce the amount of turbidity and potential cross-contamination of downstream samples. Sampling will be conducted at low tides, where appropriate, and low flow to minimize dilution of possible contaminants. Sampling activities will not occur after periods of heavy rainfall.

3.8.1 Surface Water Sampling

Field parameters (e.g., dissolved oxygen, temperature, specific conductance, and pH) will be measured prior to sample collection. Surface water samples will then be collected by

submersing the sampling container directly into the surface water body or by using a "thief" type sampler and then transferring the sample to the sample container. The body of the immersed sampling container will face downstream so that any sediment disturbed during the immersion of the container does not enter the sampling vessel. If the volume of surface water encountered is insufficient to allow the direct submersion of the sampling containers, a glass interim vessel will be used to transfer the surface water sample to the sample containers. The glass interim vessel will be laboratory cleaned to the same specifications as the sample containers.

Required containers, preservatives, and holding times for water samples will be included in the site-specific SAPs. All appropriate preservatives will be added to the sample containers by the contracted laboratory before shipment to the environmental contractor's field team. All samples will be kept cool in the field at four degrees Celsius (°C), using bagged ice.

For VOC samples, the bottles will be filled so as to minimize aeration of the samples. During the collection of surface water samples, care will be taken to ensure that any pre-added preservative is not rinsed from the sampling container during sample collection. Sample vials will be filled completely and capped to prevent the entrapment of any air bubbles in the vial.

3.8.2 Sediment Sampling

Sediment samples will typically be collected in conjunction with surface water samples. At locations where both sediment and surface water samples are being collected, the surface water sample will be collected first. This will ensure that any sediment disturbed during the sediment sampling does not enter the surface water sampling container.

Several different techniques may be used to collect sediment samples, including stainless-steel trowel sampling, stainless-steel hand auger sampling, and grab sampling with a Ponar Dredge. The method selected will typically depend on the flow and depth of water at the sampling location. A brief description of these sampling techniques and their applicability is provided below. Required containers, preservatives, and holding times for sediment samples will be included in site-specific SAPs.

During sediment sample collection, the VOC sample containers will be filled first. The sample will be placed directly into the VOC sample container to minimize the volatilization of organic compounds. The remaining sample volume will be placed into a stainless-steel bowl and mixed thoroughly. After mixing, all other sample containers will be filled.

3.8.2.1 Stainless-Steel Trowel

A stainless-steel trowel will be used to collect sediment samples in areas where there is minimal water flow across the sampling location and depth specific characterization is not required. The trowel will be used to transfer the sediment from the sampling location into the sample containers.

3.8.2.2 Stainless-Steel Hand Auger

For depth-discrete sediment sampling, a clean stainless steel, hand-held coring instrument with a disposable plastic liner tube, fitted with an eggshell catcher to prevent sample loss, will be used. The coring device will be pushed through the thickness of the sediments. The core will either be extruded into a stainless-steel bowl or directly into the appropriate

sample bottles. The sample recovery will be noted, and the discreet interval (e.g., 0 to 4 inches, 4 to 8 inches, 8 to 12 inches, or deeper if needed) will be placed in a stainless steel mixing bowl.

3.8.2.3 Ponar Dredge Sampling

A Ponar Dredge will be used to collect sediment samples from beneath any surface water greater than 1-foot in depth. The Ponar dredge is a "clamshell" type sampling device consisting of the bucket/jaws and the sampler arms. During sampling activities, a length of rope is attached to a ring on the top of the sampler arms. The sampler arms are then pushed towards the bucket to open the sampler jaws. The jaws are locked in the open position by inserting a spring-loaded steel pin through a small hole in the arms. The sampler is lifted by the rope, with the weight of the sampler creating the tension that holds the locking pin in place. The sampler is then lowered until the sediments are encountered, pulled up approximately six inches, and allowed to free-fall. With the tension relieved, the spring on the locking pin forces the pin out of the hole in the arms. As the sampler is retrieved, the jaws close, trapping the sediment sample inside. Any surface water entrapped in the sampler is slowly decanted through a screened port on the top of the Ponar.

3.9 Surface Soil Sampling

Sampling techniques that may be employed for surface soil sampling include stainless steel trowel sampling and stainless-steel hand auger sampling, depending on the nature of the material to be sampled. A stainless steel trowel will typically be used to collect samples of loosely packed materials and a stainless-steel hand auger is generally used for densely packed materials. Surface soil samples will be obtained from a depth of zero to six inches bgs and are typically used to investigate leaks and spills on the ground surface. Samples collected from beneath paved or gravel surfaces are not considered surface samples.

3.10 Subsurface Soil Sampling

3.10.1 Soil Sampling Procedures For Lithologic Characterization

Soil samples will be collected from each boring for lithologic characterization from ground surface to the total depth of the soil boring. The physical characteristics of each soil sample will be described and recorded by the field geologist or hydrogeologist. An example soil boring log is provided as Attachment 1. The following information will be recorded on the soil boring log for each soil sample.

- Soil boring identification number;
- Name of the drilling company and the driller;
- Name of the FTL;
- Drilling method;
- Sampling method;
- Sample depth;
- SPT blow counts (if applicable);
- Soil boring location and elevation (general description and survey data); and
- Physical or chemical analyses requested.

Soil types encountered will be classified according to ASTM Standard D2488-69, "Description of Soils (Visual-Manual Procedure)." The soil boring logs will show the depths at which each distinct stratum is encountered. Soil descriptions will comply with the Unified Soil Classification System (USCS), including grain-size classifications (i.e., fine, medium, and coarse sand and gravel); the use of the percentage terms "trace" (1 to 10 percent), "little" (11 to 20 percent), "some" (21 to 35 percent), and "and" (36 to 50 percent); the group symbols; the color; and relative moisture.

3.10.2 Soil Sampling Procedures for Physical Parameters

Soil samples may be collected for analysis of geotechnical parameters such as vertical hydraulic conductivity or particle size analysis. These samples will be collected using thin-walled sampling tubes (sometimes called Shelby tubes) according to ASTM D 1587, or using split-spoon samplers in accordance with ASTM D-1586.

Shelby tubes will be 24- to 36 inches long and 3- to 4-inches in diameter, depending upon the quantity of sample required. Undisturbed samples will be obtained by smoothly pressing the sampling tube through the interval to be sampled using the weight of the drilling rig. Jerking the sample should be avoided. Once the sample is brought to the surface, the tube ends will be sealed with paraffin, bees wax, or other appropriate sealing system, and then sealed with end caps and heavy tape. The sample designation, data and time of sampling, and the up direction will be noted on the sampling tube. The tube will be kept upright as much as possible and will be protected from freezing, which could disrupt the undisturbed nature of the sample. Samples for chemical analysis normally are not collected from thin-walled tube samples.

3.10.3 Soil Sampling Procedures for Analytical Parameters

3.10.3.1 Sampling for VOC Analysis

The following sampling protocol will be employed when soil samples are collected for VOCs. Because of the short hold times in effect for EnCore© samplers, CH2M HILL often elects to use the Syringe method with in-field preservation. The subcontracted analytical laboratory will supply the specific sampling containers and sampling tools required. Once the soil/sediment has been obtained, syringes and pre-prepared 40 milliliter (mL) vials may be used for sample collection.

3.10.3.1.1 Sampling Methodology

When total VOC concentrations in the soil/sediment are expected to be less than 200 µg/kg, the samples may be collected directly with the syringe. When using the syringes, the sample must be placed in the sample container (40 mL pre-prepared vial) immediately to reduce volatilization losses. The 40 mL vials should contain 10 mL of organic free water for an unpreserved sample or approximately 10 mL of organic free water and a preservative. The 40 mL vials will be prepared and weighed by the laboratory.

After collection, the sample must be immediately stored in an ice chest and cooled.

To prepare samples for shipping and analysis, about 3.7 cubic centimeters (approximately 5 grams) of sample material should be added from the syringe to the 40 mL pre-prepared containers. When using the syringes, it is important that no air is allowed to become trapped

behind the sample prior to extrusion, as this will adversely affect the sample. Secure the containers in a plastic bag. Do not use a custody seal on the container, place the custody seal on the plastic bag.

3.10.3.1.2 Special Techniques and Considerations

If low concentration samples effervesce from contact with the acid preservative, then either a test for effervescence must be performed prior to sampling, or the investigators must be prepared to collect each sample both preserved or unpreserved as needed, or all samples must be collected unpreserved.

To check for effervescence, collect a test sample and add to a pre-preserved vial. If preservation (acidification) of the sample results in effervescence (rapid formation of bubbles), then preservation by acidification is not acceptable, and the sample must be collected unpreserved.

If effervescence occurs and only pre-preserved sample vials are available, the preservative solution may be placed into an appropriate hazardous waste container and the vials triple rinsed with organic free water. An appropriate amount of organic free water, equal to the amount of preservative solution, should be placed into the vial. The sample may then be collected as an unpreserved sample. The amount of organic free water placed into the vials will have to be accurately measured.

3.10.3.1.3 Holding Times

Sample holding times are discussed in site-specific SAPs. Field investigators should note that the holding time for an unpreserved VOC soil/sediment sample is 48 hours. Arrangements should be made to ship the soil/sediment VOC samples to the laboratory by overnight delivery the day they are collected so the laboratory may preserve and/or analyze the sample within 48 hours of collection.

3.10.3.1.4 Percent Moisture

Samplers must ensure that the laboratory has sufficient material to determine percent moisture in the soil/sediment sample to correct the analytical results to dry weight. If other analyses requiring percent moisture determination are being performed upon the sample, these results may be used. If not, a separate sample (minimum of 2 ounces) for percent moisture determination will be required.

3.10.3.1.5 Safety

Methanol is a toxic and flammable liquid. Therefore, methanol must be handled with all required safety precautions related to toxic and flammable liquids. Inhalation of methanol vapors must be avoided. Vials should be opened and closed quickly during the sample preservation procedure. Methanol must be handled in a ventilated area. Use protective gloves when handling the methanol vials. Store methanol away from sources of ignition such as extreme heat or open flames. The vials of methanol should be stored in a cooler with ice at all times.

3.10.3.2 Sampling for Other Analytical Parameters

For parameters other than VOCs the following procedure will be followed. Material for samples for all other parameters should be removed to a decontaminated stainless steel tray

or bowl. The sample for semivolatile organic and inorganic analyses should be homogenized in the field by removing gravel and breaking the sample into small pieces using a decontaminated stainless steel spoon . The homogenized sample should be placed in the sample containers. If sample volume requirements are not met by a single sample collection, additional sample volume may be obtained by collecting a sample from directly below or adjacent to the original sample and compositing the sample for non-volatile parameters only. Both the bowls and spoons used during sampling will be decontaminated using the procedures outlined in Section 3.16.2.

3.11 Groundwater Sample Collection

3.11.1 DPT Borings

Discrete groundwater samples will be collected from the DPT soil borings using dedicated polyethylene tubing (or other appropriate tubing) and a peristaltic pump, or other types of submersible pumps. Discrete groundwater sampling procedures for DPT soil borings are similar to the groundwater sampling procedures for monitoring wells that are discussed in the following subsection. Once collected, discrete groundwater samples may be analyzed using an on-site mobile or fixed-base laboratory. Procedures for collecting groundwater samples from DPT borings include:

1. Decontaminate the retractable screen and other downhole equipment in accordance with decontamination procedures in Section 3.16.1.
2. Drive DPT sampler to the desired sampling depth using the truck-mounted hydraulic percussion hammer.
3. Retract DPT rod to expose screen.
4. Insert a stainless steel foot valve into the end of the polyethylene sampling tubing and insert tubing through the rods. Connect tubing to a peristaltic pump and purge sediment from inside screen.
5. Fill all sample containers, beginning with the containers for VOC analysis.
6. Remove polyethylene sampling tubing from the DPT rods. Remove the foot valve and discard polyethylene tubing.
7. Abandon borehole at each sampling location by pumping cement grout slurry through a tremie pipe extending to the bottom of the borehole, and repair the surface with like material (asphalt patch, concrete, etc.), as required. See Section Abandonment Procedures for specific procedures.

3.11.2 Groundwater Monitoring Wells

Monitoring wells will be gauged prior to purging as described in Section 3.14. Monitoring wells will be purged to remove standing water in the wells prior to collecting groundwater samples. Purge water will be containerized and transported as described in the Waste Management Plan in Attachment 2.

3.11.2.1 Purging Procedures

The following groundwater purging procedure will be used.

1. For each well sampled, information on location, diameter(s), depth, and screened interval(s) will be recorded on the groundwater sampling forms (Attachment 5).
2. Either a pump (peristaltic, electric submersible, or pneumatic bladder pumps are acceptable) or bailer will be used to purge the well. A bailer will be used when the well does not yield sufficient water for pumping; otherwise, a pump is preferred.
3. Water quality meters will be calibrated according to manufacturers' instructions. Instrument calibration records will be noted in the logbook.
4. The well number, site, weather conditions, and date will be recorded in the field logbook.
5. The well will be unlocked and opened.
6. Water level measurements will be collected, and the total well depth will be measured. The water level will be measured at the highest point on the inner PVC well casing to the nearest 0.01 foot.
7. The initial pH, specific conductance, dissolved oxygen (DO), ORP, temperature, and turbidity will be measured and recorded on the groundwater sampling form.
8. The volume (in gallons) of water in the well casing will be calculated using the following method:

   $V = 0.041\ d^2h$ gallons
   where:
   d = diameter of the well pipe in inches
   h = linear feet of water column within the well
   V = volume of water in gallons

9. The volume of water in a typical <u>2-inch</u> diameter well casing will be calculated using the following method:

   0.1632 gallons/feet x __ (linear feet of water column) = total gallons

10. In productive wells, the well purging end point will be determined using field measurements of pH, specific conductance, DO, ORP, temperature, and turbidity, although at least one well volume will be purged. A minimum of three well volumes will be removed prior to sampling if field parameters do not stabilize. For non-productive wells, the well will be bailed dry and allowed to recover before sampling.
11. The pump/hose assembly or bailer used in purging should be lowered into the top of the standing water column and not deep into the column. This is done so that the purging will "pull" water from the formation into the screened area of the well and up through the casing so that the entire static volume can be removed. If the pump is placed deep into the water column, the water above the pump may not be removed, and the subsequent samples, particularly if collected with a bailer, may not be representative of the ground water.

It is recommended that no more than three to five feet of hose be lowered into the water column. If the recovery rate of the well is faster than the pump rate and no observable draw down occurs, the pump should be raised until the intake is within one foot of the top of the water column for the duration of purging. If the pump rate exceeds the recovery rate of the well, the pump will have to be lowered, as needed, to accommodate the draw down. After the pump is removed from the well, all wetted portions of the hose and the pump should be cleaned as outlined in Appendix B of this SOP.

12. The device with the lowest pump or water removal rate and the least tendency to stress the well during purging should be selected for use. For example, if a bailer and a peristaltic pump both work in a given situation, the pump should be selected because it will greatly minimize turbidity, providing a higher quality sample.

13. Alternatives to the low flow purging procedures exist and may be acceptable. The low flow/low volume purging is a procedure used to minimize purge water volumes. The pump intake is placed within the screened interval at the zone of sampling, preferably, the zone with the highest flow rate. Low flow rate purging is conducted after hydraulic conditions within the well have re-stabilized, usually within 24 to 48 hours of well construction. Flow rates should not exceed the recharge rate of the aquifer. This is monitored by measuring the top of the water column with a water level recorder or similar device while pumping. <u>These techniques, however, are only acceptable under certain hydraulic conditions and are not considered standard procedures.</u>

14. In purging situations where the elevation of the top of the water column is no greater than approximately 25 feet below the pump head elevation, a peristaltic pump may be used. Enough tubing is deployed to reach the bottom of the well screen. At the onset of purging, the tubing is slowly lowered to the bottom of the screen and is used to remove any formation material which may have entered the well screen during installation. This is critical to ensuring rapid achievement of low turbidity conditions. After the formation material is removed from the bottom of the screen, the tubing is slowly raised through the water column to near the top of the column. The tubing can be held at this level to determine if the pump is lowering the water level in the well. If not, secure the tubing at the surface to maintain this pumping level.

    If the water column is lowered, and the pump is not variable speed, continue to lower the tubing as the water column is lowered. If a variable speed peristaltic pump is being used and draw down is observed on initiation of pumping, reduce the pump speed and attempt to match the draw down of the well. Sustained pumping at these slow rates will usually result in a relatively clear, low turbidity sample. If the draw down stabilizes, maintain that level, however, if it continues to lower, "chase" the water column until the well is evacuated. In this case, the recovered water column may be relatively free of turbidity and can be sampled. It may take several episodes of recovery to provide enough volume for a complete sample.

15. Field parameters will be measured typically every five minutes or at least once for each well volume of water removed while the well is being purged.

Well purging will be completed when field parameters have stabilized. With respect to the volume of groundwater, adequate well purging is normally achieved when the column of water in the well is free of visible sediment. A minimum of three well volumes will be

removed from the well before groundwater samples are collected if field parameters do not stabilize. A minimum of one well volume will be purged if the field parameters do stabilize.

With respect to groundwater chemistry, adequate groundwater purging is deemed to have been achieved when the pH, specific conductance, and temperature have stabilized, and the turbidity has either stabilized or is below 10 Nephelometric Turbidity Units (NTU). Stabilization occurs when pH measurements remain within 0.1 standard units (SU), specific conductance varies by no more than 10 percent, and the temperature remains constant for three consecutive readings. If sufficient water is not present to yield required purge volumes, the well will be purged to dryness.

3.11.2.2 Sampling Procedures

Groundwater samples will be collected when purging has been completed. The elapsed time between completion of well purging and groundwater sample collection will be minimized. Typically, the sample will be collected immediately after the well has been purged, but this will depend on well recovery.

If the well goes dry during sampling, wait until it recovers sufficiently to remove the required volumes to sample all parameters. It may be necessary to return periodically to the well but a particular sample container (e.g., large amber bottles for semivolatile analysis) should be filled at one time rather than over the course of two or more visits to the well. Following purging, samples should be collected using a peristaltic pump/vacuum jug assembly, a Teflon®/stainless steel bladder pump, or a closed-top Teflon® bailer.

The following procedures will be used to collect groundwater samples from permanently installed monitoring wells:

1. Before samples are collected, the well will be purged as described above. This process includes recording pertinent information on the groundwater sampling forms (Attachment 5) and collecting water level measurements. Additional information for sampling includes the sample identification number and the time of sampling.

2. As necessary, sampling equipment will be cleaned and decontaminated prior to sampling.

3. The person(s) performing the sampling will wear clean, unused nitrile gloves (or as specified by the site-specific HASP). Gloves will be changed before each sample is collected.

4. If a bailer is to be used, it will be removed from either its protective covering and attached, to a cord that is compatible with the analytes and long enough to reach the bottom of the well. If a bladder pump is to be used, air supply, sample discharge, and lifting lines will be securely attached to the pump. The lifting lines will bear the weight of the pump; the air supply and sample discharge lines will be attached to the lifting line at 5-foot intervals. If a peristaltic pump is to be used, new discharge tubing and silicone tubing will be attached to the pump head at each new sampling location.

5. Samples may be collected directly from the discharge tubing connected to a submersible pump, or from a bailer. However, samples may not be collected directly from the silicone discharge tubing used with a peristaltic pump. The procedures for collecting samples with a peristaltic pump are discussed in the following section. The submersible

pump or bailer will be lowered to the interval from which the sample is to be collected. If a bailer is to be used, it will be allowed to fill with a minimum of surface disturbance to prevent sample aeration. When the bailer is raised, the bailer cord will not be allowed to touch the ground. For the pneumatic bladder pump, the air supply lines from a regulated compressed gas source will be connected to a control box, and air flow will be started and adjusted with the throttle knob on the control box. Discharge and refill knobs on the control box will be used to control the cycling rate of flow in the bladder. Equal length cycles are generally desired, but individual well conditions will be the controlling factor.

6. The cap will be removed from the sample bottle, and the bottle will be tilted slightly.
7. The sample will be poured slowly from the bailer line or discharged from the pump so that it runs down the inside of the sample bottle with a minimum of turbulence.
8. Adequate space will be left in the bottle to allow for expansion, except for volatile organic analyte (VOA) vials, which will be filled until a positive meniscus is formed and capped. Once sealed, VOA vials will be inverted and tapped gently to detect bubbles. If bubbles are observed, the vial will be re-opened and additional sample slowly added to displace the bubble (repeat as necessary).
9. The bottle will be capped and clearly labeled. Label information will include laboratory, project name and number, sample ID, station ID, preservative, analysis, sampler's initials, date, and time.
10. Samples will be placed in appropriate containers and, if necessary, packed with ice in coolers as soon as practicable.
11. Non-dedicated samplers will be cleaned and decontaminated after use. Disposable bailers will be disposed of properly and not reused.

The procedure for collecting groundwater samples by means of a peristaltic pump are as follows:

1. Connect new discharge tubing and silicone pump head tubing to the peristaltic pump, and lower the tubing to the interval from which the sample is to be collected. Note that deep wells (greater than 50 feet) may require the use of stainless steel tubing weights to facilitate placement of the tubing at the desired depth. Tubing weights must be decontaminated between sampling locations.
2. If the peristaltic pump was also used to purge the well, stop the pump when it is time to collect the VOC sample.
3. Disconnect the discharge tubing from the silicone tubing.
4. Pinching the discharge tubing to keep the water in the tubing, remove the tubing from the well. Be sure that the tubing does not contact other than clean surfaces.
5. Allow water to flow from the tubing into each VOA vial by removing the finger from the other end of the tube.
6. Once the vials are filled, return the tubing to the well and collect any other samples required.

Non-dedicated sampling equipment will be removed from the well, cleaned, and decontaminated in accordance with Section 3.16.2. Disposable polyethylene tubing will be disposed of with PPE and other site trash.

3.11.2.3 Passive Diffusion Bag Sampling

Polyethylene passive diffusion bag (PDB) samplers may be used for groundwater sampling for specific VOCs after the site has been sufficiently characterized. Applicability of PDB use will be determined on the basis of site-specific parameters, including well screen length, groundwater table fluctuation, contaminant stratification within the well screen length, and site-specific DQOs (such as if contamination is expected to be greater in fine grained zones or in more permeable zones.)

Groundwater within the monitoring well will not be purged if PDB samplers are used. The following procedures will be used to install PDB samplers.

1. Field personnel will wear latex or nitrile gloves while setting up and handling the PDB sampler. Do not expose PDB samplers to areas where there are exhaust fumes or other fumes.
2. Measure the depth to groundwater in each monitoring well to make sure the PDB sampler will be entirely submerged during the sampling event.
3. If the PDB sampler is not prefilled, fill the PDB sampler in the field by removing the plug from the sampler bottom, inserting the provided funnel into the sampler, and pouring certified, laboratory-grade deionized water into the sampler. The sampler should be filled until water rises and stands at least half way into the funnel. Remove excess bubbles from the sampler, and then remove the funnel and securely replace the plug.
4. Slide the filled PDB sampler into a clean mesh sleeve to protect the sampler from abrasions in the monitoring well.
5. Attach the pre-measured harness or polyethylene rope to the well head to secure the PDB sampler during deployment. Next, attach the pre-measured harness and a stainless-steel weight to the PDB sampler. If a pre-measured harness is not used, attach a hangar assembly and/or a measured length of polyethylene rope and a stainless-steel weight to the PDB sampler. To keep the PDB sampler submerged a stainless-steel weight should be attached to the bottom of the PDB sampler.
6. Slowly lower the stainless-steel weight, PDB sampler, and line into the well riser until the line holding the PDB sampler is taut.
7. Close and lock the well casing to prevent precipitation from entering the well and to prevent handling of the PDB sampler during the equilibration period.

The PDB sampler should be left in the well riser for a period of at least two weeks (14 days) prior to collection of the groundwater sample. Field personnel shall wear latex or nitrile gloves when collecting water samples. Gloves shall be replaced after the sampler has been pulled out of the well but prior to sample collection. PDB sample recovery should be conducted as follows:

1. Slowly remove the PDB sampler from the well by pulling up the weighted line. Avoid exposing the sampler to heat or agitation.
2. Examine the exterior of the sampler for tears in the membrane material. Make a detailed observation in the field notes of any residues or discoloration on the exterior of the sampler. Water from samplers in which the membrane has been damaged cannot be submitted for analysis.
3. Remove the sampler from the weighted line. Discard the rope and decontaminate the weight, harness, and/or hangar assembly for future use. If pre-measured and dedicated harnesses, weights, and/or hangar assemblies are used, these can be placed in plastic bags labeled with the monitoring well station ID.
4. To minimize cross contamination, remove any excess liquid from the exterior of the sampler by wiping off the PDB sampler with a paper towel.
5. To transfer the water from the sampler to sample containers, cut open the sampler at the pouring spout (located at one end of the sampler) and slowly tilt the sampler over the sample containers, trying to avoid spilling any of the water.

Any unused water in the PDB sampler, and the PDB sampler membrane, rope, and gloves should be managed per the Investigation Derived Waste Management Plan.

3.12 Soil Boring and Monitoring Well Abandonment

DPT borings will be abandoned upon completion of sampling activities. However, monitoring wells will not be abandoned without permission from MCB Camp Lejeune. Applicable MCB, State of North Carolina, and EPA procedures and guidelines for borehole and monitoring well abandonment will be followed.

The objective of abandoning a boring or monitoring well is to prevent the introduction of surface water runoff or impacted groundwater from migrating along the boring, monitoring well, or annular space of the monitoring well. The following procedure will be used to abandon boreholes and monitoring wells.

1. Obstructions in the borehole or well that could interfere with abandonment will be removed.
2. Residual drilling fluids and other fine detritus will be purged from the borehole or well.
3. Well casing materials will be removed to ensure placement of an effective seal.
4. When the well casing is not properly grouted, the upper 20 feet of casing, at a minimum, must be removed.
5. The borehole or well will be sealed with an impermeable filler, such as neat cement grout.

All abandoned borings and monitoring wells will be grouted from the bottom of the borehole or well up to ground surface using a bentonite-cement grout consisting of Portland Type I cement conforming to ASTM C-150 standards. The cement-bentonite grout will be mixed using a maximum of seven gallons of water per 94-pound bag of cement and a maximum of 2.7 pounds of bentonite per 94-pound bag of cement. The bentonite powder

will either be mixed into the water prior to adding the cement or mixed into the cement powder prior to adding water. The grout will be mixed thoroughly before being placed into the borehole.

Each DPT boring that penetrates the Castle Hayne confining unit will be abandoned by pressure grouting through the DPT rods as the rods are withdrawn.

The rate of drill casing removal (if present) will not exceed the rise of the grout within the borehole. The driller will provide a mud scale to demonstrate that the cement grout return at the ground surface is within three percent of the weight of the cement grout being pumped into the hole. This will provide documentation that significant grout dilution by groundwater is not occurring.

Placement of the cement grout may displace volatile organic vapors, therefore ambient air quality will be monitored using the appropriate instrument listed in the Master HASP.

The purpose of abandoning a boring or monitoring well completed in a confined aquifer is to retain water in the aquifer to prevent cross-contamination of aquifers, and to minimize the potential for the borehole or monitoring well to act as a preferential pathway for contaminant migration. Where several confined aquifers are present in an abandoned monitoring well, impermeable seals are required between water-bearing sections.

3.13 Aquifer Testing

Aquifer testing that may be conducted at MCB Camp Lejeune includes slug tests, step-drawdown pumping tests, and constant-rate pumping tests.

3.13.1 Slug Tests

Rising and falling head slug tests may be performed in monitoring wells to evaluate aquifer hydraulic conductivity, transmissivity, and groundwater seepage velocity in the vicinity of the well. Slug tests will be performed after groundwater sampling, and may also be performed after pneumatic fracturing and injection to determine if any changes occurred.

The slug test will consist of submerging a PVC or stainless steel cylinder of known volume (slug), allowing the static water level time to equilibrate, rapidly removing the slug, and recording changes in head over time. The test will continue until the water level returns to within 10% of the original static water level.

Equipment used for the slug test will include a data logger and pressure transducer, a nylon rope, and a solid PVC or stainless-steel slug. Prior to the initial slug test and between each well tested, all downhole equipment will be decontaminated according to the procedures described in this SAP.

Slug testing will be completed using the following procedures:

1. Remove the well cap or cover and monitor for volatile organic vapors using the appropriate instrument listed in the HASP.
2. Measure the depth to water in the well and the total well depth using a clean electronic water level indicator. Calculate the groundwater elevation and the height of the water column. If the well screen is not fully submerged in the water column, then the data

reduction methods must be modified accordingly. If the pressure transducer and slug cannot be fully submerged in the water column, then the well should be evaluated for slug response. If a non-fully submerged slug will result in adequate drawdown, then the test should be performed. Otherwise, the well should not be used to perform a slug test.

3. Lower the pressure transducer into the well and suspend within the water column in the screened interval.
4. Lower the slug into the well and suspend in the water column above the pressure transducer.
5. Enter the appropriate test parameters into the data logger and set the zero reference point after the water column has stabilized to near original static conditions.
6. Start the pressure transducer and immediately remove the slug from the water column. Be careful not to bump the pressure transducer.
7. Record the change in head over time until readings have stabilized. The water level should be allowed to recover a sufficient amount of time to allow the rate of inflow into the well to be controlled by the formation rather than by storage in the filter pack.
8. Reduce the data by plotting the change in head versus time on semi-logarithmic paper using the Bouwer and Rice method of analysis (Bouwer, 1987) or other appropriate data reduction method.

3.13.2 Step-Drawdown Pumping Tests

Step-drawdown pumping tests may be performed to ascertain the efficiency (specific capacity) of a well and to determine an appropriate pumping rate for conducting a constant-rate pumping test.

Step-drawdown tests will be performed in order to evaluate specific capacity of a well, and determine a suitable discharge rate for the constant rate pumping test. An electric submersible pump equipped with a variable frequency drive (e.g. Grundfos Rediflo) will be used for the step-drawdown test. Therefore, a reliable and 'clean' source of electrical power will be identified and a temporary electrical outlet will be installed in the immediate vicinity of the pumping wells. The pump will be installed within the pumping well at the mid-screen interval. Discharge from the pump will be routed to a temporary holding tank. The holding tank will be sized to contain the entire discharge from a single step-drawdown test.

Arrangements should be made with the Base RAC contractor to empty the contents of the tank at the completion of the test.

Step-drawdown tests will be performed over a period of 6 to 8 hours, employing at least 3 or 4 increasing flow rates. Water level fluctuations in the pumping wells and surrounding observation wells will be gauged by electronic pressure transducers. The transducers should be programmed to record water level data on a linear time scale with the maximum time interval of 2 seconds.

3.13.3 Constant-Rate Pumping Tests

A constant-rate pumping test may be performed on a well to ascertain the transmissivity and storage coefficient, or storativity, of the aquifer for use in modeling and capture zone

analyses. An electric submersible pump should be used for the constant rate test. Therefore, a reliable and 'clean' source of electrical power should be identified and a temporary electrical outlet should be installed in the immediate vicinity of the pumping wells. The pump should be installed within the pumping well at the mid-screen interval. The pump must be equipped with a check valve to prevent back flow. Discharge from the pump should be controlled by means of a throttling valve and routed to a temporary holding tank. The holding tank should be sized to contain the entire discharge from a 24-hour period, and placed within a temporary secondary containment structure. Arrangements should be made with the RAC contractor to empty the contents of the tank at regular intervals throughout the duration of the test.

Prior to the commencement of the constant rate aquifer pumping tests, electronic pressure transducers will be placed in each observation and pumping well to measure and record antecedent water level fluctuations for a period of 24 hours. The transducers should be programmed to record water level data on a logarithmic time scale with the maximum time interval of 5 minutes (the minimum time interval should be automatically determined by the data logger, but should not exceed 0.5 seconds). Data loggers should be downloaded to a laptop computer every 6 hours, taking extreme care not to interrupt the data logging activity. Barometric pressure readings, background water levels and rainfall will be monitored throughout the tests. Groundwater discharge must be measured and recorded every 15 minutes and adjusted as necessary to maintain a constant rate. Following completion of each test, water level recovery will be monitored for a period of at least 12 hours.

3.14 Hydrologic Measurements

Groundwater or surface water hydrologic measurements may be collected at MCB Camp Lejeune. Measurement procedures are described below.

3.14.1 Groundwater Level Measurements

Groundwater level measurements will be measured in monitoring wells. Fluid level measurements will be used to evaluate the movement of groundwater, the horizontal hydraulic gradient, the vertical hydraulic gradient, and the thickness of any free product, if present. This information, when combined with other site-specific information such as hydraulic conductivity, extent of contamination, and product density, may be used to estimate contaminant movement or source areas. Fluid levels will be measured with a water level indicator or oil/water interface probe, as appropriate. The depth from the top of casing to fluid level will be recorded to the nearest 0.01 foot. The indicator will be decontaminated after use in each well.

3.14.2 Surface Water Level Measurements

Surface water level measurements may be read from surveyed staff gauges placed in surface water bodies. Surface water level measurements will be used with groundwater measurements to help determine communication between surface water and groundwater. Depth of surface water bodies may be measured using a graduated weighted tape or similar device. Average width of the water body may be measured using a tape measure or a rangefinder. The relative velocity of a water body will be estimated if the velocity cannot be measured with a flow meter.

3.15 Test Pits/Trenching

Test pits or trenches may be completed in areas where characterization of fill or other waste materials is required or the extent of contamination needs to be determined. In general, test pits/trenches may be excavated up to 15 feet in length and to a maximum depth of 10 feet. Samples of materials excavated from the trench will be collected from the bucket of the backhoe or the pile of excavated material using a stainless steel trowel or spoon. Test pits/trenches will not be entered by any member of the sampling team. OSHA trenching guidelines will be followed. Depending on the subsurface material and depth to groundwater, people and surface loads such as soil stockpiles will be kept away from the edge of the trench.

The position of the test pit/trench will be determined in the field by the Project Geologist/Scientist. Utility clearance will be conducted by a professional utilities locating service prior to excavation. Excavation equipment will be decontaminated prior to and after each test pit/trench excavation. Excavation will proceed by removing lifts of no more than about six to 12 inches, until an assessment of the material can be made. The material removed from the trench will be placed on plastic sheeting. A geologist will log the test pit materials. The cross section will be sketched or described and notable features will be identified in the field logbook. Depths will be measured from the ground surface. The length and width of the test pit will also be measured. The test pits/trenches will be backfilled with the material removed from the excavation immediately after completed to reduce site hazards and minimize the potential for rainwater accumulation and subsequent contaminant migration.

3.16 Decontamination

Decontamination procedures for well construction material and sampling equipment are described below. The decontamination area will be a temporary structure large enough to contain any well materials and the working end of the drilling rig. The area will be designed to collect, contain, and drain all fluids to a central point so that the collected fluids can be pumped and drummed. The decontamination area will be constructed of materials that preclude puncturing or leakage caused by decontamination activities. Racks will be provided to hold all equipment and well materials off the ground during decontamination. All equipment and well materials will remain racked and covered when not in use. All decontaminated well materials will be handled only with new, unused surgical gloves to avoid contamination prior to installation.

3.16.1 Drilling Equipment and Well Construction Material

Before mobilizing to the site, the sampling tools will be cleaned with a high-pressure hot-water power washer or steam jenny, or hand washed with a brush using detergent to remove oil, grease, and hydraulic fluid from the exterior of the unit. The detergent does not have to be laboratory grade detergent. Degreasers will not be used. All sampling tools will be decontaminated prior to each monitoring well installation. Groundwater sampling equipment will be decontaminated prior to each sample being collected. All augers, water storage tanks, pumps, piping, drill pipe, and similar equipment will be flushed with potable water followed by cleaning with a hot-water pressure washer.

Decontamination of all equipment, tools, and well materials will consist of hot-water pressure washing to remove all visible evidence of soil, encrustations, or films. Well materials, augers, drill rods, and split-spoon samplers will be rinsed with de-ionized water after pressure washing and prior to use.

3.16.2 Sampling Equipment

The stainless-steel sampling equipment (such as split-spoon samplers) will be decontaminated to prevent the introduction of contaminants into the boring. This decontamination will be conducted according to the following procedure:

1. Wash equipment with a laboratory detergent (i.e., alconox, liquinox, or the equivalent) and hot water, using a brush to remove any particulate matter or surface film.
2. Rinse equipment thoroughly with tap water.
3. Rinse equipment thoroughly with de-ionized or organic-free water.
4. Rinse equipment twice with pesticide-grade isopropanol and allow to air dry.
5. Rinse equipment twice with ASTM Type II Water (ASTM 01193-77).
6. Wrap equipment in aluminum foil (dull side in) to prevent contamination during storage or transport to the field. Larger pieces of equipment, such as augers, may be wrapped in new visqueen or equivalent.

Teflon® and glass field sampling equipment decontamination will be conducted according to the following procedure:

1. Wash equipment with a laboratory detergent (i.e., alconox, liquinox, or the equivalent) and hot water, using a brush to remove any particulate matter or surface film.
2. Rinse equipment thoroughly with tap water.
3. Rinse equipment with 10 percent nitric acid solution.
4. Rinse equipment thoroughly with tap water.
5. Rinse equipment thoroughly with de-ionized water or organic-free water.
6. Rinse equipment twice with pesticide-grade isopropanol and allow to air dry.
7. Rinse equipment twice with ASTM Type II Water (ASTM 01193-77).
8. Wrap equipment in aluminum foil (dull side in) to prevent contamination during storage or transport to the field.

Well sounders or tapes (used to measure groundwater levels) and submersible pumps and hoses (used to purge monitoring wells) will be decontaminated according to the following procedure:

1. Wash equipment with a laboratory detergent and tap water, running solutions through the pumps and pump hoses.
2. Rinse equipment thoroughly with tap water.

3. Rinse equipment thoroughly with de-ionized or organic-free water.
4. Place the equipment in a polyethylene bag or wrap it with polyethylene film to prevent contamination during storage or transit.

Water sampling, water level measuring, and sample preparation equipment brought onsite will be cleaned prior to and after each use. During cleaning and decontamination operations, the substitution of higher grade water for tap water is permitted and need not be noted as a variation. Personnel wearing Level D PPE will decontaminate equipment in accordance with the site-specific HASP.

3.16.3 Personnel Decontamination

Personnel decontamination is discussed in the Master HASP.

3.17 Investigation-Derived Waste Handling

Wastes generated during the investigation of potentially contaminated sites are classified as investigation-derived waste (IDW) and will be managed to protect the public and the environment, as well as to meet legal requirements. The FTL will be responsible for the documentation, containerization, on-site staging, sampling, and ultimate disposal of IDW. The containers may be drums, roll-off boxes, poly tanks, or other. The containers will be labeled (visible marker) corresponding to the appropriate IDW Classification (i.e. media, container type, waste source, etc). The containers will be transported to the temporary waste storage areas described in the Waste Management Plan (WMP) provided in Attachment 2. All IDW will be managed in accordance with the WMP, which may be periodically updated.

3.18 Quality Assurance/Quality Control Samples

Trip blanks, field blanks, equipment blanks, duplicate samples, and matrix spike/matrix spike duplicate (MS/MSD) samples may be collected and submitted for laboratory analysis. Table 3-1 describes each QA/QC sample and the required frequency of collection:

TABLE 3-1
QA/QC Samples
Master Sampling and Analysis Plan, MCB Camp Lejeune

Sample Type	Description	Frequency	Analytes
Trip Blank	Designed to detect contamination of environmental samples during transport from the field to the laboratory. A trip blank is a VOC sample bottle filled with laboratory analyte-free water, transported to the site, handled like a sample, and returned to the laboratory for analysis. Trip blanks must not be opened in the field.	One per every cooler of soil and water samples sent to the laboratory for VOC analysis	VOCs only
Field Blank	Designed to detect contamination in the decontamination water. A field blank is decontamination water collected directly in the sample bottle. It is handled like a sample and transported to the laboratory for analysis.	One field blank from each source of decontamination water for each sampling event, where a sampling event is defined as one week	All laboratory analyses requested for the environmental samples collected at the site for that week
Equipment Blank	Designed to detect contamination of environmental samples caused by contamination of sampling equipment. An equipment blank is analyte-free water that is poured into or pumped through the sampling device, transferred to a sample bottle, and transported to the laboratory for analysis.	One per each day of sampling	All laboratory analyses requested for environmental samples collected at the site on that day
Field Duplicate	Designed to check precision of data in the laboratory. A field duplicate is a sample collected in addition to the native sample at the same sampling location during the same sampling event.	10% of field samples (Do not count blanks, MS/MSDs, or other duplicates in count.)	Same parameters as native sample
MS/MSD	Designed to evaluate potential matrix interferences, accuracy, and precision. Three aliquots of a single sample – one native and two spiked with the same concentration of matrix spike compounds – are analyzed.	5% of field samples	Same parameters as native sample

3.19 Field Tests

Various field tests may be performed during sampling activities. Field tests may be used at MCB, Camp Lejeune to measure water quality parameters of groundwater and surface water and to assess the chemical or physical properties of soil.

Water quality parameters that may be measured during field activities include pH, Eh, specific conductance, DO, temperature, alkalinity, and turbidity. Measurement of these parameters will be performed in accordance with site-specific WPs and SAPs.

Field tests used to assess the chemical properties of site soils include, but are not limited to, X-ray fluorescence (XRF) field screening - to identify soil containing concentrated amounts of heavy metals; immunoassay screening - to determine the presence of polychlorinated biphenyls (PCBs), petroleum hydrocarbons, or other specific chemicals above certain concentrations; FID and PID headspace screening - to detect the presence of organic and inorganic vapors being emitted from soil. All soil field tests will be performed in accordance with site-specific WPs and SAPs.

All field equipment should be calibrated at the beginning of each day using appropriate calibrations solutions or gases. Calibrations should be noted in the field logbook.

4. Sample Handling Quality Control

4.1 Sample Designation

Sample locations and naming conventions will follow the format provided in the Contractor Electronic Data Deliverable Standards and Procedures (EMD, MCB Camp Lejeune, 2003). Each analytical sample will be assigned a unique number of the following format:

Site # - Media/Station # or QA/QC – Depth/Round

Where:

Site #	Identifying site number indicated in the site-specific SAPs
Media	GW = Groundwater
	BG = Background sample of any media
	PZ = Groundwater from a piezometer
	RW = Recovery well groundwater sample
	TP = Test pit sample
	TW = Groundwater from a temporary well
	IS = In-situ soil or groundwater sample collected by DPT
	MW = Soil or groundwater collected from a monitoring well
	SB = Subsurface soil boring
	SD = Sediment
	SS = Surface Soil, not from drilling or DPT
	SW = Surface water
	WT = Water (rinsate, decontamination fluid, ambient potable water)
Station #	Unique identification number for each collected sample
QA/QC	FB = Field blank
	DUP = Duplicate sample (following sample type/number)
	EB = Equipment blank
	MS/MSD = Matrix spike/matrix spike duplicate
	TB = Trip blank
Depth/Round	Depth or round indicators may be used for soil and groundwater samples. Appropriate identification will be discussed in site-specific SAPs and QAPPs

4.2 Sample Preservation and Handling

Sample preservation occurs in the field immediately after collection. The containers supplied by the laboratory will contain applicable preservative. This will protect field personnel from transporting, handling, and measuring concentrated acids and bases. QA/QC samples, with the exception of trip blanks, will be collected in the same type of containers with preservatives as the field samples. Preservatives and holding times for specific analyses will be included in site-specific SAPs.

Samples collected during field activities will be shipped via an overnight courier to the analytical laboratory or will be hand-delivered daily to the mobile or fixed-base laboratory. A cooler of suitable strength for packaging and shipping of samples will be used and will be manifested to meet U.S. Department of Transportation (DOT) regulations (dangerous goods, etc.). The bottom and sides of each cooler will be lined with bubble wrap or other cushioning material. Each sample jar or bottle will also be individually wrapped in bubble wrap to prevent breakage. All samples will be kept upright in the cooler. Once the samples are in the cooler, any voids will be filled with additional packaging material. Ice will be double-bagged in re-sealable bags and placed in the cooler with the samples. A sufficient amount of ice will be added to the coolers to ensure they arrive at the laboratory at a temperature of 4°C. The chain-of-custody (COC) record will be placed in a watertight plastic bag and taped to the inside lid of the cooler. The cooler will be secured with strapping tape and custody seals will be affixed to the front and back of the cooler. The custody seals will be covered with wide, clear adhesive tape.

4.3 Chain-of-Custody

A COC form will be prepared for each shipment of samples to the laboratory. At a minimum, the following will be recorded on the COC:

- Site name;
- Sampler name(s);
- Date and time of sample collection;
- Identification code unique to each sample;
- Number of containers with the same sample code;
- Analyses requested for each sample (including the analytical method numbers); and
- Signature of each individual who has custody of the sample(s).

All blank spaces (except for the signature blocks) should be crossed out and initialed prior to shipment to the lab.

A copy of the COC will be provided to MCB, Camp Lejeune before the field team demobilizes from each sampling event. If split samples are collected, they will be noted on the COC.

Upon receipt of samples at the laboratory, all samples will proceed through an orderly processing sequence specifically designed to ensure continuous integrity of both the sample and other pertinent information to the analysis. If no discrepancies are identified, the sample COC record will be signed, and the sample will be assigned a unique laboratory identification number by the laboratory for tracking and filing. The laboratory QA system

and the use of an internal COC procedure will ensure that the samples are appropriately tracked from storage through the laboratory until the analytical process is complete.

Additional information regarding COC forms is contained in the Master QAPP. Attachment 6 provides an example COC form.

5. References

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U.S. Environmental Protection Agency. *Guidance for Data Quality Objectives Process*. EPA, 2000

Water and Air Research. *Initial Assessment Study of Marine Corps Base Camp Lejeune, North Carolina*. Prepared for Naval Energy and Environmental Support Activity. 1983

Attachment 1

Sample Boring Log

Attachment 1

CH2MHILL

Boring Number:

Client:
Project:
Location:
Project Number:

Driller:
Drilling Method:
Sampling Method:
Logged by:
Start/Finish Date:

Depth (ft)	Sample Information				Soil Log	Soil Description	Depth / Elev (ft)	Comments
	Sample	Sample Type	Recovery (%)	SPT (6"-6"-6")				
0						Ground Surface	0	
							0	
5								
10								
15								
20								

Attachment 2

Waste Management Plan

Waste Management Plan

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

May 2009

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Atlantic

Under the

LANTDIV CLEAN III Program
Contract N62470-02-D-3052

Prepared by

CH2MHILL

Charlotte, North Carolina

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Attachment

1 Transportation and Disposal Log

Acronyms and Abbreviations

CERCLA	Comprehensive Environmental Responsibility Compensation and Liability Act
CFR	Code of Federal Regulations
DRO	diesel range organics
GRO	gasoline range organics
GSRA	Greater Sandy Run Area
IDW	investigation-derived waste
LDR	Land Disposal Restriction
LTM	long-term monitoring
MCAS	Marine Corps Air Station
MCB	Marine Corps Base
OVA/FID	organic vapor analyzer/flame ionization detector
POL	petroleum, oils, and lubricants
PPE	personal protective equipment
RDW	remediation-derived waste
T&D	transportation and disposal
TCLP	Toxicity Characteristic Leaching Procedure
TPH	total petroleum hydrocarbons
USEPA	United States Environmental Protection Agency
WMP	Waste Management Plan
WWTP	wastewater treatment plant

SECTION 1

Introduction

The scope of this Waste Management Plan (WMP) addresses the management and disposal requirements for wastes generated during investigation and remedial activities at Marine Corps Base (MCB) Camp Lejeune (the Base). It is anticipated that the following wastes will be generated during these activities:

- Non-hazardous and hazardous soil from investigation and remedial activities
- Non-hazardous and hazardous water from investigation and remedial activities
- Solid debris including disposable sampling equipment and personal protective equipment (PPE)

These investigation-derived wastes (IDW) and remediation-derived wastes (RDW) will require management and disposal in a manner that is consistent with state and federal law and minimizes potential hazards to the public. IDW is defined as waste that is generated while performing an investigation action. Investigations include all phases of work prior to finalizing the remedial design but excluding any removal actions. Pilot studies are considered investigations. RDW is defined as waste that is generated during any remedial, removal, or corrective action. The Environmental Management Division (EMD) has the primary responsibility for wastes generated at the Base. This plan describes methodologies and procedures that CH2M HILL's personnel will implement to handle, manage, and dispose of waste at the Base. Procedures for managing, handling, and disposing of project-specific waste will be addressed in the project-specific plan. This plan is prepared for CH2M HILL's use only, for the management of waste generated during CH2M HILL's environmental investigation and remediation work conducted at MCB Camp Lejeune.

SECTION 2

Types of Waste

2.1 Soil

Soil may be generated from either investigation or remediation activities and may include soil cuttings generated during drilling activities, soils that accumulate in the decontamination pad from the washing of equipment, and soils generated during remedial activities. Soil that is IDW and is not from a known source area or area of suspected soil contamination may be returned to the borehole or spread on the ground surface near the boring from which it was removed. All cuttings will be screened with an organic vapor analyzer/flame ionization detector (OVA/FID) prior to spreading. If a large volume of soil will be generated that will require grading, seeding, and/or erosion control measures, other disposal options should be considered. If it cannot be presumed that the soil can be spread around the borehole during fieldwork, then the soil should be properly containerized as described in Section 3. If subsequent analytical results show that the soil is not contaminated and the soils from multiple boreholes have not been aggregated or only aggregated with other boreholes in close proximity (e.g., a well cluster), the soil may be returned to the site and spread around the original borehole.

IDW soil that cannot be spread around the borehole and soil that is RDW will be used as soil cover at the Base landfill, if it is non-hazardous and contains no petroleum, oils, or lubricants (POL). If the soil cannot be disposed at the Base landfill, offsite disposal will be arranged at an appropriate facility as described in Section 6.2. Soil will be accumulated in drums, bulk containers, or stockpiles in accordance with Section 3. Containers will be temporarily staged either in a fenced and secured area or in a less-than- 90-day storage facility pending disposal. If waste containers cannot be stored in a fenced, secured area or if hazardous waste is generated, then the waste must be transported to a less-than-90-day storage facility on the Base. This location will be identified in the project-specific plan (i.e., work plan or sampling and analysis plan). All containers used to accumulate waste will be kept closed and secured when waste is not being added or removed. Roll-offs will be lined and covered while awaiting transportation and disposal.

Soil should be assumed to be non-hazardous unless there is evidence otherwise. Hazardous waste is defined as waste that is listed in 40 CFR 261 Subpart D or which is characteristically hazardous as defined by 40 CFR 261 Subpart C. No site currently identified at MCB Camp Lejeune contains waste listed in 40 CFR Subpart D. Any newly identified site would need to be assessed. Characteristically hazardous waste exhibits at least one of the following:

- Ignitable - Flashpoint that is less than 140°F
- Corrosive - pH that is less than 2 or greater than 12.4

- Reactive – the waste is normally unstable and undergoes violent change without detonating; explosive; or reacts violently or produces toxic gas when exposed to water, air, or heat.
- Toxic – The waste has constituents that exceed the toxicity limits listed in 40 CFR 261, Subpart C.

Soil sent for disposal will be characterized and a formal waste determination will be made using analytical results as described in Section 2. All wastes should be disposed of within 90 days of the accumulation start date. All containers should be labeled in accordance with Section 3. The soil disposal process is shown in **Figure 2-1**.

2.2 Water

Wastewater will be produced during monitoring well development, groundwater purging and sampling, and possibly during remedial operations. Wastewaters that are from the same site may be aggregated as long as they are the same type of waste. Different types of hazardous wastewater will never be aggregated.

The Wastewater Treatment Plant (WWTP) at Lot 203 can be used to dispose of certain wastewater that is generated by the performance of work conducted under the Comprehensive Environmental Responsibility Compensation and Liability Act (CERCLA) work on Mainside at the following approved Sites 3, 6, 78, 82, and 88. Prior notification and approval of the WWTP operator is required for disposal and any paperwork requested by the operator will be completed. At a minimum, the IDW Management Form supplied by the operator must be completed at least three days prior to planned IDW water disposal at Site 203. All wastewater that can be disposed of in this manner will be discharged prior to demobilization from the site. Based on the design limitations of the plant, the following practices will be adhered to when disposing of wastes at the WWTP:

- Water containing sediment will be allowed to settle for at least 8 hours prior to dumping to the wet well
- No free product will be disposed of at the WWTP
- CH2M HILL personnel will supervise all subcontractors that dispose of waste at the WWTP

Wastewater that cannot be disposed of at the WWTP will be accumulated in containers, in accordance with Section 3, and containers will be staged at a fenced and secured location or at a less-than-90-day storage site. All containers used to accumulate wastewater will be kept closed and secured when waste is not being added or removed. Wastewater should be assumed to be non-hazardous unless otherwise indicated. Hazardous waste is defined as waste that is listed in 40 CFR 261 Subpart D or which is characteristically hazardous as defined by 40 CFR 261 Subpart C. No site currently identified at MCB Camp Lejeune contains waste listed in 40 CFR Subpart D. Any newly identified site would need to be assessed. Characteristically hazardous waste exhibits at least one of the following:

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- Toxic – The waste has constituents with concentrations that exceed the toxicity limits listed in 40 CFR 261, Subpart C.

Wastewater will be analyzed prior to offsite disposal and a formal waste determination will be made using the results as described in Section 2. All wastewater disposed of offsite should be disposed of within 90 days. The procedure for disposing of waste water is show in **Figure 2-1**.

2.3 Solid Debris

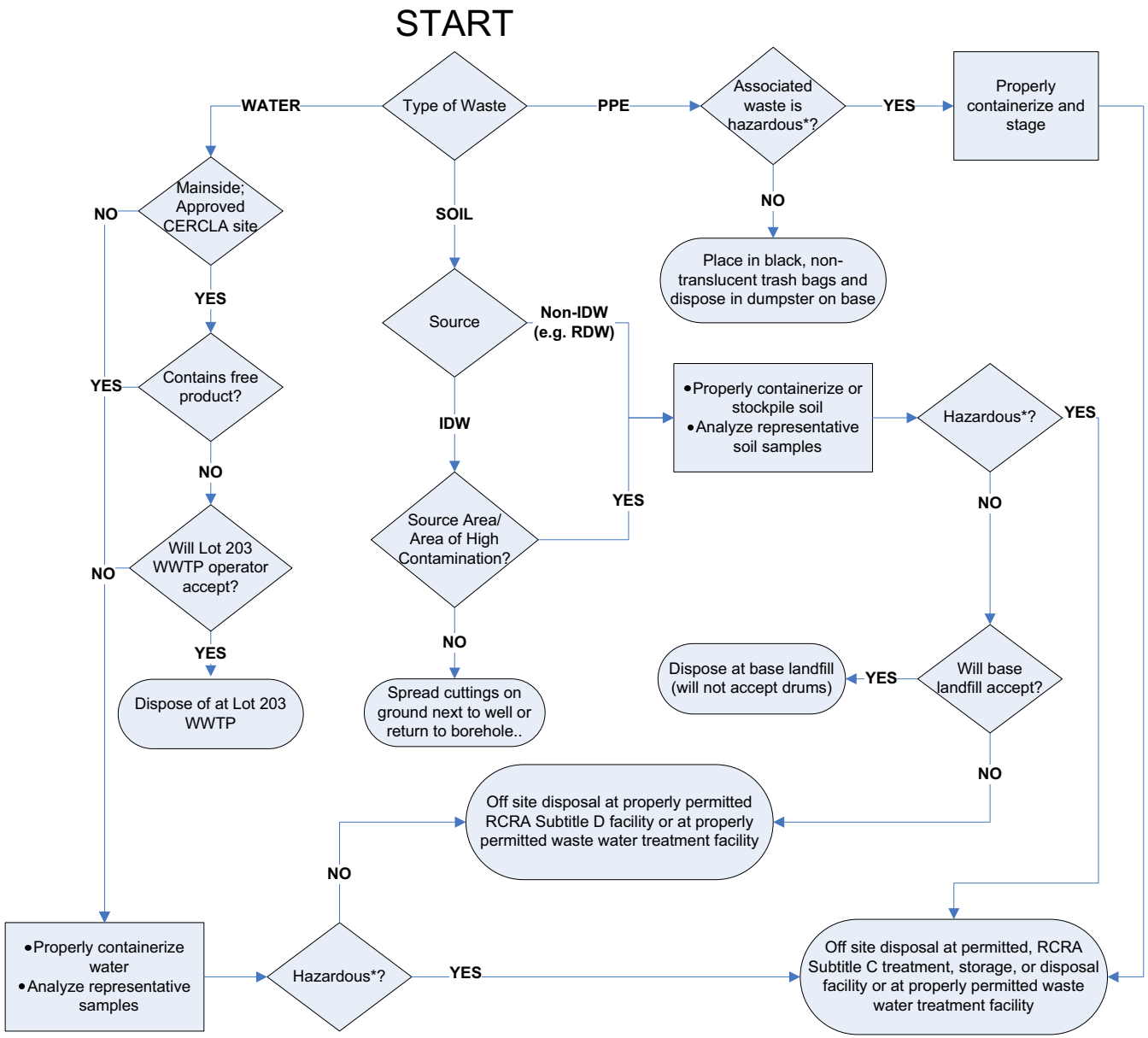
Examples of other debris that may be generated at the site include plastic sheeting, PPE, and disposable sampling equipment. These items will be characterized according to the waste that they are associated with. Debris associated with non-hazardous waste should be accumulated in black, non-translucent trash bags. The bags should be secured and disposed of in a dumpster on the Base. Debris associated with hazardous waste will be accumulated in drums or bulk containers as hazardous waste. These items will be disposed of offsite in accordance with the Section 6 of this document. The steps for disposing of solid debris are shown in **Figure 2-1**.

Things to Consider

- **Determine what types of contaminants are at the site (e.g., petroleum/non-petroleum, metals, cVOCs). Determine where you anticipate disposal and begin coordination with that facility. Always have an alternate plan; disposal facilities can refuse any waste for any reason.**
- **Is significant contamination expected? If so, engage compliance. May need to manage as hazardous waste until analytical proves otherwise.**
- **Could generator knowledge be used to classify the waste? (LTM or engage compliance)?**
- **Is the site a high traffic area or remote? In high traffic areas additional security for containers/ stockpiles is needed. There are certain areas where waste staging is not allowed.**
- **What types of containers will be used? Consider the volume and properties of the waste. Determine how containers will be procured and transported to the site.**
- **Where/how will waste be secured? All waste must be secured (i.e. inside of a fence). Do not demobilize from the site until waste is properly secured. Ensure that the location has adequate capacity. Ensure that bulk containers can be maneuvered into the space. For non-hazardous wastes use the "dog pound" area on Parachute Tower Rd. or Site 89. For hazardous waste use the <90 day areas on Base.**
- **How will the waste be moved?**

  Non-hazardous: The preferred method of waste transportation is to use a subcontractor. CH2M HILL personnel can move small quantities of non-hazardous waste *only if it can be done SAFELY.*

  Hazardous: Hazardous wastes will only be transported by a certified waste hauler.



RDW – Remediation-Derived Waste
IDW – Investigation-Derived Waste
WWTP – Wastewater Treatment Plant
LTM – Long-Term Monitoring
***As defined by 40 CFR 261**

Figure 2-1
Disposal Flowchart

SECTION 3

Waste Characterization

Historical documentation will be reviewed from each site to determine if the waste from that site is listed hazardous waste as defined by Title 40 of the Code of Federal Regulations Part 261 Subpart D (40 CFR 261 Subpart D). The Base, as the generator, will make the final determination concerning the existence of listed hazardous waste.

To characterize waste for disposal the Toxicity Characteristic Leaching Procedure (TCLP) should be used. For offsite disposal the following analyses should be performed: full TCLP, Ignitability, Corrosively, Reactive Cyanide, and Reactive Sulfide. In addition, for soil that will be used at the Base Landfill, the following analyses must be added: Total Petroleum Hydrocarbons (TPH) for Gasoline Range Organics (TPH-GRO) and Diesel Range Organics (TPH-DRO) and any analytical related to the contaminant of concern at that site.

For sites that have a single roughly homogenous plume, where wastes are collected in bulk containers, one sample per media per site is required. In other cases where waste is collected in bulk containers one sample per 500 tons of solid media and one sample per bulk liquid container are required. Where waste is collected in drums, one sample per 10 drums of each media is required. Wastes will be characterized based on analytical results, and the characterization will be documented.

In special cases, generator knowledge may be used to characterize waste. This may be appropriate for long-term monitoring (LTM) sites or sites where remedial actions have been completed. When planning to characterize waste with generator knowledge the Base must approve of this practice and the disposal facility that will be used must also agree to accept the waste with only generator knowledge to support the waste profile.

Waste characterization information will be documented on a waste profile form provided by the treatment and/or disposal facility as part of the waste acceptance process. For offsite disposal, the profile will be submitted to the Base for generator signature. As part of the submission of the waste profile CH2M HILL will also provide a data summary table. A unique profile tracking number will be assigned to the analytical and the profile. In addition this profile number will be incorporated into waste container numbers to allow personnel to easily match waste streams with containers. Profiles tracking numbers will be assigned using the following format:

CTO/TO Number -Site#- Media | count number

An explanation of each of these identifiers is given below.

CTO/TO Number	Number identifying which project generated the waste
Site Number	Identifies the location where the waste was generated.
Media	Describes the waste : W-water S – soil D-debris
Count number	The running count of the waste streams of this media generated by this project.

Under this format, "CTO040-IR78-S02" would mean the following:

CTO040-IR78-S02	Waste generated for work conducted under CTO 040
CTO040-**IR78**-S02	Waste generated at Site IR78
CTO040-IR78-**S**02	The waste is soil
CTO040-IR78-S**02**	This is the second soil profile generated by this project.

Base personnel will provide any required generator certification and/or signatures. Signed profile(s) will then be submitted to the appropriate offsite disposal facility (Section 6.2) for approval.

The profile for offsite disposal typically requires the following information including but not limited to:

- Generator information including United States (U.S.) Environmental Protection Agency Generator Identification (USEPA ID) Number (see Section 4.2 for generator number), name, mailing address, contact, and phone number
- Site name including street address
- Process generating waste (e.g., soil removal, well installation)
- Source of contamination
- Historical use for area
- Waste composition
- Physical state of waste
- Applicable hazardous waste codes

For offsite disposal, the disposal facility will be approved by the regional environmental manager prior to awarding a contract for disposal. The facility shall have the certifications

and permits listed in Section 7. A copy of the waste profile or approval letter will be received from the disposal facility prior to scheduling of offsite transportation of the waste.

SECTION 4

Waste Management

4.1 Waste Storage Time Limit

Even though all generated soil, debris, and liquids are assumed to be non-hazardous for management purposes (unless there are indications otherwise), samples will be collected for and wastes will be characterized with those results. Based on historical IDW and RDW characterization results, hazardous wastes are not expected to be generated. However, all wastes should be disposed of within 90 days of the accumulation start date.

To facilitate container tracking each container will be assigned a unique number using the following format:

Profile Tracking Number-event number-count number/total count

An explanation of each of these identifiers is given below.

Profile Tracking Number	Number identifying the waste stream associated with the container. See Section 3 (Waste Characterization) for more information.
Event number	The running count of events where this profile has been used.
Count number	The running count of drums related to this waste profile number that have been generated during this event.
Total Count	The total number of drums generated during this event.

Under this format, "CTO040-IR78-S02-02-05/10" would mean the following:

CTO040-IR78-S02-02-05-10	This waste stream is associated with this profile number
CTO040-IR78-S02-**02**-05-10	This is the second field event that will utilize this profile
CTO040-IR78-S02-02-**05/**10	This is the fifth container related to this profile that was generated during this event
CTO040-IR78-S02-02-05**/10**	A total of 10 containers were generated that are related to this profile during this event.

4.2 Labels

The labeling of waste containers will be in accordance with 49 CFR 172, 173, and 178. Labels will include the container identification number, type of waste, location from which the waste was generated, and accumulation start date (for drums the date that the drums were filled and closed, for bulk containers the date that waste first enters the container).

Containers and portable tanks used to store/accumulate waste (including soil and groundwater) will be clearly marked with and include one of the following labels:

- "**Analysis Pending**" - Temporary or handwritten label until analytical results are received and reviewed. This label will include the container identification number, generator information, Site, and accumulation start date. If the waste is produced from CERCLA or CERCLA-like work, the words, "CERCLA derived" must also be on the label. If the label is handwritten, a paint pen should be used.
- "**Hazardous Waste**" - Pre-printed hazardous waste labels with the following information:
  - Accumulation start date
  - Generator Name
  - USEPA ID number:
    - For waste generated aboard MCB Camp Lejeune (Mainside, Courthouse Bay, GSRA, Camp Geiger) NC6170022580
    - For waste generated aboard MCAS New River NC8170022570
  - Waste codes
  - Container ID (see Section 4.1)
  - Prior to transport, the manifest number must be added (for containers of less than 110-gallon capacity)
- "**Non-Hazardous Waste**" - Preprinted labels with the following information:
  - Accumulation start date
  - Generator name
  - Waste-specific information (e.g., contaminated soil)
  - Container ID
- Where applicable, the major hazards (e.g., flammable, oxidizer, carcinogen) will be included on the label.
- Large containers such as roll-off boxes may require more than one label.

4.3 Containers and Accumulation

Waste materials will be collected in drums, bulk containers, or stockpiles. Containers will be staged in a fenced and secured area pending characterization and disposal. Roll-off containers used to accumulate waste will be lined and covered to await transportation and disposal. Hazardous wastes will be segregated from non-hazardous wastes. Additionally, incompatible wastes (e.g., flammable and corrosive wastes) will be segregated. Wastes of the same matrix, contamination, and the same source may be aggregated to facilitate storage and disposal.

Generally, waste containers will be placed at the site under investigation during field activities and moved to secure locations as part of demobilization. Site conditions may warrant the movement of containers to secure locations more frequently as determined by EMD. Waste generated aboard Camp Geiger and the GSRA will be moved to a secure location at Site 89.

If hazardous waste is generated anywhere except MCAS New River it will be stored at the less-than-90-day storage facility located in Building S-962, (910) 451-5306. If the waste is generated aboard MCAS New River, it will be stored at the less-than-90-day storage facility located in Building AS-4225, (910) 449-5997. These less-than-90-day storage areas contain appropriate emergency response equipment. This equipment includes a fire extinguisher, spill response equipment, and appropriate PPE. Arrangements will be made with the Base for this material to be stored there until disposal. A certified waste transportation contractor must be hired to move hazardous waste.

All containers will be inspected upon arrival at the site for disrepair and any contamination or contents left from previous customers. If a container contains waste upon arrival or is in disrepair, it will be rejected and documented.

The determination of whether to use small or bulk containers is a management decision that depends on several criteria. The following will be considered when selecting containers:

- Compatibility with waste
- Storage location capacity
- Anticipated method of disposal and the containers that the facility will accept
- Method of transportation
- Number of characterization samples that are required
- The effect of aggregating waste in bulk containers on the overall management of waste

4.3.1 Drums/Small Containers

- Drums and small containers will be transported to the temporary accumulation areas on wood pallets and will be secured together with non-metallic banding.
- Drums will be inspected and inventoried upon arrival onsite for signs of contamination and/or deterioration.
- Adequate aisle space (at least 30 inches) will be provided for containers such as 55-gallon drums to allow the unobstructed movement of personnel and equipment. Drums will be arranged in rows that are not more than two drums wide.
- Each drum will be provided with its own label, and labels will be visible and clearly marked.
- Drums will remain closed, with all locking mechanisms engaged, except when removing or adding waste to the drum.
- Drums will be disposed of with the contents. If the contents are removed from the drums for offsite transportation and treatment or disposal, the drums will be decontaminated prior to re-use or before leaving the site.

- Drums containing liquids or hazardous waste will be provided with secondary containment.
- Drums should only be filled to three-quarters full.

4.3.2 Roll-off Boxes

- Roll-off boxes shall be inspected upon arrival onsite. Any roll-off container arriving with contents or in poor condition shall be rejected.
- Roll-off boxes will be provided with covers and disposable liners. Liners shall be disposed of as contaminated debris along with the soil.
- When not in use, securely fastened covers will be installed on all roll-off boxes.
- Old labels will be removed and a new, appropriate label applied as discussed in Section 3.2.
- Roll-off containers shall be inspected by the transporter after removal of the liner and decontaminated in the event of evidence of liner failure.

4.3.3 Portable Tanks

- Portable tanks will be inspected upon arrival onsite for signs of deterioration and contamination. Any tank arriving onsite with contents or in poor condition will be rejected.
- Portable tanks will be provided with covers and secondary containment.
- Only non-stationary tanks (such as a cargo tank or other wheeled tank) will be used to accumulate hazardous waste.
- Each tank will be labeled as discussed in Section 3.2.

4.3.4 Soil Stockpiles

- Stockpiles of contaminated soil will be located near the excavation areas and within an area of existing contamination.
- Stockpiles will be provided with liner, cover, and perimeter berm to prevent release or infiltration of liquids.
  - Minimum 10- and 6-mil polyethylene sheeting will be used for liners and covers, respectively.
  - A perimeter berm will be constructed of clean materials (e.g., hay bales under the liner) and allow for collection of any free liquids draining from the stockpile.
  - Accumulated free liquids will be pumped to a container or tank.
- Covers and perimeter berms will be secured in-place when not in use and at the end of each workday, or as necessary to prevent wind dispersion or run-off from major precipitation events.

- Construction materials for the stockpiles that contact contaminated soil will be disposed of as contaminated debris.
- Accumulation start dates will be recorded on a log or a sign located at the stockpile.

SECTION 5

Shipping Documentation

Prior to offsite disposal of any waste, CH2M HILL will provide the Base with a waste approval package for each waste stream. This package will include a waste profile naming MCB Camp Lejeune or MCAS New River as the generator of the waste, analytical summary table(s) applicable to the waste, a completed waste manifest, and any other applicable information necessary for the Base Resource Conservation and Recovery Section (RCRS) to complete its review of the disposal package and sign as the generator. **The waste profile and waste manifest can only be signed by designated EMD personnel.**

The signed profile will then be submitted to the disposal facility for acceptance and approval. Once the approved profile or approval letter is received from the disposal facility, transportation can be scheduled.

Each load of waste material will be manifested prior to leaving the site. At a minimum, the manifest form will include the following information:

- Generator information including name, address, contact, and phone number, USEPA ID number
- Transporter information including name, address, contact and phone number, USEPA ID number
- Facility information including name, address, phone number, USEPA ID number
- Site name including street/mailing address
- U.S. Department of Transportation (DOT) Proper Shipping Name (e.g., Hazardous Waste Solid, n.o.s., 9, UN 3077, PG III [D008])
- Types and numbers of containers
- Quantity of waste (volumetric estimate)
- Contract Task Order (CTO) or job number
- Profile number
- 24-hour emergency phone number
- Profile tracking number

Additionally, each shipment of waste will also have a weight ticket.

The generator and the transporter must sign the manifest prior to the load of waste leaving the site. A copy of this manifest will be retained by Base personnel. The original signed manifest will be returned to the address of the generator. The disposal facility will provide a copy of the facility-signed manifest to CH2M HILL for the final report. The final report will

include copies of the facility signed manifests, weight tickets, and the Certificates of Disposal/Destruction/Recycle.

If the signed hazardous waste manifest from the designated offsite facility is not received within 35 days of shipment, CH2M HILL will contact the transporter or the designated facility to determine the status of the waste and notify EMD. If the signed hazardous waste manifest has not been received within 45 days, CH2M HILL will prepare an Exception Report for the generator to submit to the State of North Carolina, as required under 40 CFR 262.42 as referenced by 15 NCAC 13A .0107(b).

SECTION 6

Transportation

Each transportation vehicle and load of waste will be inspected before loading waste. This inspection will be documented. The quantities of waste being transported and its final destination will be recorded in the field notes for the day. A contractor licensed for commercial transportation will transport non-hazardous wastes. In the event that wastes are hazardous, the transporter will have a USEPA ID number, and will comply with transportation requirements outlined in 49 CFR 171-179 (DOT) and 40 CFR 263.11 and 263.31 (Hazardous Waste Transportation). A copy of the documentation indicating that the selected transporter has appropriate licenses will be received and approved by CH2M HILL prior to transport of any waste.

The transporter will be responsible for weighing loads at a certified scale. For each load of material, weight measurements will be obtained for each full and empty container, dump truck, or tanker truck. Disposal quantities will be based on the difference of weight measurements between the full and empty container/dump truck. Weights will be recorded on the waste manifest. The transporter will provide copies of weight tickets to CH2M HILL.

The transporter will observe the following practices when hauling and transporting wastes offsite:

- Minimize impacts to general public traffic
- Repair road damage caused by construction and/or hauling traffic
- Cleanup waste spilled in transit
- Line and cover trucks/trailers used for hauling contaminated waste to prevent releases and contamination
- Decontaminate vehicles prior to re-use
- Seal trucks transporting liquids
- All personnel involved in offsite disposal activities will follow safety and spill response procedures outlined in the Site-specific Health and Safety Plan (HSP).
- No materials from other projects will be combined with materials from this site.

SECTION 7

Disposal

CH2M HILL will assess the potential hazards posed by the IDW and submit waste management recommendations to the Base. If test results indicate that the waste is not a hazardous waste, CH2M HILL will recommend that soil be disposed at a non-hazardous landfill; that water be disposed of at an industrial wastewater treatment plant; and that PPE and sampling expendable items be disposed of in a trash dumpster for disposal with other non-hazardous trash generated at the Base.

7.1 Onsite Disposal

The Base manages a landfill onsite where soil that is non-hazardous and contains no POL can be disposed of. Analytical results will be submitted to the Base to determine if waste solids can be disposed of there. If the waste is approved, the Base will generate a waste profile form and provide instructions for disposal. Transportation will need to be provided by a waste hauler with the appropriate qualifications as described above. Waste characterization documentation should accompany waste to the Base landfill. If landfill personnel are unable to verify the disposal authorization the Base Installation Restoration (IR) manager should be contacted.

PPE and other debris associated with the generation of non-hazardous waste will be collected and secured in black, non-translucent trash bags and disposed of at the base.

7.2 Offsite Disposal

For offsite disposal of wastes, disposal facilities with proper permits and in good standing with the state and federal agencies will be utilized. This information will be received and approved by CH2M HILL prior to profiling of any waste. In addition, the CERCLA Off-Site Rule (40 CFR 300.440) must also be complied with. It states that waste from a CERCLA or CERCLA-like project that is to be shipped offsite must be transferred to an offsite facility that has been reviewed by the USEPA Region under the Offsite Rule and found to be acceptable. This approval is in addition to the facility's EPA or State permit. Since the Base is listed on the National Priorities List, this requirement applies to all projects conducted on the Base. The disposal facility must show proof of their approval in addition to their Resource Conservation and Recovery Act (RCRA) facility permit.

Offsite treatment and disposal facilities will use their waste profile and supporting documentation (e.g., analytical data) to determine whether they will accept a waste.

- Non-hazardous wastes will be disposed at an offsite RCRA Subtitle D facility permitted to receive such wastes or at an offsite wastewater treatment facility permitted to receive such wastes.

- Uncontaminated construction debris may be sent to municipal landfills, or landfills designated for construction/demolition debris.
- Hazardous wastes will be disposed of at an offsite, permitted, RCRA Subtitle C treatment, storage, or disposal facility.
- PPE associated with the generation of hazardous waste will be properly contained and disposed of at an offsite, permitted, RCRA Subtitle C treatment, storage, or disposal facility.

The treatment and disposal facility will be responsible for providing a copy of the final facility-signed waste manifest and a certificate of treatment or disposal for each load of waste received.

SECTION 8

Recordkeeping

Records concerning waste management will be maintained. The Base, as the generator, will maintain these documents as part of their operating records in accordance with their policies. CH2M HILL will maintain copies of the following records:

- Waste analytical results
- Waste profiles
- Field notes documenting waste management including the volumes and methods of disposal
- Manifests, land disposal restriction (LDR) notifications (only for hazardous waste)/ certifications, bills of lading
- Certificates of disposal/destruction/recycle

SECTION 9

Transportation and Disposal Log

The T&D Log (Attachment 1) is used to track waste from generation to final disposition. Wastes will be logged into the T&D Log the day that it is generated and placed into containers. Transportation of wastes will be inventoried the day of transportation from the site using the T&D Log. Final disposal will be documented on the T&D Log using the Certificate of Disposal. This information will be tracked internally by CH2M HILL.

Attachment 1
Transportation and Disposal Log Form

Transportation and Disposal Log

Location _____ Task Description _____

Site _____ Staging Location(s) _____

Project Number _____

(Sub)Contractor _____

Container ID				
Boring/Well Number				
Container Type				
Waste Profile No				
Accumulation Start Date				
Date Transported to Staging Location				
Comments/Notes				

Note: All waste should be included on the Waste Tracking Log from the moment of generation.

Attachment 3

Well Completion Form

Attachment 3

PROJECT NUMBER	WELL NUMBER SHEET OF

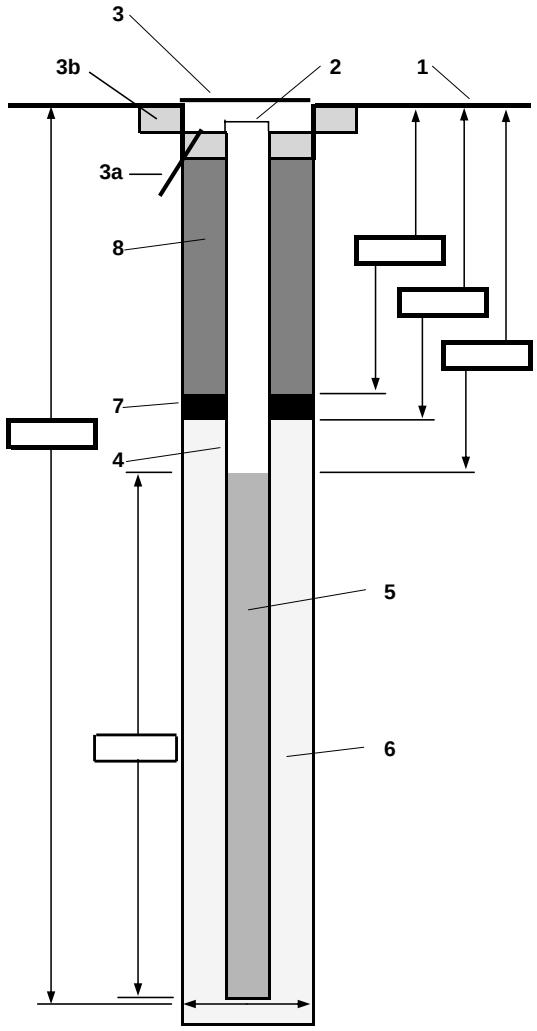
WELL COMPLETION DIAGRAM

PROJECT : LOCATION :

DRILLING CONTRACTOR :

DRILLING METHOD AND EQUIPMENT USED :

WATER LEVELS : START : END: LOGGER :



1- Ground elevation at well _____

2- Top of casing elevation _____

3- Wellhead protection cover type _____
   a) drain tube? _____
   b) concrete pad dimensions _____

4- Dia./type of well casing _____

5- Type/slot size of screen _____

6- Type screen filter _____
   a) Quantity used _____

7- Type of seal _____
   a) Quantity used _____

8- Grout
   a) Grout mix used _____
   b) Method of placement _____
   c) Vol. of well casing grout _____

Development method _____

Development time _____

Estimated purge volume _____

Comments:

Attachment 4

Well Development Form

Attachment 4

CH2MHILL

Well Development Sheet

Project Site Name: _____ **Well ID:** _____

Project No: _____ **Contractor:** _____

Development data

	Time	pH SU	Cond. mS/cm	Temp. °C	Turbidity NTU	DO mg/L	ORP mV	Volume gallons
Date:								
Method:								
Pump setting:								
Well casing dia. (in.):								
Total well depth (TOC):								
Static water level (TOC):								
One purge volume (gals.):								
Start time:								
End time:								
Total dev. volume (gals.):								
Comments:								

Observations/Notes:

Page ____ of ____

Attachment 5

Groundwater Sampling Form

Attachment 5

CH2MHILL

GROUNDWATER SAMPLING DATA SHEET

Client: _____ Project Number: _____

Location: _____ Well ID: _____

Event: _____ Sample ID: _____

Date: _____ Sampling Team: _____

Weather: _____

Total Depth: _____ FT.(BTOC) Measuring Device: _____

Depth to water: (-) _____ FT.(BTOC) Date and Time: _____

Water Column: _____ FT.

(x) _____ GAL/FT.

Well Volume: _____ GAL.

Total Purge Vol.: _____ GAL.

Purge Device: _____

Well Dia. (inches)	Volume (gallons/foot)
1	0.041
1.25	0.064
2	0.163
4	0.653

SAMPLE DATA								
Date: / Time:	Temp. °C	Cond. mS/cm	DO mg/L	pH SU	ORP mV	Turbidity NTU	Other: _____	Color / Odor / Comments
Method:								

FIELD PARAMETERS									
Time	Purge Vol. (gals)	Temp. °C	Cond. mS/cm	DO mg/L	pH SU	ORP mV	Turbidity NTU	Other: _____	Color / Odor / Comments

Sample information: method, container number, size, and type, preservative used.

Analysis	Preservative	Container requirements	No. of containers

Observations/Notes:

MS/MSD	Duplicate ID No.:
Signature(s):	

Attachment 6

Example COC Form

Attachment 6

Project #	Project Name						Number of Containers	Analyze For					Remarks
Samplers: (Signature)													
Sample #	Date	Time	Type	Comp	Grab	Sample Location							

Relinquished By:	Date:	Time:	Received By:	Relinquished By:	Date:	Time	Received By:

Relinquished By:	Date:	Time:	Received for Lab By:	Date	Time	Remarks

Handling Instructions:	Turnaround Time:

Instructions

FINAL

Master Quality Assurance Project Plan

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Prepared for

Department of the Navy

Naval Facilities Engineering Command
Atlantic Division
Norfolk, Virginia

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Abbreviations and Acronyms

AM	Activity Manager
ASTM	American Society for Testing and Materials
CA	Corrective Action
CLP	Contract Laboratory Program
COC	Chain-of-Custody
CTO	Contract Task Order
DENR	Department of Environment and Natural Resources
DM	Database Manager
DO	Dissolved Oxygen
DQOs	Data Quality Objectives
FTL	Field Team Leader
GC/MS	Gas Chromatograph/Mass Spectrometer
HASP	Health and Safety Plan
HSM	Health and Safety Manager
IDL	Instrument Detection Limit
IDW	Investigation Derived Waste
LDM	Lead Data Manager
LQAP	Laboratory Quality Assurance Plan
MCB	Marine Corps Base
MDL	Method Detection Limit
MS/MSD	Matrix Spike/Matrix Spike Duplicate
µg/L	micrograms per liter
NIST	National Institute of Standards and Testing
ORP	Oxidation/Reduction Potential
P	Percent Recovery
PAH	Polycyclic Aromatic Hydrocarbon
PARCC	precision, accuracy, representativeness, completeness, and comparability
PC	Project Chemist
PCE	Tetrachloroethylene
PM	Project Manager
PPE	Personal Protective Equipment
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
QACM	Quality Assurance Control Manager
QAPP	Quality Assurance Project Plan

RI/FS	Remedial Investigation/Feasibility Study
RPD	Relative Percent Difference
RTL	Review Team Leader
SAP	Sampling and Analysis Plan
SDGs	Sample Delivery Groups
SI	Site Investigation
SMC	System Monitoring Compound
SOP	Standard Operating Procedure
SSC	Site Safety Coordinator
TCE	Trichloroethylene
TOC	Total Organic Carbon
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds
WP	Work Plan

1. Introduction

This document presents the Master Quality Assurance Project Plan (QAPP) for the field investigation activities to be performed under contract with the Department of Navy Atlantic Division, Naval Facilities Engineering Command (NAVFAC) for Marine Corps Base (MCB), Camp Lejeune, in Onslow County, North Carolina. This Master QAPP has been developed to encompass the field investigation activities that may be performed to support Site Investigation (SI), Remedial Investigation/Feasibility Study (RI/FS), remedial action, and site-screening activities at one or more of the sites at MCB, Camp Lejeune. The purpose of this Master QAPP is to describe the data quality objectives, general quality assurance and quality control (QA/QC) procedures, and laboratory activities for conducting groundwater, surface water, sediment, soil, waste liquids and solids, and biota sampling at sites under investigation at the Base. This QAPP is intended to encompass most analytical methodologies that may be used in investigations at MCB, Camp Lejeune. Not all analytical methods will be utilized at all sites; however, this Master QAPP is intended to be comprehensive such that any analyses that might be performed for future investigations are included herein.

This Master QAPP will be updated by NAVFAC or the environmental contractor as necessary, and reviewed at least once every three years to ensure that the information contained herein is accurate and reflects current procedures and guidance. Unforeseen occurrences such as the addition of analytical parameters and changes in methodologies will be provided as addenda to this Master QAPP.

Site-specific details such as QA/QC procedures, will be described in the site-specific QAPPs, submitted under separate cover. Site-specific work plans (WPs) and QAPPs will reference this Master QAPP rather than repeat information included in this plan.

2. Project Description

Site-specific descriptions and historical information, including contamination and plans for investigation, will be discussed in the site-specific WPs and QAPPs, which will be developed as each site or group of sites is investigated.

2.1 Base Description

MCB, Camp Lejeune is located within the Atlantic Coastal Plain Physiographic Province in Onslow County, North Carolina. The Base covers approximately 236 square miles, and is bisected by the New River, which flows in a southeasterly direction and forms a large estuary before entering the Atlantic Ocean.

The Base is bordered by the City of Jacksonville, North Carolina and State Route 24 to the north; the Atlantic shoreline to the south and east; and US Route 17 to the west (not including the Greater Sandy Run Area of the Base west of US Route 17).

The majority of the land surrounding the facility is used for agriculture. Estuaries along the coast support commercial fishing; and residential resort areas are located adjacent to the Base along the Atlantic Ocean.

2.2 Base History

Construction of MCB, Camp Lejeune began in 1941 with the objective of developing the "world's most complete amphibious training base". The Base was first used as a training area to prepare Marines for combat during World War II, and has continued to be used for combat training since, including the Korean and Vietnam conflicts and the Gulf War. Currently, MCB, Camp Lejeune is host to five Marine Corps commands and one Navy command. In addition, the Base provides support and training for the following tenet commands: Headquarters Nucleus; Second Marine Expeditionary Force; Second Marine Division; Second Marine Force Service Support Group; Second Marine Surveillance, Reconnaissance, and Intelligence Group; Sixth Marine Expeditionary Brigade; the Naval Hospital; and the Naval Dental Clinic. All of the real estate and infrastructure are owned, operated, and maintained by the host command. The current mission of the Base is to maintain combat units for expeditionary deployment.

The most prevalent contaminants of concern throughout MCB, Camp Lejeune are volatile organic compounds (VOCs), specifically trichloroethylene (TCE), cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, tetrachloroethylene (PCE), and vinyl chloride. Less wide-spread contaminants of concern include polycyclic aromatic hydrocarbons (PAHs), metals, and several pesticides.

2.3 Site Activities

Studies at MCB, Camp Lejeune are often intended to characterize the potential human and ecological effects associated with past activities at the Base. Objectives of the studies include:

- Obtaining data to determine the nature and extent of contamination at each of the sites;
- Identifying potential sources, migration pathways, and receiving media;
- Obtaining data to assess the potential human health risks and ecological effects associated with contamination; and
- Obtaining data to support the selection and development of remedial alternatives.

The objectives of the sampling work to be performed are not the same for all the sampling events. Most sampling results are typically used for:

- Determining the nature and extent of contamination;
- Assessing ecological and human health risks;
- Screening;
- Assessing engineering and water quality parameters; and
- Characterizing wastes generated by site activities.

The scope and specific objectives of the studies to be conducted at MCB, Camp Lejeune are presented in each site-specific WP.

Environmental contractors for MCB Camp Lejeune will use subcontractors to perform laboratory analysis, data validation, drilling, monitoring well construction, investigative-derived waste disposal, and surveying. Specific subcontractors will vary from project to project.

3. Project Organization and Responsibilities

This section identifies key team members for each project; lists the QA/QC responsibilities associated with each position; and describes communication procedures that will be followed throughout the specific project.

3.1 Project Team Members

The organizational structure (**Figure 3-1**) and responsibilities are designed to provide project QA/QC for the field investigation activities at MCB Camp Lejeune. Each position is described in the following paragraphs. The specific people to fill the roles described below will be identified in the site-specific WPs and QAPPs.

3.1.1 Project Manager (PM)

The project manager (PM) is responsible for conducting activities in accordance with the site-specific work plans and overall project activities, including cost control, schedule control, and technical quality. In addition, the PM develops the work plan and monitors task order activities to ensure compliance with project objectives and scope. The PM also communicates with MCB, Camp Lejeune and other designated parties regarding project progress.

The PM has ultimate responsibility within the project team for conducting activities in accordance with the site-specific work plans and producing deliverables that are technically adequate, satisfactory to the client, and cost-effective. To accomplish this, the PM develops an internal project review schedule, provides written instructions and frequent guidance to the project team, and monitors budgets and schedules. The PM will work with the project team to select an internal QA/QC review team, to coordinate review efforts, to address review comments, and to adjudicate technical issues.

3.1.2 Activity Manager (AM)

The primary objectives for the activity manager (AM) are to build and maintain the relationship with the client, to provide continuity across all contract task orders (CTOs)/projects at MCB, Camp Lejeune, and to manage and assist the PM. The AM will provide overall guidance with regards to NAVFAC and MCB, Camp Lejeune, and will serve as the alternate CH2M HILL contact. The AM has overall responsibility for client satisfaction.

3.1.3 Senior Consultant and Review Team Leader (RTL)

The review team leader (RTL) is a company-wide resource with significant experience in the various technical aspects involved in a complex project. The RTL coordinates all internal QA/QC review for technical validity and adherence to both internal CH2M HILL policy and MCB criteria. The review team is responsible for evaluating the technical merit of the work planning documents before field activities begin, and reviewing all deliverables before

submittal to MCB, Camp Lejeune. The RTL assists the PM in selecting an internal QA/QC review team, coordinating review efforts, addressing review comments, and resolving technical issues.

3.1.4 Project Chemist (PC)

The project chemist (PC) assists with the preparation of the project work planning documents, provides a point of communication between the laboratory and the project team, supervises the analytical data quality evaluation, and participates in preparing deliverables to the client. The PC coordinates with the project team and the analytical laboratory during the field activities. The PC is also responsible for monitoring project-specific laboratory activities, including checking laboratory invoices and reports, and may audit the laboratory or field operations at the PM's direction. The PC also monitors field and laboratory activities to ensure that the QA/QC requirements described in both this Master QAPP and the site-specific QAPPs are met effectively.

3.1.5 Lead Data Manager (LDM)

The lead data manager (LDM) is responsible for the structure, organization, format, implementation, and operation of the project database as described in the site-specific WPs. The LDM supervises the data management team and provides direction to the database manager.

3.1.6 Database Manager (DM)

The database manager (DM) works with the database on a daily basis and provides data summaries and data queries to the project team.

3.1.7 Field Team Leader (FTL)

The PM delegates responsibility for all field activities to the field team leader (FTL). The FTL reports to the PM and is responsible for coordinating field efforts; providing and maintaining sampling equipment and materials; providing shipping and packing materials; and accurately completing the field logbook. The FTL will supervise the completion of all chain-of-custody (COC) records and the proper handling and shipping of samples. As the lead field representative, the FTL is also responsible for consistently implementing program QA/QC measures at the site and for performing field activities in accordance with approved WPs, policies, and field SOPs.

3.1.8 Site Safety Coordinator (SSC)

The site safety coordinator (SSC) develops and implements the Master Health and Safety Plan (HASP) as well as the site-specific HASPs in the field. The SSC will assist in conducting site briefings and perform all final safety checks. The SSC is responsible for stopping any investigation-related operation that threatens the health and safety of the field team or surrounding populace.

3.1.9 Health and Safety Manager (HSM)

The health and safety manager (HSM) reviews and approves both the Master and site-specific HASPs as well as subcontractor Health and Safety Plans. The HSM serves as the

point of contact for the SSC for any health- or safety-related issues, and may conduct project audits. The HSM is also responsible for investigating accidents should any occur during the course of the project.

3.1.10 Subcontractors

Subcontractors will be used for various activities at MCB, Camp Lejeune. Subcontractors may provide any of the following services:

- Utility location;
- Drilling and groundwater monitoring well installation;
- Remediation system installation;
- Analytical laboratory services;
- Geotechnical laboratory services;
- Data Validation;
- Transportation and disposal of investigation-derived waste (IDW); and
- Survey of the location and elevation of soil borings, groundwater monitoring wells, and other sampling locations.

Procurement of subcontractors will be performed in accordance with the Navy Clean Contract Procurement manual.

3.2 Project Communication

One of the most critical elements in performing any type of project is to establish and maintain lines of communication among all project personnel. At the beginning of the project or the start or end of major milestones, the PM will prepare written project instructions that will be distributed to all team members. These instructions will document project and task instructions, and each team member's responsibility in meeting the objectives, as well as a budget and schedule for successfully executing the work.

Before field activity begins, a project team meeting will be held to review the concept, assumptions, objectives of the field approach, and project objectives. Periodic meetings will be held to review data validity, technical evaluations, major decisions, and overall progress toward completing the project. Additionally, a team kickoff meeting will be held before work on each task is started. Senior personnel, including the RTL, will participate in the meetings to help focus the project approach and to define specific issues.

During the field investigation phase of projects, the field teams will meet daily to review the status of the project and to discuss technical and safety issues. When necessary, other meetings will be scheduled or the FTL will meet individually with field personnel or the subcontractors to resolve problems. During the field effort, the FTL will prepare a weekly report detailing project progress.

During the field effort, the FTL will be in regular telephone or face-to-face contact with the project team. When significant problems or decisions requiring additional authority occur, the FTL can immediately contact the PM for assistance. The PC, in consultation with the PM, will coordinate communication with the laboratory during sample collection, sample analysis, and data quality evaluation.

Daily and weekly reports, boring logs, QA reports, and other project information will be shared by the members of the project team as needed. All communications with MCB, Camp Lejeune will be channeled through the PM who will be informed of field activities being conducted on a daily basis.

3.3 Project Schedule

Sample collection events will be planned to maximize efficiency while maintaining field quality control. A detailed schedule will be included in the site-specific WPs.

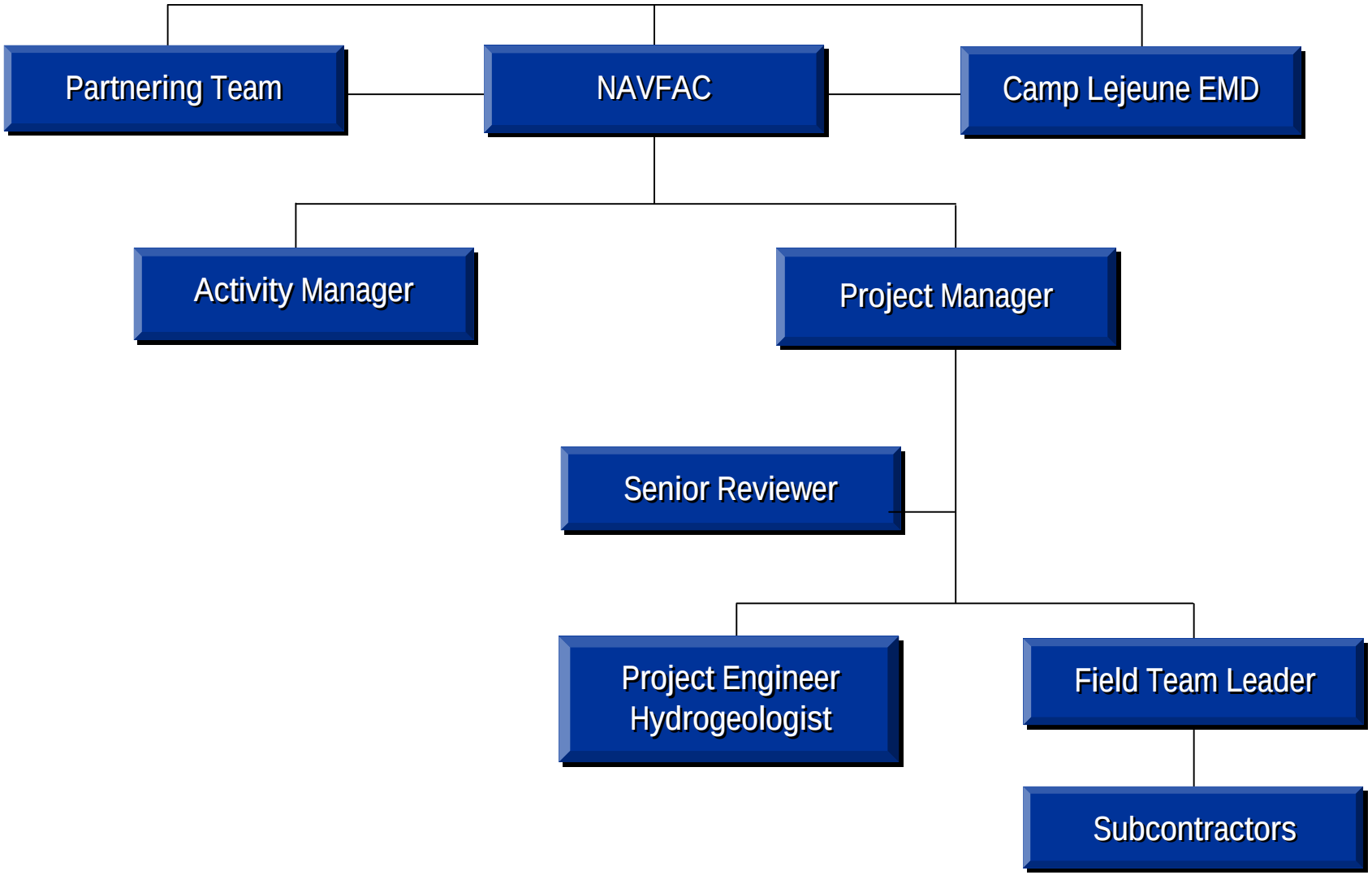


Figure 3-1
Project Organization
Master Quality Assurance Project Plan
MCB Camp Lejeune, North Carolina

4. Quality Assurance Objectives

Data Quality Objectives (DQOs) will be established for each major sample collection effort as specified in the *EPA Guidance for Quality Assurance Project Plans*, EPA QA/G-5, February 1998; *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*, EPA QA/R-5; and *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, September 1994. DQOs are the quantitative and qualitative descriptions that specify the quality of data required from field and laboratory data collection activities to support decisions concerning risk and remediation. DQOs are established prior to data collection and describe what data are needed, why the data are needed, and how the data will be used to address the problems being investigated. DQOs help to ensure that all data collected are legally and scientifically defensible.

The following fundamental mechanisms will be used to achieve quality goals:

- Prevention of errors through planning, documented instructions and procedures, and careful selection and training of personnel;
- Assessment of data through field and laboratory audits and data validation of the analytical results; and
- Correction of errors through a corrective-action program.

The Master QAPP and SAP contain the plans and procedures for safe, competent sampling and for effective management of the data. Each laboratory providing analytical data for the sampling efforts has developed its own laboratory quality assurance plan (LQAP).

System audits in the field and in the laboratories will determine how the QA/QC procedures are being implemented. Discrepancies, if any, will be addressed through the corrective action programs described in the Master SAP and the LQAP.

4.1 Levels of Data Quality

Three categories of data may be collected as part of a field effort at MCB, Camp Lejeune, and each category has a different level of supporting QA/QC documentation. Level 1 includes field monitoring activities, such as pH, conductivity, temperature, and turbidity. Level 2 includes the analyses for physical parameters such as percent moisture, porosity, permeability, and grain size distribution. Level 2 also includes the analyses associated with the characterization of the investigation derived waste (IDW) samples. All other samples will be submitted to the laboratory for Level 3 analyses. For each QC level, the measures and methods to be used, as well as the applicable data package deliverables are outlined below.

4.1.1 Level 1 – Field Surveys

Level 1 encompasses field monitoring or screening activities and does not require formal data package deliverables. Level 1 activities are focused on easily measured characteristics of a sample such as pH, conductivity, oxidation/reduction potential (ORP), dissolved

oxygen (DO), temperature, turbidity, and total organic vapors. The data generated from field surveys are used to make decisions about the execution of the investigation or to provide general sample screening before laboratory analysis.

Monitoring results, as well as pertinent data concerning the sampling event, will be documented in the field logbook. Level 1 documentation will consist of the following:

- Instrument identification;
- Calibration information (standards used and results);
- Date and time of calibration and field measurements; and
- Field measurement results.

The logbooks will be reviewed daily by the FTL for completeness and correctness. No additional documentation or data quality evaluation is required.

4.1.2 Level 2 – Physical Parameters and IDW Analyses

Level 2 includes the samples submitted to the laboratories for physical parameter testing and IDW characterization. Samples submitted for analysis under Level 2 will require the delivery of an analytical data package. Level 2 documentation will consist of the following:

- Case narrative;
- Sample results;
- Selected QC information such as surrogate recovery;
- Associated blank results; and
- Completed COC form and sample receipt information.

4.1.3 Level 3 – Laboratory Analyses

The purposes of Level 3 data include the following:

- To further define the nature and extent of contamination at MCB, Camp Lejeune;
- To define the risk associated with contamination;
- To define the fate and transport mechanisms of site-related contaminants; and
- To monitor contaminant levels at the Base.

The list of methods and the corresponding target compound lists will be designed to meet the needs of the specific project. In general, samples will be analyzed using EPA-approved methods from the current edition of *SW-846, Test Methods for Evaluating Solid Waste,* the Contract Laboratory Program (CLP) statement of work, or ASTM. Specific methods are included in the site-specific QAPPs. Level 3 data package deliverables are summarized in **Table 4-1**.

TABLE 4-1
Level 3 Data Package Deliverables (Standard Deliverable Package)
Master Quality Assurance Project Plan, MCB Camp Lejeune

All Analytical Fractions
Case Narrative Sample ID Cross Reference Sheet (Lab IDs and Client IDs) Completed COC form and any sample receipt information Any analytical/procedural changes (copies of "Confirmation of Communication") Copies of non-conformance memos and corrective actions
GC/MS Organic Analyses
Form 1 – Sample Results Form 2 – Surrogate Recovery Summary Form 3 – Matrix Spike and Matrix Spike Duplicate (MS/MSD) Accuracy and Precision Summary Form 4 – Method Blank Summary Form 5 – Instrument Tuning Summary Form 6 - Initial Calibration Summary Form 7 – Continuing Calibration Summary Form 8 – Internal Standard Summary
Metals
Form 1 – Sample Results Form 2A – Initial and Continuing Calibration Summary Form 3 – Initial and Continuing Calibration Blanks and Method Blanks Summary Form 4 – Interference Check Standard Summary Form 5A - Pre-digestion Matrix Spike Recoveries Summary Form 6 – Native Duplicate or MS/MSD Precision Summary Form 7 – Laboratory Control Sample Recovery Summary Form 8 – Method of Standard Addition (if necessary) Form 9 – Serial Dilution Form 10 – Instrument or Method Detection Limit Summary Form 12 – Linear Range Summary Form 13 – Preparation Log Summary Form 14 – Analytical Run Sequence and GFAA Post-spike Recovery Summary
General Chemistry
Includes potentiometric, gravimetric, colorimetric, and titrimetric analytical techniques. Examples, TRPH (418.1), TOC, etc. The following forms must be included (where applicable) Form 1 – Sample Results Form 2A – Initial and Continuing Calibration Summary Form 3 - Initial and Continuing Calibration Blanks and Method Blanks Summary Form 5A –MS/MSD Recoveries Summary Form 6 – Native Duplicate and MS/MSD Precision Summary Form 7 – Laboratory Control Sample Recovery Summary Form 10 – Instrument or Method Detection Limit Summary Form 13 – Preparation Log Summary

4.2 QA Objectives for Chemical Data Management

Analytical performance requirements are expressed in terms of precision, accuracy, representativeness, comparability, and completeness (PARCC). Site-specific quality

objectives will be provided in the site-specific SAPs. Brief definitions for each PARCC parameter are presented below.

4.2.1 Precision

Precision is a measure of the agreement or repeatability of a set of replicate results obtained from duplicate analyses made under identical conditions. Precision is estimated from analytical data and cannot be measured directly. The precision of a duplicate determination can be expressed as the relative percent difference (RPD).

For a given laboratory analysis, the duplicate RPD values are tabulated, and the mean and standard deviations of the RPD are calculated. Control limits for precision usually are plus or minus two standard deviations from the mean.

Precision will be monitored by using field duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples. These data alone cannot be used to evaluate the precision of individual samples but will be used to assess the long-term precision of the analytical method.

4.2.2 Accuracy

Accuracy is a measure of the agreement between an experimental determination and the true value of the parameter being measured. Analytical accuracy can be determined through the use of known reference materials or matrix spikes. It is calculated from analytical data and is not measured directly. Spiking of reference materials into the actual sample matrix is the preferred technique because it quantifies the effects of the matrix on the analytical accuracy. Accuracy can be expressed as percent recovery (P).

4.2.3 Representativeness

Representativeness is a qualitative measure of the degree to which sample data accurately and precisely represent a characteristic environmental condition. Representativeness will be assessed by reviewing the presence/absence of contaminants in method blanks, trip blanks, and equipment blanks; sample condition/integrity upon receipt and storage at the laboratory; and laboratory adherence to sample holding times. In addition, the effects of sample matrix interferences, if any, will be evaluated to determine possible data impact.

4.2.4 Comparability

Comparability is a qualitative measure that describes the confidence with which one data set can be compared with another. Sample collection and handling techniques, sample matrix type, and analytical method all affect comparability. Comparability is limited by the other PARCC parameters because data sets can be compared with confidence only when precision and accuracy are known. This criterion becomes important if more than one field team is collecting samples or more than one laboratory is analyzing samples.

4.2.5 Completeness

Completeness is defined as the percentage of analytical measurements that are judged to be valid, compared to the total number of measurements made for a specific sample matrix and

analysis. The completeness goal for analytical data is 90 percent. All validated data will be used. During the data validation process, an assessment will be made of whether the valid data are sufficient to meet project objectives. If sufficient valid data are not obtained, corrective action (CA) will be initiated by the PM.

5. Sample Collection Procedures

Descriptions of sampling procedures are provided in the Master SAP. Procedures are included that describe the following, at a minimum:

- Sampling methods;
- Sample packing, handling, and shipment, including time considerations;
- Preparation and use of trip blanks, field blanks, equipment blanks, and duplicate samples; and
- Documentation of sampling activities.

Site-specific sampling procedures, sampling point selection, special conditions for sample container preparation, or special time requirements will be addressed in the site-specific SAPs.

Site-specific SAPs will be developed for each investigative effort. The sampling and quality assurance procedures will be specific to the known or anticipated contaminant at the site. At MCB Camp Lejeune, these may include metals, pesticides, PCBs, SVOCs, VOCs, chlorinated solvents, petroleum hydrocarbons, ordnance, acids, or chemical training agents.

6. Sample and Document Custody Procedures

A sample is physical evidence collected from a hazardous waste site, the immediate environment, or another source. Because of the potential evidentiary nature of samples, the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence in enforcement proceedings.

COC procedures are used to maintain and document sample possession for enforcement purposes. The principal documents used to identify samples and to document possession are:

- Packing Lists
- COC Records
- Air Bills (such as Federal Express, UPS)
- Field Logbooks
- Color photographs of the field activities

Sample custody and COC records will be maintained by the field team until samples are delivered to the laboratory. Sample shipping information from each day will be maintained by the FTL and relayed to the laboratory as soon as possible after sample pickup. These documents may be introduced as evidence should a site investigation result in legal action. To document sample possession, COC procedures are followed.

6.1 Definition of Custody

A sample is under the field team's custody if one or more of the following criteria are met:

- It is in the field team's possession
- It is in the field team's view, after being in the field team's possession
- It was in the field team's possession and then the field team locked it up to prevent tampering
- It is in a designated secure area

6.2 Field Custody

In collecting samples, the amount collected should be only enough to provide a good representation of the media being sampled. To the extent possible, the quantity and types of samples and sample locations are determined before the actual field work begins.

The following procedures will be used to document, establish, and maintain custody of field samples:

- Labels will be completed for each sample with waterproof ink, making sure that the labels are legible and affixed firmly on the sample container.

- All sample-related information will be recorded in the site logbook.

- The field sampler will retain custody of the samples until they are transferred or properly dispatched.
- To simplify the COC record and minimize potential problems, as few people as possible will handle the samples or physical evidence. One individual from the field sampling team will be designated as the responsible individual for all sample transfer activities. This field investigator will be responsible for the care and custody of the samples until they are properly transferred to another person or facility.
- All samples will be accompanied by a COC record, which documents the transfer of custody of samples from the field investigator to another person, the laboratory, or other organizational elements. A signature for relinquishment and a signature of receipt of the samples must accompany each change of possession.
- Completed COC forms will be placed in a plastic cover, which is then placed inside the shipping container used for sample transport from the field to the laboratory.
- When samples are relinquished to a shipping company for transport, the tracking number from the shipping bill or receipt will be recorded on the COC form or in the site logbook.
- Custody seals will be used on the shipping containers when samples are shipped to the laboratory to inhibit sample tampering during transportation.

6.3 Sample Labels

The sampling location identification and sample labeling, handling, and shipping must be performed using standardized and well-documented procedures, so that a sample can be tracked to its point of origination. Tracking will be performed from the time of sampling until the analytical data are released from the laboratory. The effectiveness of the tracking process will determine the integrity of the samples. Therefore, a sample numbering system with a tracking mechanism that allows the retrieval of sample information, including sampling locations, date, time, and analytical parameters must be used. Procedures for this system are provided in the project Work Plan. The method of sample identification to be used depends on the type of sample collected and the sample container type, as follows.

- Samples collected for in-situ field analysis are those collected for specific field analyses or measurements for which the data are recorded directly in the field logbooks or recorded on field data sheets, along with sample identity information, while in the custody of the sampling team. Examples are samples for measurement of field pH, specific conductance, and temperature.
- Samples other than those collected for in-situ field measurements or analyses are to be identified on a sample label affixed to the sample container by the FTL. The following information must be included on the label:
  - Laboratory
  - Project name (and number where appropriate)
  - Sample ID
  - Station ID

- Date (for key to sampling round)
- Preservation
- Analysis
- Sampler's initials, date, and military time of collection

Sample labels that are not produced by an electronic sample tracking program must be written in indelible ink.

6.4 Chain-of-Custody Record

Samples are accompanied by a COC record, which will contain the information described in the Master SAP. An example COC form is also contained in the Master SAP. A copy of the COC forms will be provided to MCB Camp Lejeune to indicate the samples collected.

6.5 Transfer-of-Custody and Shipment

When transferring samples, the individuals relinquishing and receiving the samples will sign, date, and note the time on the COC record. This record documents custody transfer from the sampler to the analyst at the laboratory.

Samples will be packaged properly for shipment and dispatched to the appropriate laboratory for analysis, with a separate COC record accompanying each shipping container. Shipping containers will be sealed with custody seals for shipment to the laboratory. Courier name(s), and other pertinent information, will be entered in the "Received By" section of the COC record.

When samples are split with a facility owner or agency, this information will be noted in the "Sample Remarks" section of the COC record and will be signed by both the sampler and the recipient. If the split is refused, the refusal will be noted and signed by both parties. The "Sample Remarks" section will also indicate if a representative is unavailable or refuses to sign. When appropriate, as in the case of the representative being unavailable, the COC record should contain a statement that the samples were delivered to the designated location at the designated time.

All shipments will be accompanied by the COC record identifying their contents. The original record and yellow copy will accompany the shipment to the laboratory, and the pink copy will be retained by the FTL.

If sent by mail, the package will be registered with return requested. If sent by common carrier, a bill of lading will be used. Freight bills, postal service receipts, and bills of lading will be retained as part of the permanent documentation.

6.6 Laboratory Chain-of-Custody Procedures

When samples are shipped to the laboratory, they will be placed in containers that are sealed on each side with at least one custody seal. A designated sample custodian will accept custody of the shipped samples following the procedure outlined below.

When sample analyses and necessary QA checks have been completed in the laboratory, the unused portion of the sample will be disposed of properly. All identifying stickers, data sheets, and laboratory records will be retained as part of the documentation. Sample containers and remaining samples will be disposed in compliance with all federal, state, and local regulatory requirements.

6.6.1 Sample Receipt

A designated sample custodian will accept custody of the shipped samples and verify that the packing list sample numbers match those on the COC record. The custodian will enter pertinent information as to shipment, pickup, and courier in the "Sample Remarks" section of the COC record, and enter the sample numbers into a field logbook, which is arranged by project code and station number. Upon receipt of the samples, the custodian will check the original COC and request-for-analysis documents and compare them with the labeled contents of each sample container for corrections and traceability. The sample custodian will sign the COC and record the date and time received. The sample custodian also will assign a unique laboratory sample number to each sample. Cooler temperature (temperature vial) will be checked and recorded.

Care will be exercised to annotate any labeling or descriptive errors. If discrepancies occur in the documentation, the laboratory will immediately contact the FTL as part of the CA process. A qualitative assessment of each sample container will be performed to note anomalies, such as broken or leaking bottles. This assessment will be recorded as part of the incoming COC procedure.

6.6.2 Sample Storage

The laboratory custodian will use the sample identification number and assign a unique laboratory number to each sample, and is responsible for seeing that all samples are transferred to the proper analyst or stored in the appropriate secure area. The laboratory will send a sample acknowledgement letter to the PM or FTL as a record of the shipment's arrival and the condition of the containers. The laboratory custodian will identify any discrepancies and CAs will be performed. The PC may need to provide guidance concerning additional actions. A copy of the sample acknowledgement letter will be retained with the COC by the PM.

6.6.3 Data Recording

The custodian will distribute samples to the appropriate analysts. Laboratory personnel are responsible for the care and custody of samples from the time they are received until the sample is exhausted or returned to the custodian. The data from sample analyses are recorded on the laboratory report form.

6.7 Documentation Procedures

Field documentation for activities at MCB Camp Lejeune will consist of one or more site-specific field logbooks, field forms, sample logs/labels, and an equipment calibration log. Each logbook will be identified uniquely by project task and consecutively numbered. For

extended field activities, logbooks will be maintained onsite until complete, then stored in the project files.

Photographs will be taken during key field activities. The photographs will be collected at the end of the field work and will be submitted to the MCB Camp Lejeune project manager within two weeks of the completion of field work.

6.7.1 Field Logs

Field logs will consist of all associated field logbooks and field forms.

6.7.1.1 Site Logbook

The site logbook chronicles field investigation activities, but does not have the same level of detail as the field logbook. The site logbook delineates conditions and activities that occur on a given day and references the appropriate field logbooks and forms for specific information. The site logbook also is used to record field changes, along with supporting rationale (**Attachment 1**).

The responsible person for the field effort will complete the site logbook. Pages will not be removed from the document. Partially used pages will be lined out, dated, and initialed to prevent data entry at a later date.

The front cover or first page of the site logbook must list the project name, the project number, and dates of use. The following items are to be included, as appropriate to the work scope, in the site logbook:

- Date
- Weather conditions
- List of CH2M HILL personnel, subcontractor personnel, and site visitors by name, title, organization, and purpose, who entered the project area during the day;
- Brief descriptions of activities conducted
- Field changes or variances with references to the appropriate documentation of these changes
- Specific comments related to peculiar problems that occurred during the day, if any, and their resolution

6.7.1.2 Field Logbook

Information required on the cover of the site logbook also must be provided on the cover of each field logbook. Entries in the field logbook must be continuous through the day. Field logbook pages, as well as the logbooks themselves, are numbered consecutively. The following information should be included in the field logbook:

- Date, time of specific activities, and physical location
- Weather conditions
- Names, titles, and organization of personnel onsite, names and titles of visitors, and times of visits
- Field observations, including specific details on sampling activities (including type of sampling, time of sampling, and sample numbers), a description of any field tests and their results, and references to any field forms used and type of document generated

- A detailed description of samples collected and any splits, duplicates, matrix spikes, or blanks that were prepared. A list of sample identification numbers, packaging numbers, and COC record numbers pertinent to each sample or referenced to the appropriate documentation should be noted
- Specific problems, including equipment malfunctions and their resolutions
- List of times, equipment types, and decontamination procedures followed (if different from those in the Master WP or site-specific WPs) or a reference to the appropriate documentation
- Photograph records

Additional information may be recorded at the discretion of the logbook user. Recorded information may include the following:

- Identification of well
- Static water level, depth, and measurement technique
- Presence of immiscible layers and detection methods
- Collection method for immiscible layers and sample identification numbers
- Total depth of well
- Well yield
- Purge volume and pumping rate
- Well purging times and volumes
- Sample withdrawal procedure
- Date and time of collection
- Well sampling sequence
- Types of sample containers and sample identification numbers
- Preservatives used
- Laboratory analyses requested
- Field analysis data and methods
- Sample distribution and transporter

6.7.2 Corrections to Documentation

All original handwritten data recorded in field logbooks, sample identification tags, COC records, and receipts-for-sample forms will be written with black, waterproof ink. Corrections must be marked with a single line, dated, and initialed. Documents such as site, field, and calibration logbooks are not to be destroyed or discarded, even if illegible or inaccurate. None of these accountable control documents are to be destroyed or discarded, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on an accountable document assigned to one team member, the FTL may make corrections simply by drawing a single line through the error and entering the correct information. The erroneous information should not be obliterated. The person who made the entry should correct any subsequent error discovered on an accountable document. All subsequent corrections must be initialed and dated.

6.7.3 Final Evidence File Documentation

Documentation, including voided entries, must be maintained within project files.

7. Calibration Procedures

Field and laboratory equipment must operate satisfactorily within specified operating limits before it can be expected to produce reliable and usable data for a project. Documentation concerning the calibration of laboratory equipment should include instrument type, calibration frequency, reference standards used, calibration acceptance criteria, and calibration documentation procedures. Calibration applies to field and laboratory instruments, including balances, refrigerators, and ovens.

Instrument testing is primarily achieved by following the manufacturer's instructions with regard to proper voltages, carrier gas flow rates, temperatures, mass or retention time windows, and certified calibration standards. Practically all instruments come with manufacturer's instructions for initial setup, routine checks, CAs, and preventative maintenance.

7.1 Field Instruments

Field instruments will be calibrated at the beginning of each day using the method described by the manufacturer's instructions and then checked periodically during the day and at the end of the measurement period. Standards used to calibrate the field survey instruments will be traceable to National Institute of Standards and Testing (NIST) standards. All instrument calibration activities are documented in the field logbooks.

The water quality indicators will be decontaminated before each sample is measured. The probes will be rinsed three times with American Society for Testing and Materials (ASTM) Type II water before storage each day. The meters will be checked for battery charge and physical damage each day. The meters and standard solutions will be stored in a cool, dry environment. Standard solutions will be discarded before they expire.

All field instruments will be set up and operated in strict accordance with the manufacturer's instructions. When the operation of these instruments needs modification because of specific site or sample conditions, such modification will be documented in the instrument logs and field logbooks.

If an individual suspects an equipment malfunction, the meter will be removed from service and tagged so that it is not inadvertently used, and the equipment manager will be notified so that a substitute piece of equipment can be used. Some backup equipment will be available in the field for use in case of a malfunction.

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

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

7.2 Laboratory Equipment

Laboratory instruments will be calibrated in accordance with the manufacturer's directions and applicable method specifications. Laboratory instrument calibration procedures will be summarized in the LQAP, which will be reviewed and approved by the project chemist PC or designee before samples are submitted for analysis.

8. Analytical Procedures

Analytical procedures will be specified in the site-specific QAPP. Potential contaminants which may be analyzed for may include metals, pesticides, PCBs, SVOCs, VOCs, chlorinated solvents, petroleum hydrocarbons, ordnance, acids, or chemical training agents.

8.1 Field Testing and Screening

All field parameters will be analyzed in accordance with standard operating procedures (SOPs) for the individual equipment. Field parameters include pH, DO, conductivity, ORP, temperature, and turbidity.

8.2 Laboratory Methods

All laboratory analyses will be performed by a laboratory utilizing EPA-approved methods. Project-specific analytical methods are discussed in site-specific QAPPs.

9. Data Reduction, Validation, and Reporting

Data reduction and reporting are steps in the overall management and use of both field and laboratory data, while data validation is a step in the overall management and use of laboratory data. The data quality evaluation process is used to assess the effect of the overall analytical process on the usability of the data.

9.1 Level 1 – Field Survey Data

Field instruments used to collect field survey data (or bulk measurements, such as pH or conductivity) are direct readings, thus making field calculations and subsequent data reduction unnecessary. Field data will be recorded in the site logbooks by appropriately trained field personnel. Field data will include the following:

- Instrument identification;
- Calibration information (standards used and results);
- Date and time of calibration and sample measurement;
- Sample results; and
- Supporting information if appropriate.

Data will be reviewed by the FTL, who is responsible for the collection and verification of all field data while in the field. Data initially will be accepted or rejected by the FTL before leaving the sampling site. Extreme readings (readings that appear significantly different from other readings at the same site) will be accepted only after the instrument has been checked for malfunction and the readings verified by re-testing.

Field documentation, sample data, instrument calibrations, and QC data will be reviewed by the PM (or a designee) before being included in the project files.

9.2 Level 2 – Screening Analyses

Level 2 data includes the samples submitted to the laboratories for physical parameter testing and IDW characterization. Samples submitted for Level 2 analysis will require the delivery of a limited data package, which includes:

- Case narrative;
- Sample results;
- Selected QC information, such as surrogate recovery;
- Associated blank results; and
- Completed COC forms and sample receipt information.

The PC will review the supporting information and will provide a summary report to the PM at the end of the field effort.

9.3 Level 3 - Laboratory Analyses

The PC or designee will perform data quality evaluation. The data quality evaluation process is used to assess the effect of the overall analytical process on the usability of the data. The two major categories of data evaluation are laboratory performance and matrix interferences. Evaluation of laboratory performance is a check for compliance with the method requirements and identifies whether the laboratory did, or did not, analyze the samples within the limits of the analytical method. Evaluation of the matrix interferences is more subtle and involves analysis of several results including surrogate spike recoveries, matrix spike recoveries, and duplicate sample results.

Before the analytical results are released by the laboratory, both the sample and QC data will be reviewed carefully to verify sample identify, instrument calibration, detection limits, dilution factors, numerical computations, accuracy of transcriptions, and chemical interpretations. Additionally, the QC data will be reduced and spike recoveries will be included in control charts, and the resulting data will be reviewed to ascertain whether they are within the laboratory-defined limits for accuracy and precision. Any non-conforming data will be discussed in the data package cover letter and case narrative. The laboratory will retain all of the analytical and QC documentation associated with each data package.

The data package will be reviewed by the PC using the process outlined in the following guidance documents:

- Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA, 1994); and
- Contract Laboratory Program National Function Guidelines for Organic Data Review (EPA, 1994).

For non-Contract Laboratory Program (CLP) methods, the validation will be performed in a process analogous to the National Function Guidelines, but will use QC criteria established by the method.

The data review and validation process is independent of the laboratory's checks; it focuses on the usability of the data to support the project data interpretation and decision-making process. Areas of review include data package completeness, holding time compliance, initial and continuing calibration, spiked sample results, method blank results, and duplicate sample results. A data review worksheet will be completed for each data package. Acceptance criteria for each area of review are specified in the analytical method.

Sample results that do not meet the acceptance limit criteria will be indicated with a qualifying flag, which is a one- or two-letter abbreviation that indicates a possible problem with the data. Flags used in the text may include the following:

- **U** – Undetected. Samples were analyzed for this analyte, but it was not detected above the method detection limit (MDL) or instrument detection limit (IDL);
- **UJ** – Detection limit estimated. Samples were analyzed for this analyte, but the results were qualified as not detected. The results are estimated;
- **J** – Estimated. The analyte was present, but the reported value may not be accurate or precise; and

- **R** – Rejected. The data are unusable. (Note: Analyte/compound may or may not be present).

It is important to note that laboratory qualifying flags are included on the data summary forms that are submitted by the laboratory. However, during the data review and validation process, the laboratory qualifying flags are evaluated and replaced with project-specific validation flags.

Once each of the data packages has been reviewed, and the data review worksheets completed, then the entire data set will be evaluated for overall trends in data quality and usability. Information summarized as part of the data quality evaluation may include chemical compound frequencies of detection, dilution factors that might affect data usability, and patterns of target compound distribution. The data set will also be evaluated to identify potential data limitations or uncertainties in the laboratory. Additional areas of review are listed below.

9.3.1 Field and Laboratory Blank Contamination

The appearance and concentration of target compounds in field and laboratory blanks as well as environmental samples will be reviewed. Common field sampling and laboratory contaminants detected in blanks include acetone, methylene chloride, and phthalates. Acetone and methylene chloride are used to extract samples in the laboratory, and hence, are common laboratory contaminants. Phthalates (such as bis(2-ethylhexyl)phthalate) are used as plasticizers and are often introduced during sample handling.

If these compounds are encountered in a method blank at a concentration greater than the practical quantitation limit (PQL), CAs will be taken in an attempt to eliminate these compounds. These compounds may also be detected in field blanks above the PQL. In either case, all analytical data above the PQL associated with these compounds will be flagged to indicate possible cross-contamination.

9.3.2 Surrogate Spike Recoveries

Surrogate spike compounds are added to each sample for the organic analytical methods. Surrogate spike compounds are structurally similar (but not identical) to target compounds and should behave in a similar manner during analysis. Surrogate spike recoveries are used to monitor both laboratory performance and matrix interferences. Surrogate spike recoveries from field and laboratory blanks are used to evaluate laboratory performance because these blanks represent an ideal sample matrix. Surrogate spike recoveries for field samples are used to evaluate the potential for matrix interferences.

When surrogate spike recoveries for field samples fall outside the method target acceptance windows, the samples are re-extracted if appropriate, then re-analyzed. If the surrogate spike recovery is still outside the acceptance window for the re-analyzed sample, then the sample results are qualified as affected by matrix interferences.

9.3.3 Matrix Spike Recoveries

For this QC measure, three aliquots of a single sample are analyzed – one normal and two spiked with the same concentration of matrix spike compounds. Unlike the surrogate spike compounds, matrix spike compounds are found on the method target compound list. Spike

recovery is used to evaluate potential matrix interferences, as well as accuracy. The duplicate spike results are compared to evaluate precision.

9.3.4 Laboratory Control Samples

An aliquot of ASTM Type II water or "Ottawa sand" for organic analyses is spiked with target analytes or compounds at concentrations in the middle of the linear calibration range, and then prepared and analyzed with a batch of samples. The laboratory control sample is used to ensure quality control for each preparation batch.

9.3.5 Duplicate Sample Results

Duplicate samples will be collected and submitted for laboratory analysis. Both the native and duplicate samples will be analyzed for the same parameters. Target compounds that are detected in both the native and duplicate samples will be compared and the precision estimated for the sample results calculated.

9.3.6 Laboratory Data Reporting

In general, laboratory data will be reported using Level 3 QC procedures and validated for use in risk assessments. Level 3 reporting includes all QC and calibration summaries for a project-specific batch of samples.

10. Quality Control Checks

A number of QA/QC samples will be collected to check the adequacy of sample collection and analysis and to monitor laboratory performance. The QC samples will be submitted blind to the laboratory, where duplicates, blanks, and spiked samples are used to determine if the sampling technique affects the analytical results, to measure the internal consistency of the samples, and estimate variances or biases in the analytical process.

10.1 Field Measurements

The measurements of field parameters are used as screening tools to determine when adequate well development and purging is achieved, to determine sample conditions, to screen for contamination to aid in focusing sample collection, and to monitor field conditions for health and safety.

10.1.1 Well Development and Purging

During well development and purging, measurements of pH, conductivity, temperature, and turbidity are collected to determine when adequate development and purging has been accomplished. Readings are recorded in the field log book for future reference as needed.

10.1.2 Sample Conditions

Immediately prior to sampling groundwater and surface water, field measurements of pH, temperature, DO, specific conductance, ORP, and turbidity are typically taken to characterize the aquifer or surface water body. These values are recorded in the field log book and later entered into the electronic data base using the field data entry tool. These data are typically presented in the investigation report.

10.1.3 Contamination Screening

Soil samples are sometimes screened in the field using organic vapor monitors or analyzers or field test kits. These screening data are typically used to select samples for more detailed laboratory analyses. Contamination screening results are recorded in the field log book, and, if applicable, presented in the investigation report in summary tables, on boring logs, or in some other fashion.

10.1.4 Health and Safety Conditions

Breathing zone air and atmospheric conditions at the work site may be monitored for organic vapors, oxygen content, and explosive conditions to make health and safety decisions. These readings are recorded in the field log book.

10.2 Field Sampling QC Procedures

Field sampling QC procedures will include collecting trip blanks, field blanks, equipment blanks, field duplicates, and matrix spike/matrix spike duplicate (MS/MSD) samples. QC duplicate samples and blanks are used to provide a measure of the internal consistency of the samples and an estimate of variance and bias. The number and type of each field QC sample is discussed in the Master SAP.

Field sampling and laboratory analyses will be conducted in accordance with the *Navy Installation Restoration Laboratory Quality Assurance Guide*, Interim Guidance Document (NFESC, February 1996). This is site-dependent. Details will be provided in the site-specific SAPs.

10.2.1 Blanks

Blanks provide a measure of cross-contamination sources, decontamination efficiency, and other potential errors that can be introduced from sources other than the sample. ASTM Type II water will be used for blanks. Four types of blanks will be generated during sampling activities: trip blanks, field blanks, equipment blanks, and temperature blanks.

One trip blank will be included each day for each cooler containing samples for VOC analysis. The trip blanks will be prepared before each sampling event, shipped or transported to the field with the sampling bottles, and sent to the laboratory unopened for analysis. Trip blanks will not be prepared or handled in the field. Trip blanks will indicate whether contamination is introduced during shipment to the field, storage in the field, or shipment from the field to the analytical laboratory.

One field blank will be collected each week of sampling, or more frequently if windy and dusty conditions are present. The field blanks will indicate whether contamination has been introduced by handling the sample bottle in the field or in the laboratory. The pre-preserved sample container will be filled with ASTM Type II water in the field at the time of sampling.

One equipment blank will be collected each day during sampling. The equipment blanks will indicate the completeness of equipment decontamination procedures.

A temperature blank will be included in each cooler contain samples for CLP analyses so that the laboratory can record the temperature without disturbing the samples. The temperature blank will not be given a sample number nor listed as a sample on the COC.

10.2.2 Duplicates

Field duplicate samples will be collected at a frequency of one per 10 field samples per matrix. The locations from which the duplicates are taken will be selected with a bias for locations where contamination is expected. The duplicate sample will be submitted for analysis as two independent samples with different sample numbers. Data validators will use these results to evaluate the accuracy of the analytical data.

10.2.3 Matrix Spike/Matrix Spike Duplicates

MS/MSD samples will be collected at a frequency of one per 20 field samples. Analytical results from these samples indicate the effect that the matrix (e.g., water, soil, sediment, etc.) has on extracting the analyte for analysis. Data validators will use these results to evaluate the accuracy of the analytical data.

10.3 Laboratory Analytical QC Procedures

The analytical laboratory will use the following QC elements:

- Analytical methodology according to the specific methods described in the site-specific QAPPs
- Instrument calibrations and standards as defined by the specific methods described in the site-specific QAPPs
- Laboratory blank measurements to monitor potential contamination introduced during analysis at a minimum frequency of five percent or one-per batch
- MS/MSD measurements to assess accuracy and precision at a minimum frequency of five percent or one-per-set
- Data reduction and reporting according to the specific methods listed in the site-specific SAP and the specifications outlined in Section 9 of this Master QAPP
- Laboratory documentation according to the specifications outlined in Section 9 of this Master QAPP

Method blanks monitor potential contamination introduced during analysis. Calibration standards are used to calibrate the instrumentation, thereby controlling the accuracy of the results. Once an instrument has been calibrated, calibration is confirmed periodically by monitoring the instrument response to internal standards. For some analyses, such as those performed by gas chromatograph/mass spectrometer (GC/MS), a sample and a blank are spiked with a surrogate compound or a system-monitoring compound (SMC) chosen for properties similar to those of the analyte of interest. The surrogate spikes or SMCs evaluate the efficiency of the analytical procedure in recovering the true amount of a known compound. Laboratory duplicates are performed in certain instances (especially for inorganic analyses) to evaluate the reproducibility of the method.

MS/MSDs are spiked by the laboratory in two separate aliquots of a sample selected by the sampler from each batch of 20 field samples. The MS/MSDs will be used to assess accuracy and precision. The MSD is identical to the MS; both are analyzed to determine the reproducibility of the results. The sampler will collect a triple volume of one sample to give the laboratory enough material for analyzing the sample, the spiked sample, and the spiked sample duplicate.

11. Performance and Systems Audits

Performance and systems will be audited to verify documentation and implementation of the project-specific QAPP, to identify nonconformance, and to verify correction of identified deficiencies.

Assessment activities may include surveillance, inspections, peer review, management system review, readiness review, technical systems audit, performance evaluation, and data quality assessment. The Quality Assurance Control Manager (QACM) will be responsible for initiating audits, selecting the audit team, and overseeing audit implementation.

The QACM, or designee, in consultation with the PM, will evaluate the need for an independent audit. The client may also perform independent project audits. Performance audits are used to quantitatively assess the accuracy of analytical data through the use of performance evaluation and blind check samples. The QACM or a designee will audit laboratory performance.

11.1 Project Systems Audit

A systems surveillance of operations may be required by the project-specific WP and would be used to review the total data generation process. This will include onsite review of the field operational system, physical facilities for sampling, and equipment calibrations. Informal document control surveillance will consist of checking each document for completeness, including such items as signatures, dates, and project numbers.

An audit report summarizing the results and corrections will be prepared and entered in the project files.

11.2 Technical Performance Audits

The FTL or a designated representative will conduct an informal surveillance of the field activities. Surveillance for completeness will include the following items:

- Sample labels
- COC records
- Field logbooks
- Sampling operations

The first three items above will be checked for completeness. Sampling operations will be reviewed to determine if they are being performed as stated in the project-specific WP or as directed by the FTL. A performance surveillance may be conducted by the PM and the FTL during the first week of sampling if it is deemed necessary by the PM, FTL, or client. The surveillance may focus on verifying that proper procedures are followed so that subsequent sample data will be valid. Before the surveillance, a checklist will be prepared by the PM and the FTL to serve as a guide for the performance surveillance. The surveillance may verify the following:

- Collection of samples follows the available written procedures
- COC procedures are followed for traceability of sample origin
- Appropriate QC checks are being made in the field and documented in the field logbook
- Specified equipment is available, calibrated, and in proper working order
- Sampling crews are adequately trained
- Record-keeping procedures are being followed and appropriate documentation is maintained
- CA procedures are followed

An audit report summarizing the results and corrections will be prepared and entered in the project files.

11.3 Field Audits

Field audits are not currently anticipated for field activities at MCB Camp Lejeune, but will be performed if necessary. A field performance audit checklist is included in Attachment 2.

11.4 Laboratory Audits

The analytical laboratory will conduct both internal and external QC checks. External QC checks include participation in EPA's certification and performance evaluation programs. The results of quarterly performance evaluation samples will be made available to the PM upon request. Internal QC checks (duplicates, blanks, and spiked samples) will be performed in accordance with the approved methods.

Laboratory systems are audited annually and as required by specific projects. The laboratories are required to submit a LQAP and relevant SOPs before the field effort begins. During data evaluation and data use, if any problems are noted, specific CAs will be implemented on a case-by-case basis. An additional systems audit may be requested if warranted.

The laboratory will be required to perform the following:

- Monthly project review of 10 percent of all projects done by the QA department
- Audits by the laboratory QA manager at a frequency greater than specified in the LQAP
- Special audits by the QACM or corporate management when a problem is suspected
- Yearly audits by the corporate QACM

12. Preventive Maintenance

12.1 Field Equipment

The field personnel operating the field equipment and appropriate offsite laboratory chemists are responsible for the maintenance of their respective instruments. Preventive maintenance will be provided on a scheduled basis to minimize down time and the potential interruption of analytical work. All instruments will be maintained in accordance with the manufacturer's recommendations and normal approved laboratory practice.

Scheduled periodic calibration of testing equipment does not relieve field personnel of the responsibility of using properly functioning equipment. If a project team member suspects an equipment malfunction, the device will be removed from service, tagged so that it is not inadvertently used, and the appropriate personnel notified so that a recalibration can be performed or a substitute piece of equipment can be obtained.

12.2 Laboratory Equipment

Designated laboratory personnel will be trained in routine maintenance procedures for all major instrumentation. When repairs become necessary, they will be made by either trained staff or trained service engineers/technicians employed by the instrument manufacturer. The laboratory will have multiple instruments that will serve as backup to minimize the potential for downtime.

Preventive maintenance will be performed according to the procedures delineated in the manufacturer's instrument manuals, including lubrication, source cleaning, detector cleaning, and the frequency of such maintenance. Procedures should be listed in greater detail in the LQAP.

Chromatographic carrier gas purification traps, injector liners, and injector septa will be cleaned or replaced on a regular basis. Precision and accuracy data will be examined for trends and excursions beyond control limits to identify evidence of instrument malfunction. Maintenance will be performed when an instrument begins to degrade, as evidenced by the degradation of peak resolution, shift in calibration curves, decrease in sensitivity, or failure to meet one or more of the QC criteria.

Instrument downtime will be minimized by keeping adequate supplies of all expendable items (i.e., an expected lifetime of less than one year). Selected items include gas tanks, gasoline filters, syringes, septa, GC columns and packing, ferrules, printer paper and ribbons, pump oil, jet separators, open-split interfaces, and MS filaments.

12.3 Instrument Maintenance Logbooks

All maintenance will be documented in permanent logs that will be available for review by auditing personnel. Both scheduled and unscheduled maintenance required by operational

failures will be recorded. The designated laboratory operations coordinator will review maintenance records regularly to ensure that required maintenance is occurring.

Instrument maintenance logbooks are maintained in laboratories at all times. The logbooks, in general, contain a schedule of maintenance, as well as a complete history of past routine and non-routine maintenance. Prior to the start of analyses, the project chemist will audit the laboratories.

13. Data Measurement Assessment Procedures

The final activity of the data quality evaluation is an assessment of whether the data meet the DQOs. The goal of this assessment is to demonstrate that a sufficient number of representative samples were collected and that the resulting analytical data can be used to support the project decision making process.

Data assessment will follow the data review and validation described in Section 9 of this Master QAPP. An assessment report will be prepared at the end of the project. The report will summarize the findings of the data review/validation as relevant to project usage. Data accuracy, precision, and completeness values will be summarized in the assessment report. The following sections describe the quantitative definition of accuracy, precision, and completeness.

13.1 Precision

Precision is a measure of the agreement or repeatability of a set of replicate results obtained from duplicate analyses made under identical conditions. Precision is estimated from analytical data and cannot be measured directly. The precision of a duplicate determination can be expressed as the relative percent difference (RPD) and is calculated as follows:

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

X_1 = native sample
X_2 = duplicate sample

13.2 Accuracy

Accuracy is a measure of the agreement between an experimental determination and the true value of the parameter being measured. Accuracy is estimated through the use of known reference materials or matrix spikes. It is calculated from analytical data and is not measured directly. Spiking of reference materials into a sample matrix is the preferred technique because it provides a measure of the matrix effects on analytical accuracy. Accuracy, defined as percent recovery (P), is calculated as follows:

$$P = \left[\frac{(SSR - SR)}{SA} \right] \text{x } 100$$

SSR = spiked sample result
SR = sample result (native)
SA = the spike concentration added to the spiked sample

13.3 Completeness

Completeness is defined as the percentage of measurements judged to be valid compared to the total number of measurements made for a specific sample matrix and analysis. Completeness is calculated using the following formula:

$$\text{Completeness} = \frac{\text{Valid Measurements}}{\text{Total Measurements}} \times 100$$

Experience on similar projects has shown that laboratories typically achieve about 90 percent completeness. All validated data will be used. During the data validation process, an assessment will be made of whether the valid data are sufficient to meet project objectives. If sufficient valid data are not obtained, CA will be initiated by the PM.

14. Corrective Actions

14.1 Field Activities

The PM is responsible for initiating CAs. The steps involved in implementing CAs include problem identification, investigation responsibility assignment, investigation, action to eliminate the problem, increased monitoring of the effectiveness of the CA, and verification that the problem has been eliminated.

Documentation of the problem is important to the overall management of the study. A CA request form for problems associated with sample collection is completed by the person discovering the QA problem (**Attachment 3**). This form identifies the problem, establishes possible causes, and designates the person responsible for action. The responsible person will be either the PM or the FTL.

The CA request form includes a description of the CA planned and has space for follow-up. The PM verifies that the initial action has been taken and appears to be effective, and at an appropriate later date, checks to see if the problem has been resolved fully. The PM receives a copy of all CA request forms and enters them into the CA log. This permanent record aids the PM in follow-up and assists in resolving the QA problems.

Examples of CA include, but are not limited to, correcting COC forms, analysis re-runs (if holding time criteria permit), re-calibration with fresh standards, replacement of sources of blank contamination, or additional training in sampling and analysis. Additional approaches may include the following:

- Re-sampling and re-analyzing
- Evaluating and amending sampling and analytical procedures
- Accepting the data and acknowledging the level of uncertainty or inaccuracy by flagging the validated data and providing an explanation for the qualification

14.2 Laboratory Activities

The laboratory department supervisors review the data generated to verify that all QC samples have been run as specified in the protocol. Laboratory personnel will be alerted that CAs may be necessary if the following should occur:

- QC data are outside the warning or acceptable windows for precision and accuracy established for laboratory samples
- Blanks contain contaminants at concentrations above the levels specified in the LQAP for any target compound
- Undesirable trends are detected in matrix spike recoveries or RPD between matrix spike duplicates
- There are unusual changes in detection limits

- Deficiencies are detected by the laboratory QA Director during internal or external audits, or from the results of performance evaluation samples

If nonconformances including, but not limited to, analytical methodologies or QC sample results are identified by the bench analyst, CAs will be implemented immediately. CA procedures will be handled initially at the bench level by the analyst, who will review the preparation or extraction procedure for possible errors and check the instrument calibration, spike and calibration mixes, instrument sensitivity, etc. The analyst will immediately notify his/her supervisor of the problem and the investigation being made. If the problem persists or cannot be identified, the matter will be referred to the laboratory supervisor and QA/QC Officer for further investigation. Once resolved, full documentation of the CA procedure will be filed with the laboratory supervisor, and the QA/QC Officer will be provided a CA memorandum for inclusion in the project file if data are affected. CAs may include, but are not limited to, the following:

- Re-analyzing suspect samples
- Re-sampling and analyzing new samples
- Evaluating and amending sampling and/or analytical procedures
- Accepting data with an acknowledged level of uncertainty
- Recalibrating analytical instruments
- Qualifying or rejecting the data

Following the implementation of the required CA measures, data that are deemed unacceptable may not be accepted by the PM, and follow-up CAs may be explored. Details of laboratory CAs are provided in the LQAP. CA requests will be documented with the form in **Attachment 3**.

15. Quality Assurance Reports

A QA report will be completed at the end of the field activity to summarize the QA/QC status of the project and problems, if any. The purpose of QA reports is to document implementation of the QAPP. These reports include periodic assessments of measurement data accuracy, precision, and completeness of the results of performance audits, the results of system audits, and the identification of significant QA problems and recommended solutions.

The analytical laboratory will be responsible for submitting monthly progress reports to the PM. The PM is responsible for submitting these reports to the client, as required.

The final QA report will be attached as an appendix to the project report and may include the following:

- Data quality assessment in terms of PARCC, and the MDLs
- The degree to which DQOs were met
- Limitations of the measurement data and usability of the data
- Applicability of the data to site conditions
- Laboratory QC activities, including a summary of planned versus actual laboratory QC activities, explanations for deviations, and an evaluation of data quality for each analysis for each medium
- Field QC activities, including a summary of planned versus actual field QC activities, explanations for deviations, and evaluations of the data quality of field QC samples/activities and estimated effect on sample data
- Data presentation and evaluation, including an assessment of sampling and analysis techniques, data quality for each analysis and each medium, and data usability

A final report will be submitted to the client after comments from the client and regulatory agencies have been incorporated.

16. References

CH2M HILL, 2004. NAVY CLEAN SOPS\MASTER.

Environmental Management Division, MCB Camp Lejeune, 2003. *Contractor Electronic Data Deliverable Standards and Procedures.*

NFESC, 1996. *Navy Installation Restoration Laboratory Quality Assurance Guide*, Interim Guidance Document. February 1996.

U.S. Environmental Protection Agency, 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*. Region 4, November 2001.

U.S. Environmental Protection Agency, 1994. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*.

U.S. Environmental Protection Agency, 1994. *Contract Laboratory Program National Functional Guidelines for Organic Data Review*.

U.S. Environmental Protection Agency, 1998. *EPA Guidance for Quality Assurance Project Plans*, EPA QA/G-5, February 1998.

U.S. Environmental Protection Agency, 1998. *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*, EPA QA/R-5.

U.S. Environmental Protection Agency, 1994. *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, September 1994.

Attachment 1
Field Change Documentation

Field Change Documentation

Date: _____
Page _____ **of** _____

Project:

Project No.:

Applicable Document:

Change Description:

Reason for change:

Recommended disposition:

Impact on present and completed work:

Final disposition (MCB Camp Lejeune only)

Request by:
CH2M HILL Project Manager: _____ Date:_____
Approvals:

MCB Camp Lejeune Project Manager: _____ Date:_____

Attachment 2
Field Performance Audit Checklist

FIELD PERFORMANCE AUDIT CHECKLIST

Project Responsibilities

Project No.: _____ Date: _____

Project Location: _____ Signature: _____

Team Members: _____ Project Manager: _____

Yes __ No __ 1) Were any Project-Specific Checklists Prepared?
Comments _____
_____
_____

Yes __ No __ 2) Was a briefing held for project participants?
Comments _____
_____
_____

Yes __ No __ 3) Were additional instructions given to project participants?
Comments _____
_____
_____

Yes __ No __ 4) Is the approved Master Project Plan (MPP) and approved Project Specific-Checklist being used?
Comments _____
_____
_____

Sample Collection

Yes __ No __ 1) Is there a written list of sampling IDs, locations and descriptions?
Comments _____
_____

Yes __ No __ 2) Are samples collected as stated in the MPP?
Comments _____
_____
_____

Yes __ No __ 3) Are samples collected in the type of containers specified in the MPP?
Comments _____
_____
_____

Yes __ No __ 4) Are samples preserved as specified in the MPP?
Comments _____
_____

Yes __ No __ 5) Are the number, frequency, and type of samples collected as specified in the MPP?
Comments _____
_____
_____

Yes __ No __ 6) Are samples properly identified with sample tags or labels?
Comments _____
_____

Yes __ No __ 7) Are quality assurance checks (e.g. sample blanks and calibration) performed as specified in the MPP?
Comments _____
_____
_____

Yes __ No __ 8) Are all site activities documented as specified in the MPP?
Comments _____
_____
_____

Yes __ No __ 9) Have samples been properly packed for delivery and properly shipped by the designated shipping company?
Comments _____
_____
_____

Document Control

Yes __ No __ 1) Have any accountable documents been lost?
Comments _____
_____
_____

Yes __ No __ 2) Have any accountable documents been voided?
Comments _____
_____
_____

Yes __ No __ 3) Have any accountable documents been disposed of?
Comments _____
_____
_____

Yes __ No __ 4) Are the samples properly identified with sample tags or labels?
Comments _____
_____
_____

Yes __ No __ 5) Are blank and duplicate samples properly identified?
Comments _____
_____
_____

Yes __ No __ 6) Are samples listed on a chain-of-custody record?
Comments _____
_____
_____

Yes __ No __ 7) Is chain-of-custody documented and maintained?
Comments _____
_____
_____

Yes __ No __ 8) Are copies of the shipping bill and tracking number documented and maintained?
Comments _____
_____
_____

Attachment 3
Corrective Action Request Form

CORRECTIVE ACTION REQUEST FORM

Person initiating corrective action _____ Date _____

Description of problem and when identified: _____

_____

_____

Cause of problem, if known or suspected: _____

_____

_____

_____

Sequence of Corrective Action (CA): (including action planned, date implemented and personnel/data affected) _____

_____

_____

_____

_____

_____

_____

_____

CA implemented by: _____ Date: _____

CA initially approved by: _____ Date: _____

Follow-up date: _____

Final CA approved by: _____ Date: _____

Information copies to:

_____

_____

_____

_____

FINAL

Master Health and Safety Plan

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Prepared for

Department of the Navy

Naval Facilities Engineering Command
Atlantic Division
Norfolk, Virginia

Contract No.
N62470-02-D-3052
CTO-060
Clean III Program

June 2008

Prepared by

CH2MHILL

Introduction

The health and safety of site personnel and the public are a primary concern during investigative and remedial activities at potentially hazardous sites. This Master Health and Safety Plan (HASP) presents the conditions and hazards known or anticipated to be present at Remedial Investigation/Feasibility Study (RI/FS) and other environmental investigation sites at Marine Corps Base (MCB), Camp Lejeune, North Carolina. This Master HASP will be used by CH2M HILL and its subcontractors to identify and mitigate potential site and task-specific hazards and to select appropriate health and safety protective measures to be used during future tasks and operations on Base.

This Master HASP has been developed based on available information pertaining to MCB Camp Lejeune and contains information pertinent to the general conditions on the Base such as general site information, hazard evaluation and control, personnel responsibilities and requirements, a general description of personal protective equipment, customary decontamination procedures, and emergency response procedures. A site-specific HASP addendum will be written each time task orders and field activities are initiated at an area of investigation. The site-specific HASP addendum will address specific sites and incorporate new information in the areas of site tasks, environmental hazards, site control procedures, personal protective equipment (PPE), and environmental monitoring. A template of the site specific HASP is included as **Attachment 1**. As field programs proceed, this Master HASP will be periodically evaluated (every one year at a minimum) against current information and Base concerns. As significant changes are presented, this Master HASP will be updated.

Policy

It is the policy of CH2M HILL that on-site hazardous waste management activities be performed in conformance with both the Master HASP and a site-specific HASP. Both documents are written based on the anticipated hazards and expected work conditions and apply to field activities to be performed under this Contract. Applicability of this Master HASP and the site-specific HASP extends to all CH2M HILL employees, CH2M HILL's subcontractors, and visitors entering the specific site. CH2M HILL subcontractors must follow an established health and safety plan; in most cases either adopting this master plan with appropriate site-specific HASP (e.g. surveyor), or adopting same and amending both with safety and/or health requirements specific to their work (e.g. driller). Subcontractor-authored HASPs must be reviewed by the Project Health and Safety Officer (PHSO) before commencing on-site work. This information will then become part of the site-specific HASP. On-site personnel must review the Master HASP and the site-specific HASP and sign an agreement to comply with its provisions prior to commencing on-site work. The Master HASP and site-specific HASP are considered operational documents which are subject to revisions in response to various site-specific conditions which may be encountered. However, they may be modified/updated only with the approval of the PHSO and Project Manager. Proper notification will be given to the Mid-Atlantic Division, Naval Facilities Engineering Command (NAVFAC) Navy Technical Representative (NTR) when significant changes to the HASPs are implemented.

This Master HASP, in combination with each site-specific HASP will, at a minimum, meet the requirements under OSHA Standard 29 Code of Federal Regulations (CFR) 1910.120 (Hazardous Waste Operations and Emergency Response).

Pre-Entry Requirements

During site mobilization, the Site Health and Safety Officer (SHSO) will perform a reconnaissance of each site as identified in the site-specific Work Plan (WP) to evaluate and determine the chemical, physical, and environmental hazards; establish or confirm emergency points of contact and procedures; and review any other issues deemed necessary to address site safety and health. The SHSO will then conduct a health and safety briefing with the site personnel to discuss data obtained from the previous site reconnaissance, provisions outlined in this Master HASP and site-specific HASP, and appropriate safety and health related procedures and protocol.

CH2M HILL MASTER HEALTH AND SAFETY PLAN

(Reference CH2M HILL SOP HS-19, *Written Plans*)

This health and safety plan will be kept on the site during field activities and will be reviewed and updated as necessary. The plan adopts, by reference, the standards of practice (SOP) in the CH2M HILL *Corporate Health and Safety Program* as appropriate. The site safety coordinator (SC-HW) is to be familiar with these SOPs and the content of this plan. Site personnel must sign **Attachment 2**. In addition, this plan adopts procedures in the work plan for the project.

1. GENERAL PROJECT INFORMATION AND DESCRIPTION

REFER TO THE SITE-SPECIFIC HASP FOR ADDITIONAL INFORMATION

CLIENT OR OWNER: Department of the Navy
Mid-Atlantic Division
Naval Facilities Engineering Command

PROJECT NO: Multiple project numbers

BASE NAME: Marine Corps Base (MCB), Camp Lejeune

BASE LOCATION: Jacksonville, North Carolina

DATE HEALTH AND SAFETY PLAN PREPARED: June 2004

DATE(S) OF SITE WORK: 2004 - 2009

BASE ACCESS: Access to all sites is restricted. 'Main-Side" sites, e.g. Hadnot Point Industrial Area Sites 78, 88, and 94, etc. may be accessed through the Main Gate or the Piney Green Road Gate (contractors entrance) on the east side of the New River, while sites located within the Marine Corps Air Station (MCAS) New River, e.g. Sites 35, 86, 89, and 93 should be accessed via the MCAS New River Gate located west of the New River.

BASE SIZE: MCB, Camp Lejeune is approximately 236 square miles.

BASE TOPOGRAPHY: MCB, Camp Lejeune is located within the generally flat, Atlantic Coastal Plain. The topography across the Base and in the general vicinity of the Site displays very low relief. Across the Base, surface elevations range from sea level to approximately 70 feet above mean sea level (msl). Most of the Base has an elevation range of 20 to 40 feet above msl. MCB, Camp Lejeune is bisected by the New River and its tributaries. Drainage at MCB, Camp Lejeune is generally toward the New River, except in areas near the coast, which drain through the Intercoastal Waterway. In developed areas, natural drainage has been altered by asphalt cover, storm sewers, and drainage ditches. Approximately 70 percent of MCB, Camp Lejeune is in broad, flat interstream areas, where drainage is poor.

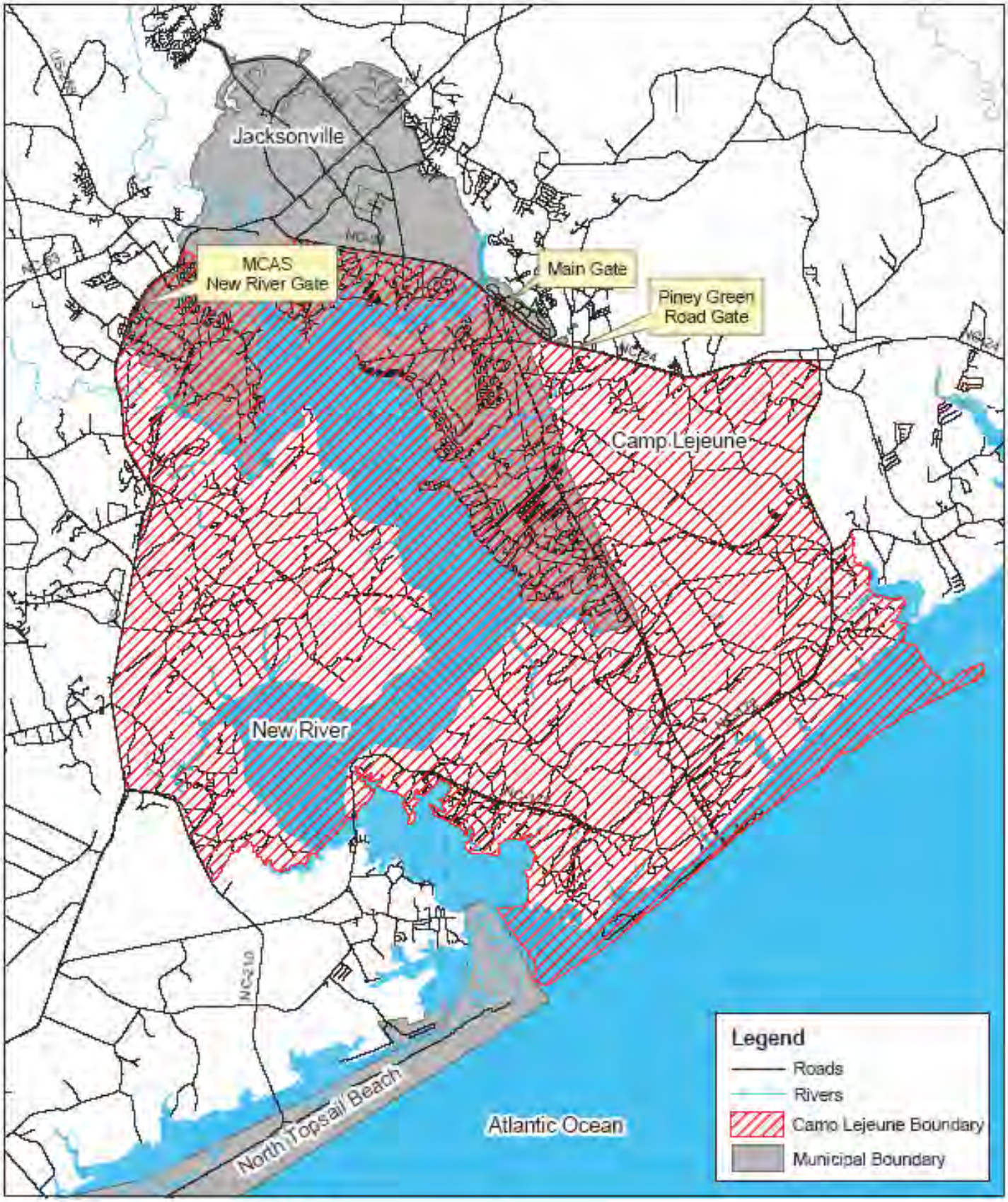
The location of the Base is shown in **Figure 1-1**. Specific sites under investigation will be located within Camp Lejeune.

PREVAILING WEATHER: The climate at MCB, Camp Lejeune is characterized by mild winters and hot humid summers. Winters are usually short and mild with occasional and short duration cold periods. Summers are long, hot and humid. Average annual net precipitation is approximately 50 inches. Ambient air temperatures generally range from 33 to 53 degrees Fahrenheit (°F) in the winter months, and 71°F to 88°F during the summer months. Winds are generally south-southwesterly in the summer, and north-northwesterly in the winter (Water and Air Research, 1983). The hurricane season in the immediate area surrounding Camp Lejeune begins on June 1 and continues through November 30. Storms of non-tropical origins such as frontal passages, local thunderstorms, and tornadoes are more frequent and can occur year-round.

BASE DESCRIPTION AND HISTORY: Construction of MCB, Camp Lejeune began in 1941 with the objective of developing the "World's Most Complete Amphibious Training Base". Construction of the Base started at Hadnot Point where the major functions of the Base are centered. During World War II, MCB, Camp Lejeune was used as a training area to prepare Marines for combat. MCB, Camp Lejeune was again used for training during the Korean and Vietnam conflicts, and the Gulf War. MCB, Camp Lejeune is host to five Marine Corps commands and one Navy command. In addition, MCB Camp Lejeune provides support and training for the following tenet commands: Headquarters Nucleus; Second Marine Expeditionary Force; Second Marine Division; Second Marine Force Service Support Group; Second Marine Surveillance, Reconnaissance, and Intelligence Group; Sixth Marine Expeditionary Brigade; the Naval Hospital; and the Naval Dental Clinic. All of the real estate and infrastructure are owned, operated, and maintained by the host command. The mission of Camp Lejeune is to maintain combat ready units for expeditionary deployment.

MCB, Camp Lejeune is bisected by the New River, which flows in a southeasterly direction and forms a large estuary before entering the Atlantic Ocean. The Atlantic Ocean forms the southeastern boundary of the facility. The western and northwester boundaries are U.S. Route 17 and State Route 24, respectively. The City of Jacksonville, North Carolina is located immediately northwest of MCB, Camp Lejeune.

A majority of the land surrounding the facility is used for agriculture. Estuaries along the coast support commercial fishing and residential resort areas are located adjacent to MCB, Camp Lejeune along the Atlantic Ocean.



2.5 0 2.5 Miles

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Figure 1-1
Location Map
Marine Corps Base, Camp Lejeune
North Carolina

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2. REGULATED AND UNREGULATED TASKS TO BE PERFORMED

2.1 DESCRIPTION OF TASKS (Reference CH2M HILL SOP HS-19, *Written Plans*)

Refer to site-specific addenda (i.e., work plan, field sampling plan) for detailed task information. A health and safety risk analysis has been performed for each task and is incorporated in the site-specific addendum to this HASP plan through task-specific hazard controls and requirements for monitoring and protection. Tasks in addition to those listed below and in the site-specific addendum require an approved amendment before additional work begins. Refer to Section 10.2 for procedures related to tasks that do not involve hazardous waste operations and emergency response (Hazwoper).

2.1.1 HAZWOPER-REGULATED TASKS

- Direct Push Technology (DPT) boring
- Geophysical surveys
- Subsurface soil sampling
- Surface soil sampling
- Sediment sampling
- Monitoring well/drive point installation
- Surveying
- MIP Profiling
- Monitoring well abandonment
- Groundwater sampling
- Aquifer testing
- Surface water sampling
- Investigation-derived waste (drum) sampling and disposal
- Observation of loading of material for offsite dispo
- Oversight of remediation and construction

2.1.2 NON-HAZWOPER-REGULATED TASKS

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the HSM is required before these tasks are conducted on regulated hazardous waste sites.**

3. HAZARD EVALUATION AND CONTROL

This section discusses the evaluation and control of some hazards typically associated with MCB, Camp Lejeune. Each new task or area of investigation may introduce other hazards not listed in this Master HASP.

REFER TO THE SITE-SPECIFIC HASP FOR INFORMATION ON OTHER SITE SPECIFIC POTENTIAL HAZARDS

3.1 HEAT AND COLD STRESS (Reference CH2M HILL SOP HS-09, *Heat and Cold Stress*)

3.1.1 PREVENTING HEAT STRESS

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

3.1.2 SYMPTOMS AND TREATMENT OF HEAT STRESS

	Heat Syncope	Heat Rash (*miliaria rubra*, "prickly heat")	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!

3.1.3 HEAT-STRESS MONITORING

For field activities part of ongoing site work activities in hot weather, the following procedures should be used to monitor the body's physiological response to heat and to estimate the work-cycle/rest-cycle when workers are performing moderate levels of work. These procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high (>50%), or when the workers exhibit symptoms of heat stress.

The heart rate (HR) should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/minute, or 20 beats/minute above resting pulse. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 110 beats/minute at the beginning of the next rest period, the following work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 110 beats/minute, or 20 beats/minute above resting pulse.

3.1.4 PREVENTING COLD STRESS

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

3.1.5 SYMPTOMS AND TREATMENT OF COLD STRESS

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

3.2 PROCEDURES FOR LOCATING BURIED UTILITIES

Utility Mark-Out Service for utilities not owned by MCB, Camp Lejeune
Name: NC Call One
Phone: 1-800-632-4949

Procure a licensed subcontractor to locate utilities owned by MCB, Camp Lejeune.

- Where available, obtain utility diagrams for the facility.
- Review locations of sanitary and storm sewers, electrical conduits, water supply lines, natural-gas lines, and fuel tanks and lines.
- Review proposed locations of intrusive work with facility personnel knowledgeable of locations of utilities. Check locations against information from utility mark-out service.
- Where necessary, clear locations with a utility-locating instrument (e.g., metal detector).
- Where necessary (e.g., uncertainty about utility locations), excavation or drilling of the upper depth interval should be performed manually.
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon).
- When the client or other onsite party is responsible for determining the presence and locations of buried utilities, the SC-HW should confirm that arrangement.

3.3 RISK ANALYSIS

Engineering and administrative controls are to be implemented by the party in control of the site or the hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees and subcontractors must, at a minimum, remain aware of hazards affecting them regardless of who is responsible for controlling the hazards. Specialty subcontractors are responsible for the safe operation of their equipment (e.g., drill rig, heavy equipment). CH2M HILL employees are not to operate, or assist in the operation of, any subcontractor or contractor equipment.

		Tasks									
Hazard (Refer to SOP, or HSP Section)	**Engineering Controls, Administrative Controls, and Work Practices**	**Test Pit and Excavation**	**Drilling, Geoprobe Installation, Well Installation and Abandonment**	**Groundwater Monitoring , Aquifer Testing, and Video Surveying of Wells**	**Surface Water and Sediment Sampling Using a Boat**	**Surface Water and Sediment Sampling from the Shore or Water**	**Hand Auguring**	**Surveying**	**IDW Drum Sampling and Disposal[a]**	**Observation of Loading of Material for Offsite Disposal**	**Remediation and Construction Oversight**
Flying debris/objects (HS-07)	Provide shielding and PPE; maintain distance.	X	X		X	X	X		X	X	X
Noise > 85 dBA	Noise protection and monitoring required.	X	X		X					X	X
Gas cylinders (HS-21)	Instruct employees in the safe use of compressed gases. Make certain gas cylinders are properly anchored and chained. Keep cylinders away from ignition sources. Cap cylinders when not in use.	X	X								
Electrical	Make certain third wire is properly grounded. Do not tamper with electrical wiring unless qualified to do so. Ground as appropriate. Project field sites should have ground fault circuit interrupters (GFCIs) installed for all wiring, including extension cords. Heavy equipment (e.g., drill rig) should remain at least 15 feet from overhead power line for power lines of 50 kV or less. For each 10 kV > 50, increase distance by ½ foot. Operate and maintain equipment according to manufacturer's instructions. Use only extension cords that are three-wire grounded. Cords passing through work areas must be covered or elevated to protect from damage. Use only electrical tools and equipment that are either effectively grounded or double-insulated UL approved. Properly label switches, fuses, and circuit breakers. Remove cord from an outlet by grasping the plug, not pulling the cord. Protect all electrical equipment, tools, switches, etc., from elements. Avoid physical contact with power circuit. Only qualified electricians are to install and work on electrical circuits and equipment.	X	X	X	X						X
Suspended loads	Work not permitted under suspended loads.	X	X		X					X	X
Buried utilities, drums, tanks, etc. (Section 3.3)	Locate buried utilities, drums, tanks, etc., before digging or drilling and mark location.	X	X				X				X
Slip, trip, fall hazards (e.g., wet/muddy surface, inadequate railing, unstable surface)	Provide slip-resistant surfaces, ropes, and/or other devices to be used. Brace and shore equipment	X	X	X	X	X	X	X	X	X	X
Back injury (HS-29)	Use proper lifting techniques, or provide mechanical lifting aids.	X	X	X	X	X	X		X		X
Confined space entry (Section 9.0)	Space must be evaluated by qualified person. Additional controls and monitoring, training, and an approved entry permit are generally required.	NOT				APPROVED					
Trenches/excavations (HS-32)	Make certain trench meets OSHA standard before entering. All excavations > 4 feet deep must be sloped or shored. and have a ladder every 25 feet. Personnel and equipment must remain at least 2 feet from edge of trench at all times.	X									X
Protruding objects	Flag visible objects.	X	X	X	X	X	X	X	X	X	X
Visible lightning	Stop work.	X	X	X	X	X	X	X	X	X	X
Vehicle traffic (HS-24)	Provide temporary traffic controls, including trained flaggers and lookouts. Implement traffic control program when required.									X	X
Stairways, ladders, and scaffolds (HS-25)	Stairways and ladders are generally required when there is a break in elevation of 19 inches or more. Keep access ways clear. Equipment must meet OSHA specifications. Document employee training.		X								X
Elevated work area/falls (HS-31)	Provide guardrail, safety net, floor covers, body harness, and monitoring system, where applicable. Document employee training.	X				X					X

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		Tasks									
Hazard (Refer to SOP, or HSP Section)	**Engineering Controls, Administrative Controls, and Work Practices**	**Test Pit and Excavation**	**Drilling, Geoprobe Installation, Well Installation and Abandonment**	**Groundwater Monitoring , Aquifer Testing, and Video Surveying of Wells**	**Surface Water and Sediment Sampling Using a Boat**	**Surface Water and Sediment Sampling from the Shore or Water**	**Hand Auguring**	**Surveying**	**IDW Drum Sampling and Disposal[a]**	**Observation of Loading of Material for Offsite Disposal**	**Remediation and Construction Oversight**
Fire prevention and control (HS-22)	No spark sources are allowed within exclusion or decontamination zones. Appropriate firefighting equipment must be available on the site. Extinguishers are to be inspected visually every month and undergo an annual maintenance check. Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations. Keep areas near exits and extinguishers clear. Open flames are prohibited in the vicinity of flammable materials. Combustible materials stored outside should be at least 10 feet from the building. Unnecessary combustible materials and flammable or combustible liquids must not be allowed to accumulate. Flammable or combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.	X	X			X			X		X
Inadequate illumination	Site work will be performed during daylight hours whenever possible. Work conducted during hours of darkness will require enough illumination intensity "to read a newspaper without difficulty."	X	X	X	X	X	X	X	X	X	X
Entanglement in rotating equipment	• Prohibit loose clothing and hair • Prohibit wearing jewelry		X				X				
Drilling (HS-35)	• The drill rig is not to be operated in inclement weather. • The driller is to verify that the rig is properly leveled and stabilized before raising the mast. • Personnel should be cleared from the sides and rear of the rig before the mast is raised. • The driller is not to drive the rig with the mast in the raised position. • The driller must check for overhead power lines before raising the mast. A minimum distance of 15 feet between mast and overhead lines (<50 kV) is recommended. Increased separation may be required for lines greater than 50 kV. • Personnel should stand clear before rig startup. • The driller is to verify that the rig is in neutral when the operator is not at the controls. • Become familiar with the hazards associated with the drilling method used (cable tool, air rotary, hollow-stem auger, etc.). • Do not wear loose-fitting clothing, watches, etc., that could get caught in moving parts. • Do not smoke or permit other spark-producing equipment around the drill rig. • The drill rig must be equipped with a kill wire or switch, and personnel are to be informed of its location. • Be aware and stand clear of heavy objects that are hoisted overhead. • The driller is to verify that the rig is properly maintained in accordance with the drilling company's maintenance program. • The driller is to verify that all machine guards are in place while the rig is in operation. • The driller is responsible for housekeeping (maintaining a clean work area). • The drill rig should be equipped with at least one fire extinguisher. • If the drill rig comes into contact with electrical wires and becomes electrically energized, do not touch any part of the rig or any person in contact with the rig, and stay as far away as possible. Notify emergency personnel immediately.		X								

3.3 RISK ANALYSIS

Engineering and administrative controls are to be implemented by the party in control of the site or the hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees and subcontractors must, at a minimum, remain aware of hazards affecting them regardless of who is responsible for controlling the hazards. Specialty subcontractors are responsible for the safe operation of their equipment (e.g., drill rig, heavy equipment). CH2M HILL employees are not to operate, or assist in the operation of, any subcontractor or contractor equipment.

		Tasks									
Hazard (Refer to SOP, or HSP Section)	**Engineering Controls, Administrative Controls, and Work Practices**	**Test Pit and Excavation**	**Drilling, Geoprobe Installation, Well Installation and Abandonment**	**Groundwater Monitoring , Aquifer Testing, and Video Surveying of Wells**	**Surface Water and Sediment Sampling Using a Boat**	**Surface Water and Sediment Sampling from the Shore or Water**	**Hand Auguring**	**Surveying**	**IDW Drum Sampling and Disposal[a]**	**Observation of Loading of Material for Offsite Disposal**	**Remediation and Construction Oversight**
Heavy equipment	• Become familiar with hazards specific to the equipment being used. • Always confirm that the operator is aware of your location, particularly when you approach or pass by equipment. • Backup alarm is required for heavy equipment. Do not count on backup alarms always functioning. Look around when alarm sounds. • Do not ride equipment not designed for passengers. • Do not climb on operating equipment. • Do not place yourself between fixed and moving parts or objects. • Do not stand adjacent to the equipment. • Stay clear of equipment on cross slopes and unstable terrain. • Stay clear of pile-driving operations. • Stay outside the turning radius of the equipment. • Operators using all-terrain vehicles (ATV) must be trained; other ATV requirements may apply. • Observer must remain in contact with operator and signal safe backup. • Personnel must remain outside the turning radius.	X	X		X					X	X
Working near water	• U.S. Coast Guard-approved personal flotation devices (PFDs–e.g., life jacket) provided for each employee will be worn. • PFDs will be inspected before and after each use. Defective equipment will not be used. • Sampling and other equipment will be used according to the manufacturer's instructions. • A minimum of one life-saving skiff will be provided for emergency rescue. • A minimum of one ring buoy with 90 feet of 3/8-inch solid-braid polypropylene (or equal) rope will be provided for emergency rescue. • Keep nonessential personnel 3 feet from edge of water					X					
Working on water	• Safe means of boarding or leaving a boat or a platform will be provided to prevent slipping and falling. Boat/barge must be equipped with adequate railing. instructions/warnings (e.g., protect from pinch points, sharp objects, rope burns/entanglement). • Work requiring the use of a boat will take place only during daylight hours. • Work requiring the use of a boat will not take place during inclement weather. • The boat/barge must be operated according to U.S. Coast Guard regulations (speed, lightning, right-of-way, etc.). Shut off engine before refueling; do not smoke while refueling.				X						
IDW Drum sampling	Personnel are allowed to handle and/or sample drums containing investigation-derived waste (IDW) only; handling or sampling other drums requires a plan revision or amendment approved by the CH2M HILL HSM. The following control measures will be taken when sampling drums containing IDW: • Minimize transportation of drums. • Minimize number of people involved in the actual sampling. • Sample only labeled drums or drums known to contain IDW. • Use caution when sampling bulging or swollen drums. Relieve pressure slowly. • If drums contain, or potentially contain, flammable materials, use nonsparking tools to open. • Picks, chisels, and firearms may not be used to open drums. • Reseal bung holes or plugs whenever possible. • Avoid mixing incompatible drum contents. • Sample drums without leaning over the drum opening.								X		

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3.3 RISK ANALYSIS

Engineering and administrative controls are to be implemented by the party in control of the site or the hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees and subcontractors must, at a minimum, remain aware of hazards affecting them regardless of who is responsible for controlling the hazards. Specialty subcontractors are responsible for the safe operation of their equipment (e.g., drill rig, heavy equipment). CH2M HILL employees are not to operate, or assist in the operation of, any subcontractor or contractor equipment.

		Tasks									
Hazard (Refer to SOP, or HSP Section)	**Engineering Controls, Administrative Controls, and Work Practices**	**Test Pit and Excavation**	**Drilling, Geoprobe Installation, Well Installation and Abandonment**	**Groundwater Monitoring , Aquifer Testing, and Video Surveying of Wells**	**Surface Water and Sediment Sampling Using a Boat**	**Surface Water and Sediment Sampling from the Shore or Water**	**Hand Auguring**	**Surveying**	**IDW Drum Sampling and Disposal[a]**	**Observation of Loading of Material for Offsite Disposal**	**Remediation and Construction Oversight**
	• If there is evidence of contamination on the lid of the drum, cover the lid with plastic sheeting. • Transfer the content of drums using a method that minimizes contact with material. • Air monitoring and PPE requirements specified in sections 5 and 6 must address drum sampling. • Spill-containment procedures specified in Section 8 must be appropriate for the material to be handled.										

3.4 BIOLOGICAL HAZARDS AND CONTROLS

Hazard and Location	Control Measures
Snakes typically are found in underbrush and tall grassy areas.	If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Carry the victim or have him/her walk slowly if the victim must be moved. Try to identify the type of snake: note color, size, patterns, and markings.
Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas.	Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.
Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with medical or other potentially infectious material, or when coming into contact with landfill waste or waste streams containing such infectious material.	Training is required before a task involving potential exposure is performed. Exposure controls and personal protective equipment (PPE) are required as specified in CH2M HILL SOP HS-36, *Bloodborne Pathogens*. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.
Bees and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic.	Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SC-HW and/or the buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

3.5 TICK BITES (Reference CH2M HILL HS-03, *Tick Bites*)

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

Prevention against tick bites includes avoiding tick areas; wearing tightly woven light-colored clothing with long sleeves and wearing pant legs tucked into boots or socks; spraying only outside of clothing with insect repellent containing permethrin or permanone, and spraying skin with DEET; and checking yourself frequently for ticks and showering as soon as possible. To prevent chemical repellents from interfering with sample analyses, exercise care while using repellents during the collection and handling of environmental samples.

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

Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, bone pain may develop. If symptoms appear, seek medical attention.

3.6 RADIOLOGICAL HAZARDS AND CONTROLS

Refer to CH2M HILL's SOP HS-10, *Radiation Monitoring,* for standards of practice for operating in contaminated areas.

Hazards	Controls
None Anticipated	None Required

3.7 HAZARDS POSED BY CHEMICALS BROUGHT ON THE SITE

This section discusses hazards posed by chemicals commonly used during RI/FS and other environmental investigation activities. Additional chemicals may be needed for future and/or site-specific tasks.

3.7.1 HAZARD COMMUNICATION

(Reference CH2M HILL SOP HS-05, *Hazard Communication*)

The project manager is to request Material Safety Data Sheets (MSDSs) from the client or from the contractors and the subcontractors for chemicals to which CH2M HILL employees potentially are exposed. The SC-HW is to do the following:

- Give employees required site-specific HAZCOM training.
- Confirm that the inventory of chemicals brought on the site by subcontractors is available.
- Before or as the chemicals arrive on the site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, if any.

The chemical products listed below will be used on the site. Refer to Master HASP, **Attachment 3** for MSDSs.

Chemical	Quantity	Location
Methane (calibration gas)	1 liter, compressed gas	Support Zone
Isobutylene (calibration gas)	1 liter, compressed gas	Support Zone
Pentane (calibration gas)	1 liter, compressed gas	Support Zone
Hydrochloric Acid (sample preservative)	< 500 ml	Support/Exclusion Zone
Nitric Acid (sample preservative)	< 500 ml	Support/Exclusion Zone
Sulfuric Acid (sample preservative)	< 500 ml	Support/Exclusion Zone
Sodium Hydroxide (sample preservative)	< 500 ml	Support/Exclusion Zone
Methanol (decontamination solvent)	< 1 gallon	Support/Decontamination Zone
Hexane (decontamination solvent)	< 1 gallon	Support/Decontamination Zone
Isopropanol (decontamination solvent)	< 1 gallon	Support/Decontamination Zone
pH Buffers (calibration standard)	< 500 ml	Support Zone
Alconox/Liquinox (detergent)	< 1 liter, powder/liquid	Support/Decontamination Zone

3.7.2 SHIPPING AND TRANSPORTATION OF CHEMICAL PRODUCTS

(Reference CH2M HILL's *Procedures for Transporting Dangerous Goods,* **Attachment 5**)

Nearly all chemicals brought to the site are considered hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive the CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

3.8 CONTAMINANTS OF CONCERN

(REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Acetone	Site 78 – GW 35 □g/L Site 86 – GW 5 □g/L **(J, B)** Site 94 – GW 740 □g/L SWMU 311 – SB 41 □g/kg SWMU 360 – SB 26 □g/kg	750 ppm	2,500 ppm	Irritant eyes, nose, throat; headache, dizziness, CNS depression; dermatitis	9.69
Alpha-chlordane	SWMU 43 – GW 0.09 □g/L **(J)** SB 4,900 □g/kg SWMU 361 – GW 5.8 □g/L SB 140 □g/kg	0.5 mg/m^3 "Skin"	100 mg/m^3 Ca	Blurred vision, confusion, ataxia, delirium, coughing, abdominal pain, nausea, vomiting, diarrhea, irritability, tremors, anuria	UK
Arsenic	SWMU 43 – SB 106 mg/kg SWMU 46 – SB 6.1 mg/kg SWMU 53/296 – SB 6.4 mg/kg SWMU 89 – SB 1.4 mg/kg SWMU 253 – SB 3.2 mg/kg SWMU 254 – SB 1.1 mg/kg SWMU 255 – SB 1.2 mg/kg SWMU 261/297 – SB 1.5 mg/kg SWMU 262 – SB 2.7 mg/kg SWMU 264 – SB 5.2 mg/kg SWMU 269 – SB 4.3 mg/kg SWMU 272 – SB 13.4 mg/kg SWMU 273 – SB 3.2 mg/kg SWMU 279 – SB 1.1 mg/kg SWMU 280 – SB 8.6 mg/kg SWMU 284/286 – SB 1.4 mg/kg SWMU 285 – SB 4.1 mg/kg SWMU 291 – SB 11.3 mg/kg SWMU 295 – SB 1.7 mg/kg SWMU 299 – SB 2.1 mg/kg SWMU 300 – SB 1.2 mg/kg SWMU 301 – SB 2 mg/kg SWMU 303 – SB 5.9 mg/kg SWMU 304 – SB 2 mg/kg SWMU 305 – SB 2.3 mg/kg SWMU 307 – SB 2.3 mg/kg SWMU 308 – SB 2.3 mg/kg SWMU 309 – SB 2.1 mg/kg SWMU 310 – SB 1.6 mg/kg SWMU 311 – SB 4.5 mg/kg SWMU 312 – SB 2.7 mg/kg SWMU 313 – SB 1.6 mg/kg	0.01 mg/m^3	5 mg/m^3 Ca	Ulceration of nasal septum, respiratory irritation; dermatitis; gastrointestinal disturbances; peripheral neuropathy, hyperpigmentation	NA

3.8 CONTAMINANTS OF CONCERN

(REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Arsenic (cont'd)	SWMU 314 – SB 2 mg/kg SWMU 315 – SB 3.6 mg/kg SWMU 316 – SB 1.9 mg/kg SWMU 317 – SB 2.6 mg/kg SWMU 318 – SB 14.3 mg/kg SWMU 319 – SB 1.6 mg/kg SWMU 337 – SB 1.5 mg/kg SWMU 339 – SB 1.5 mg/kg SWMU 360 – SB 7.9 mg/kg SWMU 361 – SB 1.8 mg/kg	0.01 mg/m^3	5 mg/m^3 Ca	Ulceration of nasal septum, respiratory irritation; dermatitis; gastrointestinal disturbances; peripheral neuropathy, hyperpigmentation	NA
Barium	SWMU 311 – SB 30.7 mg/kg **(J)** SWMU 43 – GW 70.9 □g/L **(J)** SB 50.5 mg/kg SWMU 360 – GW 145 □g/L **(J)** SB 29.4 mg/kg **(J)**	0.5 mg/m^3	50 mg/m^3	Irritant eyes, skin, upper respiratory system; skin burns, gastroenteritis; muscle spasm; slow pulse, extrasystoles, hypokalemia.	NA
Benzene	Site 3 – GW 0.2 □g/L **(J)** Site 6 – GW 26 □g/L Site 35 – GW 10 □g/L Site 41 – GW 2 □g/L **(J)** Site 69 – GW 2 □g/L **(J)** Site 73 – GW 18 □g/L Site 78 – GW 510 □g/L **(D)** Site 82 – GW 26 □g/L Site 86 – GW 5 □g/L Site 93 – GW 0.9 □g/L **(J)** SWMU 269 – GW 50 □g/L SWMU 360 – SB 5 □g/kg	1 ppm "Skin"	500 ppm Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.25
Benzo(a)anthracene	SWMU 254 – SB 6,000 □g/kg SWMU 285 – SB 3,600 □g/kg SWMU 299 – SB 3,400 □g/kg SWMU 303 – SB 1,000 □g/kg SWMU 318 – SB 4,100 □g/kg SWMU 319 – SB 660 □g/kg	0.2 mg/m^3	80 mg/m^3 Ca	Dermatitis, bronchitis	UK

3.8 CONTAMINANTS OF CONCERN

(REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Benzo(a)pyrene	SWMU 253 – SB 84 □g/kg SWMU 254 – SB 9,000 □g/kg SWMU 256 – SB 400 □g/kg SWMU 257 – SB 73 □g/kg SWMU 265 – SB 120 □g/kg SWMU 279 – SB 93 □g/kg SWMU 285 – SB 3,700 □g/kg SWMU 299 – SB 2,500 □g/kg SWMU 300 – SB 5,000 □g/kg SWMU 302 – SB 420 □g/kg SWMU 303 – SB 650 □g/kg SWMU 312 – SB 100 □g/kg SWMU 314 – SB 510 □g/kg SWMU 316 – SB 280 □g/kg SWMU 318 – SB 5,000 □g/kg SWMU 319 – SB 740 □g/kg	0.2 mg/m^3	80 mg/m^3 Ca	Dermatitis, bronchitis	UK
Benzo(b)fluroanthene	SWMU 254 – SB 15,000 □g/kg SWMU 285 – SB 2,300 □g/kg SWMU 299 – SB 6,100 □g/kg SWMU 300 – SB 3,000 □g/kg SWMU 303 – SB 1,100 □g/kg SWMU 314 – SB 1,400 □g/kg SWMU 318 – SB 5,900 □g/kg	0.2 mg/m^3	80 mg/m^3 Ca	Dermatitis, bronchitis	UK
Benzo(k)fluroanthene	SWMU 254 – SB 7,200 □g/kg SWMU 299 – SB 6,700 □g/kg SWMU 318 – SB 6,900 □g/kg	0.2 mg/m^3	80 mg/m^3 Ca	Dermatitis, bronchitis	UK
Bis(2-chloroethyl)ether	SWMU 308 – SB 260 □g/kg	5 ppm	100 ppm Ca	Irritation nose, throat, respiratory system; lacrimation (discharge of tears); cough; nausea, vomiting; in animals: pulmonary edema; liver damage; [potential occupational carcinogen]	UK
Bis(2-ethylhexyl)phthalate	SWMU 269 – SB 9,800 mg/kg	5 mg/m^3	5,000 mg/m^3 Ca	Irritation eyes, mucous membrane; in animals: liver damage; teratogenic effects; [potential occupational carcinogen]	UK
2-Butanone	SWMU 360 – SB 3.8 □g/kg **(J)**	200 ppm	3,000 ppm	Eye, skin, and nose irritation; headache; dizziness; vomiting; dermatitis	9.54
Cadmium	Site 41 – SD 0.17 mg/kg **(J)** SWMU 43 – SB 2.6 mg/kg SWMU 311 – SB 1.1 mg/kg **(J)** SWMU 318 – SB 57.2 mg/kg SWMU 360 – 0.58 mg/kg **(J)**	0.005 mg/m^3	9 mg/m^3 Ca	Pulmonary edema, coughing, chest tightness/pain, headache; chills, muscle aches, nausea, vomiting, diarrhea; difficulty breathing; loss of sense of smell; emphysema; mild anemia	NA

3.8 CONTAMINANTS OF CONCERN

(REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Carbon disulfide	Site 36 – GW 0.2 □g/L **(J)** Site 78 – GW 4 □g/L **(J)** Site 86 – GW 0.4 □g/L **(J)** SWMU 311 – SB 28 □g/kg SWMU 360 – SB 2 □g/kg **(J)**	4 ppm	500 ppm	Dizziness, headache, poor sleep, fatigue, low weight, nervousness, psychosis, Parkinson-like syndrome, ocular changes; coronary heart disease, gastritis; kidney, liver injury; eye, skin burns, dermatitis, reproductive effects	10.08
Carbon tetrachloride	Site 6 – GW 0.9 □g/L **(J)** Site 82 – GW 0.9 □g/L **(J)**	2 ppm	200 ppm Ca	CNS depression, nausea, vomiting, eye and skin irritation, liver and kidney injury, drowsiness, dizziness	11.47
Chlorobenzene	Site 2 – GW 0.9 □g/L **(J)** Site 6 – GW 57,000 □g/L Site 69 – GW 320 □g/L **(D)** Site 78 – GW 4 □g/L **(J)** Site 82 – GW 21 □g/L	10 ppm	1,000 ppm	Skin, eye, and nose irritation; drowsiness; uncoordination; CNS depression	9.07
Chloroform	Site 6 – GW 13 □g/L **(J)** Site 73 – GW 0.2 □g/L **(J)** Site 78 – GW 2 □g/L **(J)** Site 82 – GW 13 □g/L **(J)** Site 86 – GW 0.4 □g/L **(J)** Site 89 – GW 0.4 □g/L **(J)** SWMU 360 – GW 6.9 □g/L **(J)**	2 ppm	500 ppm Ca	Dizziness, mental dullness, nausea, confusion, disorientation, headache, fatigue, eye and skin irritation, anesthesia, enlarged liver	11.42
Chloroethane	Site 36 – SW 3 □g/L **(J)** Site 78 – GW 8 □g/L	1,000 ppm	3,800 ppm	Incoordination, inebriation; abdominal cramps; cardiac arrhythmias, cardiac arrest; liver, kidney damage	10.97
Chloromethane (Methyl chloride)	Site 6 – GW 2 □g/L **(J)** SW 2 □g/L **(J)** Site 69 – GW 1 □g/L **(J)** Site 78 – GW 3 □g/L **(J)** Site 82 – GW 2 □g/L **(J)** SW 2 □g/L **(J)**	100 ppm	2000 ppm Ca	Dizziness, nausea, vomiting; visual disturbance, stagger, slurred speech, convulsions, coma; liver, kidney damage; liquid: frostbite; reproductive, teratogenic effects; [potential occupational carcinogen]	11.28
Chromium	SWMU 311 – SB 7.4 mg/kg SWMU 43 – SB 51.9 mg/kg SWMU 360 – SB 14.7 mg/kg	0.5 mg/m3	25 mg/m^3	Irritated eyes, sensitization dermatitis, histologic fibrosis of lungs	N/A
Dibenz(a,h)anthracene	SWMU 254 – SB 2,800 □g/kg SWMU 285 – SB 660 □g/kg SWMU 299 – SB 830 □g/kg SWMU 314 – SB 1,210 □g/kg SWMU 318 – SB 2,300 □g/kg SWMU 319 – SB 110 □g/kg	0.2 mg/m^3	80 mg/m^3 Ca	Dermatitis, bronchitis	UK
Dibromochloromethane	Site 36 – SW 0.3 □g/L **(J)**	N/A	N/A	N/A	N/A

3.8 CONTAMINANTS OF CONCERN

(REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
1,4-Dichlorobenzene	SWMU 318 – SB 4,300 □g/kg	75 ppm	150 ppm Ca	Eye irritation, swelling periorbital (situated around the eye); profuse rhinitis; headache, anorexia, nausea, vomiting; weight loss, jaundice, cirrhosis; in animals: liver, kidney injury; [potential occupational carcinogen]	8.98
1,1-Dichloroethane	Site 6 – GW 6 Site □g/L **(J)** Site 78 – GW 200 □g/L **(D)** Site 82 – GW 6 Site □g/L **(J)** Site 86 – GW 71 □g/L Site 88 – GW 0.6 □g/L **(J)**	100 ppm	3,000 ppm	CNS depression, skin irritation; liver, kidney, and lung damage	11.06
1,2-Dichloroethane (Ethylene dichloride)	Site 6 – GW 3 □g/L **(J)** Site 36 – GW 0.3 □g/L **(J)** Site 69 – GW 17 □g/L Site 73 – GW 2 □g/L **(J)** Site 78 – GW 18 □g/L Site 82 – GW 3 □g/L **(J)** Site 86 – GW 7 □g/L	1 ppm	50 ppm Ca	CNS depression; nausea; vomiting; dermatitis; eye irritation; liver, kidney, and CNS damage; corneal opacity	11.05
1,1-Dichlorethylene	Site 6 – GW 30 □g/L Site 35 – GW 7 □g/L Site 69 – GW 6 □g/L Site 73 – GW 6 □g/L Site 78 – GW 31 □g/L Site 82 – GW 30 □g/L Site 86 – GW 660 □g/L Site 88 – GW 53 □g/L Site 89 – GW 130 □g/L **(J)** SWMU 360 – GW 7 □g/L SB 9 □g/kg	None listed	ND Ca	Irritant eyes, skin, throat; dizziness, headache, nausea; breathing difficulty; liver, kidney dysfunction;nueritis	10.00
1,2-Dichloroethylene	Site 89 – SD 5 □g/L **(J)**	200 ppm	1,000 ppm	Irritant eyes, respiratory system; CNS depression	9.65

3.8 CONTAMINANTS OF CONCERN

(REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
cis-1,2-Dichloroethylene	Site 3 – GW 0.7 □g/L **(J)** Site 6 – GW 5,800 □g/L **(D)** SW 4 □g/L **(J)** Site 35 – GW 2,200 □g/L Site 36 – GW 21 □g/L SW 3 □g/L **(J)** Site 69 – GW 41,000 □g/L **(D)** Site 73 – GW 370 □g/L Site 78 – GW 1,500 □g/L **(D)** Site 82 – GW 5,800 □g/L **(D)** SW 4 □g/L **(J)** Site 86 – GW 220 □g/L Site 88 – GW 84,000 □g/L **(D)** Site 89 – GW 48,000 □g/L SD 5 □g/L **(J)** SW 60 □g/L Site 93 – GW 710 □g/L Site 94 – GW 38 □g/L SWMU 269 – GW 180 □g/L SWMU 311 – GW 2 □g/L SWMU 360 – GW 750 □g/L **(J)** SB 237 □g/kg	200 ppm	1,000 ppm	Irritation eyes, respiratory system; central nervous system depression	9.65
trans-1,2-Dichlorethylene	Site 6 – GW 2,200 □g/L **(D)** SW 2 □g/L **(J)** Site 35 – GW 350 □g/L Site 36 – GW 2 □g/L **(J)** SW 2 □g/L **(J)** Site 69 – GW 720 □g/L **(D, J)** Site 73 – GW 29 □g/L Site 78 – GW 69 □g/L Site 82 – GW 2,200 □g/L **(D)** SW 2 □g/L **(J)** Site 86 – GW 11 □g/L Site 88 – GW 150 □g/L Site 89 – GW 19,000 □g/L **(J)** SW 37 □g/L Site 93 – GW 290 □g/L Site 94 – GW 0.84 □g/L SWMU 360 – GW 4 □g/L SB 4 □g/kg	200 ppm	4,000 ppm	Irritant eyes, respiratory system; CNS depression	9.65
1,2-Dichloropropane (Propylene Dichloride)	Site 78 – GW 5 □g/L	75 ppm	2,000 ppm (Ca)	Inhalation: Eye irritant; drowsiness, light-head; Contact: irritant skin; (carcinogen)	10.87

3.8 CONTAMINANTS OF CONCERN

(REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Dieldrin	SWMU 43 – SB 26 □g/kg	0.25 mg/m³ Ca	50 mg/m³ Ca	Headache, dizziness; nausea, vomiting, malaise (vague feeling of discomfort), sweating; myoclonic limb jerks; clonic, tonic convulsions; coma; [potential occupational carcinogen]; in animals: liver, kidney damage	UK
4,4′-DDD	SWMU 43 – SB 500 □g/kg **(J)**	0.5 mg/m³ "Skin"	500 mg/m³ Ca	Paresthesia of tongue, lips, hand, and face; tremors; dizziness; confusion; headache; fatigue; convulsions; eye and skin irritation; vomiting	UK
4,4′-DDE	SWMU 43 – SB 210 □g/kg SWMU 361 – GW 0.84 □g/L	0.5 mg/m³ "Skin"	500 mg/m³ Ca	Paresthesia of tongue, lips, hand, and face; tremors; dizziness; confusion; headache; fatigue; convulsions; eye and skin irritation; vomiting	UK
4,4′-DDT	SWMU 43 – SB 860,000 □g/kg	0.5 mg/m³ "Skin"	500 mg/m³ Ca	Paresthesia of tongue, lips, hand, and face; tremors; dizziness; confusion; headache; fatigue; convulsions; eye and skin irritation; vomiting	UK
Ethylbenzene	Site 2 – GW 37 □g/L Site 6 – GW 0.6 □g/L **(J)** Site 69 – GW 0.8 □g/L **(J)** Site 73 – GW 0.5 □g/L **(J)** Site 78 – GW 1,800 □g/L **(D)** Site 82 – GW 0.6 □g/L **(J)** Site 86 – GW 3 □g/L **(J)** SWMU 360 – SB 63 □g/kg	100 ppm	800 ppm	Eye, skin, and mucous membrane irritation; headache; dermatitis; narcotic; coma	8.76
Gamma-chlordane	SWMU 43 – GW 0.11 □g/L **(J)** SB 5,500 □g/kg SWMU 361 – GW 1.9 □g/L SB 37 □g/kg	0.5 mg/m³ "Skin"	100 mg/m³ Ca	Blurred vision, confusion, ataxia, delirium, coughing, abdominal pain, nausea, vomiting, diarrhea, irritability, tremors, anuria	UK
Heptachlor		0.5 mg/m³ "Skin"	35 mg/m³ Ca	In animals: tremor, convulsions, liver damage	UK
Heptachlor epoxide	SWMU 361 – GW 3.3 □g/L	0.5 mg/m³ values for Heptachlor used	35 mg/m³ Ca values for Heptachlor used	In animals: tremor, convulsions; liver damage; [potential occupational carcinogen] values for Heptachlor used	NA
2-Hexanone	Site 78 – GW 4 □g/L **(J)**	1 ppm	1600 ppm	Irritation eyes, nose; peripheral neuropathy: lassitude (weakness, exhaustion), paresthesia; dermatitis; headache, drowsiness	9.34
Indeno(1,2,3-cd)pyrene	SWMU 254 – SB 7,400 □g/kg SWMU 285 – SB 1,200 □g/kg SWMU 299 – SB 1,900 □g/kg SWMU 318 – SB 4,700 □g/kg	0.2 mg/m³	80 mg/m³ Ca	Dermatitis, bronchitis	UK

3.8 CONTAMINANTS OF CONCERN

(REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Isopropylbenzene	SWMU 360 – 6.1 g/kg **(J)**	50 ppm	900 ppm	Irritation eyes, skin, mucous membrane; dermatitis; headache, narcosis, coma	8.75
Lead	Site 41 – GW 499 g/L SD 2.6 mg/kg **(J)** SWMU 43 – SB 133 mg/kg SWMU 46 – SB 12,300 mg/kg SWMU 261/297 – SB 604 mg/kg SWMU 299 – SB 636 mg/kg SWMU 311 – SB 51.2 mg/kg **(J)** SWMU 360 – GW 2.5 g/L **(J)** SB 23.4 mg/kg **(J)**	0.05 mg/m^3	100 mg/m^3	Weakness, lassitude; facial pallor; pal eye; weight loss, malnutrition; abdominal pain, constipation; anemia; gingival lead line; tremors; paralysis of wrist and ankles; encephalopathy; kidney disease; irritated eyes; hypotension	NA
Mercury	SWMU 43 – GW 0.82 g/L SB 0.55 mg/kg	0.01 mg/m^3	10 mg/m^3	Skin and eye irritation, cough, chest pain, difficult breathing, bronchitis, pneumontitis, tremors, insomnia, irritability, indecision, headache, fatigue, weakness, GI disturbance	NA
Methylcyclohexane	SWMU 360 – SB 1.3 g/kg **(J)**	400 ppm	1,200 ppm	Irritation eyes, skin, nose, throat; dizziness, drowsiness; in animals: narcosis	9.85
Methylene Chloride	Site 86 – GW 6 g/L **(J)** Site 94 – GW 0.64 g/L SWMU 311 – SB 3 g/kg **(J)**	25 ppm	2300 ppm Ca	Irritation eyes, skin; lassitude (weakness, exhaustion), drowsiness, dizziness; numbness, tingle limbs; nausea; [potential occupational carcinogen]	11.32
Naphthalene	SWMU 269 – GW 64 g/L SWMU 299 – GW 35 g/L	10 ppm	250 ppm	Eye irritation, headache, confusion, excitement, nausea, vomiting, abdominal pain, bladder irritation, profuse sweating, dermatitis, corneal damage, optical neuritis	8.12
Selenium	SWMU 311 – SB 1.7 mg/kg SWMU 43 – GW 5.4 g/L SB 1.3 mg/kg **(J)** SWMU 269 – SB 0.82 mg/kg SWMU 360 – GW 5.7 g/L SB 0.87 mg/kg **(J)**	0.2 mg/m^3	1 mg/m^3	Irritation eyes, skin, nose, throat; visual disturbance; headache; chills, fever; dyspnea (breathing difficulty), bronchitis; metallic taste, garlic breath, gastrointestinal disturbance; dermatitis; eye, skin burns; in animals: anemia; liver necrosis, cirrhosis; kidney, spleen damage	NA
Silver	SWMU 311 – SB 0.65 mg/kg **(J)** SWMU 43 – SB 2 mg/kg **(J)**	0.01 mg/m^3	10 mg/m^3	Blue-gray eyes, nasal septum, throat, skin; irritation, ulceration skin; gastrointestinal disturbance	NA
Styrene	Site 78 – GW 16 g/L	50 ppm	700 ppm	Irritation eyes, nose, respiratory system; headache, lassitude (weakness, exhaustion), dizziness, confusion, malaise (vague feeling of discomfort), drowsiness, unsteady gait; narcosis; defatting dermatitis; possible liver injury; reproductive effects	8.40

3.8 CONTAMINANTS OF CONCERN

(REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
1,1,2,2-Tetrachloroethane	Site 6 – GW 4,700 □g/L **(D,J)** Site 35 – GW 8 □g/L Site 36 – GW 23 □g/L SW 9 □g/L Site 69 – GW 20 □g/L Site 82 – GW 4,700 □g/L **(D,J)** Site 89 – GW 1,200,000 □g/L SW 97 □g/L Site 93 – GW 70 □g/L	1 ppm	100 ppm Ca	Nausea, vomiting, abdominal pain, finger tremors, jaundice, hepatitis, liver tenderness, monocytosis, kidney damage, dermatitis	11.10
Tetrachloroethylene	Site 6 – GW 3,100 □g/L **(D,J)** Site 35 – GW 1 □g/L **(J)** Site 36 – GW 0.8 □g/L **(J)** Site 69 – GW 0.6 □g/L **(J)** Site 78 – GW 2 □g/L **(J)** Site 82 – GW 3,100 □g/L **(D,J)** Site 86 – GW 160 □g/L Site 88 – GW 72,000 □g/L **(D), free product in the area of Building 25** Site 89 – GW 2,600 □g/L **(J)** Site 93 – GW 95 □g/L SWMU 311 – SB 1.3 □g/kg **(J)** SWMU 336 – GW 27 □g/L SWMU 360 – GW 5,100 □g/L **(J)** SB 118 □g/kg	100 ppm	150 ppm	Irritant to eyes, nose, and throat; nausea, flushed face, neck, vertigo, dizziness, incoordination, headache, somnolence, skin erythema, liver damage	9.32
Toluene	Site 2 – GW 0.8 □g/L **(J)** Site 3 – GW 0.5 □g/L **(J)** Site 6 – GW 0.8 □g/L **(J)** Site 35 – GW 4 □g/L **(J)** SW 0.3 □g/L **(J)** Site 69 – GW 2 □g/L **(J)** Site 78 – GW 7,900 □g/L **(D)** Site 82 – GW 0.8 □g/L **(J)** Site 86 – GW 1 □g/L **(J)** SWMU 360 – GW 3 □g/L SB 9.7 □g/kg **(J)**	100 ppm	500 ppm	Irritant to eyes, nose, fatigue, weakness, confusion, euphoria, dizziness, headache, dilated pupils, lacrimation, nervousness, muscular fatigue, insomnia, paresthesia, dermatitis, liver and kidney damage	8.82
1,1,1-Trichloroethane (Methyl chloroform)	Site 6 – GW 1 □g/L **(J)** Site 78 – GW 24 □g/L Site 82 – GW 1 □g/L **(J)**	350 ppm	1000 ppm (Ca)	Inhalation: head, lassitude , CNS depression, poor equilibrium; Contact: irritant eyes, dermatitis; Ingestion: cardiac arrhythmia	11.00

3.8 CONTAMINANTS OF CONCERN

(REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
1,1,2-Trichloroethane	Site 6 – GW 72 □g/L **(J)** Site 35 – GW 1 **(J)** Site 36 – GW 0.8 □g/L **(J)** Site 69 – GW 33 □g/L Site 82 – GW 72 □g/L **(J)** Site 88 – GW 12,000 □g/L **(D)** Site 89 – GW 9,600 □g/L **(J)** SW 1 □g/L **(J)**	10 ppm	100 ppm (Ca)	Eye and nose irritation, CNS depression, liver damage, dermatitis	11.00
1,1,2-Trichloro-1,2,2-Trifluoroethane	Site 86 – GW 740 □g/L	1,000 ppm	2,000 ppm	Irritation skin, throat, drowsiness, dermatitis; central nervous system depression; in animals: cardiac arrhythmias, narcosis	11.99
Trichloroethylene	Site 6 – GW 13,000 □g/L **(D,J)** SW 5 □g/L **(J)** Site 35 – GW 2,800 □g/L Site 36 – GW 46 □g/L SW 9 □g/L Site 69 – GW 70 □g/L Site 73 – GW 1,600 □g/L Site 78 – GW 5,400 □g/L **(D)** Site 82 – GW 13,000 □g/L **(D,J)** SW 5 □g/L **(J)** Site 86 – GW 570 □g/L Site 88 – GW 2,600 □g/L **(D,J)** Site 89 – GW 620,000 □g/L SW 19 □g/L Site 93 – GW 230 □g/L Site 94 – GW 54 □g/L SWMU 269 – GW 14 □g/L SWMU 360 – GW 460 □g/L **(J)** SB 23 □g/kg	25 ppm	1,000 ppm (Ca)	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
1,2,3-Trichloropropane	SWMU 360 – GW 2 □g/L	10 ppm	100 ppm	Irritation eyes, nose, throat; central nervous system depression; in animals: liver, kidney injury; [potential occupational carcinogen]	UK
Vinyl chloride	Site 6 – GW 200 □g/L SW 0.6 □g/L **(J)** Site 35 – GW 74 □g/L Site 36 – GW 3 □g/L SW 1 □g/L **(J)** Site 69 – GW 3,200 □g/L **(D)** Site 73 – GW 65 □g/L	1 ppm	NL Ca	Weakness, abdominal pain, GI bleeding, enlarged liver, pallor or cyanosis of extremities, liquid frostbite	9.99

3.8 CONTAMINANTS OF CONCERN

(REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Vinyl chloride (cont'd)	Site 78 – GW 250 □g/L **(D)** Site 82 – GW 200 □g/L SW 0.6 □g/L **(J)** Site 86 – GW 19 □g/L **(J)** Site 88 – GW 45,000 □g/L **(D)** Site 89 – GW 1,800 □g/L SD 3 □g/L **(J)** SW 28 □g/L Site 93 – GW 10 □g/L SWMU 269 – GW 3.6 □g/L SWMU 360 – GW 2 □g/L **(J)**	1 ppm		Weakness, abdominal pain, GI bleeding, enlarged liver, pallor or cyanosis of extremities, liquid frostbite	
m/p-Xylenes	SWMU 360 – 230 □g/kg	100 ppm	900 ppm	Irritant to eyes, skin, nose, and throat, dizziness, excitement, drowsiness, incoordination, staggering, gait corn vacuolizationl anorexia, nausea, vomiting, abdominal pain, dermatitis	8.56
o-Xylene	SWMU 100 □g/kg	100 ppm	900 ppm	Irritant to eyes, skin, nose, and throat, dizziness, excitement, drowsiness, incoordination, staggering, gait corn vacuolizationl anorexia, nausea, vomiting, abdominal pain, dermatitis	8.56
Xylenes, total	Site 2 – GW 310 □g/L Site 3 – GW 3 □g/L **(J)** Site 6 – GW 4 □g/L **(J)** Site 41 – SD 0.7 □g/L **(J)** Site 69 – GW 3 □g/L **(J)** Site 73 – GW 2 □g/L **(J)** Site 78 – GW 7,800 □g/L **(D)** Site 82 – GW 4 □g/L **(J)** Site 86 – GW 7 □g/L	100 ppm	900 ppm	Irritant to eyes, skin, nose, and throat, dizziness, excitement, drowsiness, incoordination, staggering, gait corn vacuolizationl anorexia, nausea, vomiting, abdominal pain, dermatitis	8.56

3.8 CONTAMINANTS OF CONCERN

(REFER TO PROJECT FILES FOR MORE-DETAILED CONTAMINANT INFORMATION)

Contaminant	Location and Highest[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)

Footnotes:
a: Documents from previous site investigations mention the presence of manganese, lead, cadmium, chromium at Site 11, and TPH at Site 5, however, the concentrations of these contaminants is unknown.
b: Appropriate value of PEL, REL, or TLV listed
c: IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen
d: PIP = photoionization potential; NA = Not applicable; UK = Unknown

GW – Groundwater

SD - Sediment

SW – Surface Water

J – Estimated concentration

D – Compound identified in analysis at a secondary dilution factor

B – Analyte found in associated blank as well as in sample

3.9 POTENTIAL ROUTES OF EXPOSURE		
DERMAL: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 5.	INHALATION: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 5 and 6, respectively.	OTHER: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before eating, drinking, or smoking).

4. PERSONNEL

4.1 CH2M HILL EMPLOYEE MEDICAL SURVEILLANCE AND TRAINING

(Reference CH2M HILL SOPs HS-01, *Medical Surveillance*, and HS-02, *Health and Safety Training*)

The employees listed below are enrolled in the CH2M HILL Comprehensive Health and Safety Program and meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated "SC-HW" have received 8 hours of supervisor and instrument training and can serve as site safety coordinator (SC-HW) for the level of protection indicated. All personnel designated as SC-HW are qualified to supervise Level D or C activities, and must be present during all tasks performed in exclusion or decontamination zones that involve the potential for exposure to health and safety hazards. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones that involve the potential for exposure to health and safety hazards. All onsite employees will have completed Bloodborne Pathogen training as required by 29CFR1910.1030. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILL's SOP HS-04, *Reproduction Protection*, including obtaining a physician's statement of the employee's ability to perform hazardous activities, before being assigned fieldwork.

Employee Name	Office	Responsibility	SC-HW/FA-CPR
Matt Louth	VBO	Activity Manager	SC-HW, FA-CPR
Chris Bozzini	CLT	Senior Consultant	SC-HW, FA-CPR
Teg Williams	CLT	Senior Consultant	SC-HW, FA-CPR
Bill Schmithorst	RDU	Project Manager	FA-CPR
Dan Tomczak	RDU	Project Manager	SC-HW, FA-CPR
Jessica Skeean	CLT	Project Manager	SC-HW, FA-CPR
Mike Skeean	CLT	Project Manager	SC-HW, FA-CPR
Keri Halberg	CLT	Project Manager	SC-HW, FA-CPR
Theron Grim	CLT	Project Manager	SC-HW, FA-CPR
Renee Clore	CLT	Project Manager	SC-HW, FA-CPR
James Frank	RDU	Field Team Member	SC-HW, FA-CPR
Erin Must	RDU	Field Team Member	SC-HW, FA-CPR
David Seed	RDU	Field Team Member	SC-HW, FA-CPR
Beth Bevc	RDU	Field Team Member	SC-HW, FA-CPR
Tom Konopka	RDU	Field Team Member	SC-HW, FA-CPR
Rachel Zajac	RDU	Field Team Member	SC-HW, FA-CPR
Dan Hockett	CLT	Field Team Member	FA-CPR
Jeff Albano	CLT	Field Team Member	SC-HW, FA-CPR
Dan Brown	CLT	Field Team Member	SC-HW, FA-CPR
Barak West	CLT	Field Team Member	SC-HW, FA-CPR
Monica Tiburzi	CLT	Field Team Member	SC-HW, FA-CPR
Matt Westendorf	CLT	Field Team Member	SC-HW, FA-CPR

Mark Strong	CLT	Field Team Member	SC-HW, FA-CPR

4.2 FIELD TEAM CHAIN OF COMMAND AND COMMUNICATION PROCEDURES

4.2.1 CLIENT

Client Contact
Gary Tysor
NAVFAC Mid-Lant
Code: OPCEV
6506 Hampton Blvd
Norfolk, Virginia 23508-1278
(757) 322-4851
(757) 322-4805 fax
gary.tysor@usmc.mil

Base Contact
Robert Lowder
Camp Lejeune - EMD
Building 12
Marine Corps Base
Camp Lejeune, NC 28542-0004
(910) 451-9607
(910) 451-5997
robert.a.lowder@usmc.mil

4.2.2 CH2M HILL

The SC-HW is responsible for contacting the field team leader and the project manager. In general, the project manager either will contact or will identify the client contact. The Health and Safety Manager (HSM) should be contacted as appropriate. The SC-HW or the project manager must notify the client and the HSM when a serious injury or a death occurs or when health and safety inspections by OSHA or other agencies are conducted. Refer to sections 10 through 12 for emergency procedures and phone numbers.

4.2.3 SUBCONTRACTORS

(Reference CH2M HILL SOP HS-55, *Subcontractor, Contractor, and Owner)*

When specified in the project documents (e.g., contract), this plan may cover CH2M HILL subcontractors. However, this plan does not address hazards associated with tasks and equipment that the subcontractor has expertise in (e.g., operation of drill rig). Specialty subcontractors are responsible for health and safety procedures and plans specific to their work. Specialty subcontractors are to submit plans to CH2M HILL for review and approval before the start of fieldwork. Subcontractors must comply with the established health and safety plan(s). CH2M HILL must monitor and enforce compliance with the established plan(s).

General health and safety communication with subcontractors contracted with CH2M HILL and covered by this plan is to be conducted as follows:

- Request that the subcontractor, if a specialty subcontractor, submit a safety or health plan applicable to their expertise (e.g., drill-rig safety plan or nuclear density gauge [NDG] health plan); attach the reviewed plan.
- Supply subcontractors with a copy of this plan, and brief them on its provisions.
- Direct health and safety communication to the subcontractor-designated safety representative.
- Notify the subcontractor-designated representative if a violation of the plan(s) is observed. Specialty subcontractors are responsible for mitigating hazards in which they have expertise.
- If a hazard condition persists, inform the subcontractor. If the hazard is not mitigated, stop affected work as a last resort and notify the project manager.
- When an apparent imminent danger exists, promptly remove all affected personnel. Notify the project manager.
- Make clear that consistent violations of the health and safety plan by a subcontractor may result in termination of the subcontract.

4.2.4 CONTRACTORS

(Reference CH2M HILL SOP HS-55, *Subcontractor, Contractor, and Owner*)

This plan does not cover contractors that are contracted directly to the client or the owner. CH2M HILL is not responsible for directing contractor personnel and is not to assume responsibility through their actions. When the contractor is in control of the site, ask the contractor to conduct a briefing of their health and safety practices and to describe how they apply to CH2M HILL's activities. Request a copy of the contractor's health and safety plan.

General health and safety communication with contractors *not* contracted with CH2M HILL is listed below. These procedures can also be applied to other third party communications (e.g., client personnel).

- Ask the contractor to brief CH2M HILL on the contractor's health and safety plan for how the plan affects CH2M HILL employees on the site.
- If acceptable to the client, communicate about health and safety directly with the contractor PM or other onsite contractor-designated representative. CH2M HILL employees are not to direct the details of the contractor's work or to advise on health and safety (e.g., how the contractor corrects unsafe conditions).
- If an observed hazard poses a risk to CH2M HILL personnel, notify the party controlling the work activity as soon as possible. Notify the project manager; the project manager will notify the client. Document oral notification in project records (i.e., the field logbook).
- If a hazardous condition endangering a CH2M HILL employee persists, inform the contractor and the project manager (the project manager will contact the client) that CH2M HILL cannot execute the assigned work until the hazard is mitigated.
- When an apparent imminent danger exists, orally warn the person(s) in danger and orally notify the contractor promptly. When an imminent danger involves a CH2M HILL employee, remove the employee and suspend CH2M HILL work immediately until the hazard has been mitigated. Inform the project manager and the contractor promptly.
- The SC-HW or the project manager must notify the client and CH2M HILL health and safety staff when (1) the contractor fails to remedy an unsafe condition affecting CH2M HILL personnel, (2) the contractor does not remedy the hazardous condition within a reasonable period of time, or (3) the contractor repeatedly creates the hazardous condition.

5 PERSONAL PROTECTIVE EQUIPMENT (PPE)

(Reference CH2M HILL SOPs HS-07, *Personal Protective Equipment*, HS-08, *Respiratory Protection*)

REFER TO THE SITE-SPECIFIC HASP FOR THE REQUIRED LEVEL OF PERSONAL PROTECTION TO USE DURING FIELD ACTIVITIES

5.1 GENERAL PPE SPECIFICATIONS[a]

Level	Body	Head	Respirator[b]
D	Work clothes; steel-toe, steel-shank leather work boots; work gloves	Hardhat[c] Safety glasses Ear protection[d]	None required
Modified D	**COVERALLS:** Uncoated Tyvek® **BOOTS**: Steel-toe, steel-shank chemical-resistant boots OR steel-toe, steel-shank leather work boots with outer rubber boot covers GLOVES: Inner surgical-style nitrile glove AND outer chemical-resistant nitrile glove.	Hardhat[c] Splash shield[c] Safety glasses Ear protection[d]	None required
C	**COVERALLS**: Polycoated Tyvek® **BOOTS**: Steel-toe, steel-shank chemical-resistant boots OR steel-toe, steel-shank leather work boots with outer rubber boot covers **GLOVES**: Inner surgical-style nitrile glove AND outer chemical-resistant nitrile glove.	Hardhat[c] Splash shield[c] Ear protection[d] Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with cartridges[e] or equivalent

[a] Modifications are as indicated. CH2M HILL will provide PPE to only CH2M HILL employees.
[b] No facial hair that would interfere with respirator fit is permitted.
[c] Hardhat and splash-shield areas are to determined by the SC-HW.
[d] Ear protection should be worn while working around drill rigs or other noise-producing equipment or when conversations cannot be held at distances of 3 feet or less without shouting. Refer to Section 6 for other requirements.
[e] The appropriate cartridge is specified in the site-specific addendum to this plan.

5.2 REASONS FOR UPGRADING OR DOWNGRADING LEVEL OF PROTECTION

Upgrade*	Downgrade
• Request from individual performing task. • Change in work task that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels (Section 6) exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decreases the hazard. • Change in work task that will reduce contact with hazardous materials.

*Performing a task that requires an upgrade to a higher level of protection (e.g., level D to level C) is permitted only when the PPE requirements have been specified in Section 5 and an SC-HW who meets the requirements specified in subsection 4.1 is present.

6. AIR MONITORING SPECIFICATIONS FOR POTENTIAL AIR MONITORING DEVICES

(Reference CH2M HILL SOP HS-06, *Air Monitoring*)

Air monitoring will be conducted in the breathing zone for all intrusive work in the exclusion zone. Air monitoring results will be recorded in the field logbook and will be verbally transmitted to all field personnel. In cases of exposure above OSHA PEL's, notification of affected personnel will be made in writing in accordance with 29CFR1910.

REFER TO THE SITE-SPECIFIC HASP FOR THE REQUIRED MONITORING INSTRUMENTS TO USE DURING FIELD ACTIVITIES

Instrument	Tasks	Action Levels[a]	Frequency[b]	Calibration
FID: TVA model 1000 or equivalent	Geoprobe sampling. Monitoring well drilling and sampling. Sediment sampling Water level monitoring of wells Groundwater sampling activities. IDW drum sampling	see Site-Specific HASP Addendum	Initially and periodically during task	Daily
PID: MultiRAE or MinRAE with appropriate lamp, see Site-Specific HASP Addendum	Geoprobe sampling. Monitoring well drilling and sampling. Sediment sampling Water level monitoring of wells Groundwater sampling activities. IDW drum sampling	see Site-Specific HASP Addendum	Initially and periodically during task	Daily
Colorimetric Detector Tube: see Site-Specific HASP Addendum	Geoprobe sampling. Monitoring well drilling and sampling. Sediment sampling Water level monitoring of wells Groundwater sampling activities. IDW drum sampling	see Site-Specific HASP Addendum	Initially and periodically when PID/FID >1ppm	Not Applicable
CGI: MSA model 260 or 261 or equivalent	Geoprobe sampling. Monitoring well drilling and sampling. Sediment sampling Water level monitoring of wells Groundwater sampling activities. IDW drum sampling	0-10%[c] LEL: No explosion hazard 10-25%[c] LEL: Potential explosion hazard >25%[c] LEL: Explosion hazard; evacuate or vent	Continuous during advancement of boring or trench	Daily
O_2 Meter: MSA model 260 or 261 or equivalent	Drilling	>25.0%[c] O_2: Explosion hazard: evacuate or vent 20.9%[c] O_2: Normal O_2 <19.5%[c] O_2: O_2 deficient; vent	Continuous during advancement of boring or trench	Daily; before and after each period of use
Dust Monitor: MiniRAM	see Site-Specific HASP Addendum	see Site-Specific HASP Addendum	Initially and periodically during task	Zero twice daily; once before use and once at midday

Note a: Action levels apply to sustained breathing-zone measurements above background.

Note b: The exact frequency of monitoring depends on field conditions and is to be determined by the SC-HW; generally, every 5 to 15 minutes is acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time and measurement result, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3," "at surface/SB-2," etc.).

Note c: If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply to only ambient working atmospheres, and do not apply to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry; refer to Section 9.

6.1 CALIBRATION SPECIFICATIONS

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Air monitoring equipment shall be calibrated before and after each period of use.

Instrument	Gas	Span	Reading	Method
PID: MultiRAE, 10.6 eV lamp	100 ppm isobutylene	9.8 ± 2.0	55 ppm	1.5 lpm reg T-tubing OR
MultiRAE, 11.7 eV lamp		5.0 ± 2.0	68 ppm	0.25 lpm reg direct tubing
PID: MiniRAE, 10.6 eV Bulb	100 ppm isobutylene	CF=53	53 ppm ±5 ppm	1.5 lpm reg T-Tubing
PID: TVA 1000	100 ppm isobutylene	CF=0.55	55 ppm ± 5 ppm	1.5 lpm reg T-Tubing
FID: TVA 1000	100 ppm methane	CF=1.00	100 ppm ± 10	1.5 lpm reg T-Tubing
Dust Monitor: Miniram-PDM3	Dust-free air	N/A	0.00 mg/m^3 in "Measure" mode	Dust-free area OR Z-bag with HEPA filter
CGI: MSA 260, 261, 360, or 361	0.75% pentane	N/A	50% LEL ± 5 % LEL	1.5 lpm reg direct tubing

6.2 AIR SAMPLING

Sampling may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, and certain volatile organic compounds. Contact the HSM immediately if these contaminants are encountered.

Method Description: **REFER TO SITE-SPECIFIC HASP IF APPLICABLE**

Results must be sent immediately to the HSM. Regulations may require reporting to monitored personnel. Results reported to:

HSM: Michael Goldman CIH
Other:

7. DECONTAMINATION

(Reference CH2M HILL SOP HS-13, *Decontamination*)

The SC-HW must monitor the effectiveness of the decontamination procedures. Decontamination procedures found to be ineffective will be modified by the SC-HW.

7.1 DECONTAMINATION SPECIFICATIONS

Personnel	Sample Equipment	Heavy Equipment
• Boot wash/rinse • Glove wash/rinse • Outer-glove removal • Body-suit removal • Inner-glove removal • Respirator removal • Hand wash/rinse • Face wash/rinse • Shower ASAP • **PPE-disposal method:** Collect in container to be managed by IDW contractor • **Water-disposal method:** Collect in container to be managed by IDW contractor	• Wash/rinse equipment • Solvent-rinse equipment **Solvent-disposal method:** Collect in container to be managed by IDW contractor	• Power wash • Steam clean **Water-disposal method:** Collect in container to be managed by IDW contractor

7.2 DIAGRAM OF PERSONNEL-DECONTAMINATION LINE

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SC-HW should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 7-1 illustrates a typical establishment of work zones, including the decontamination line. Work zones are to be modified by the SC-HW to accommodate task-specific requirements.

8. SPILL-CONTAINMENT PROCEDURES

Sorbent material will be maintained in the support zone. Incidental spills will be contained with sorbent and will be disposed of properly.

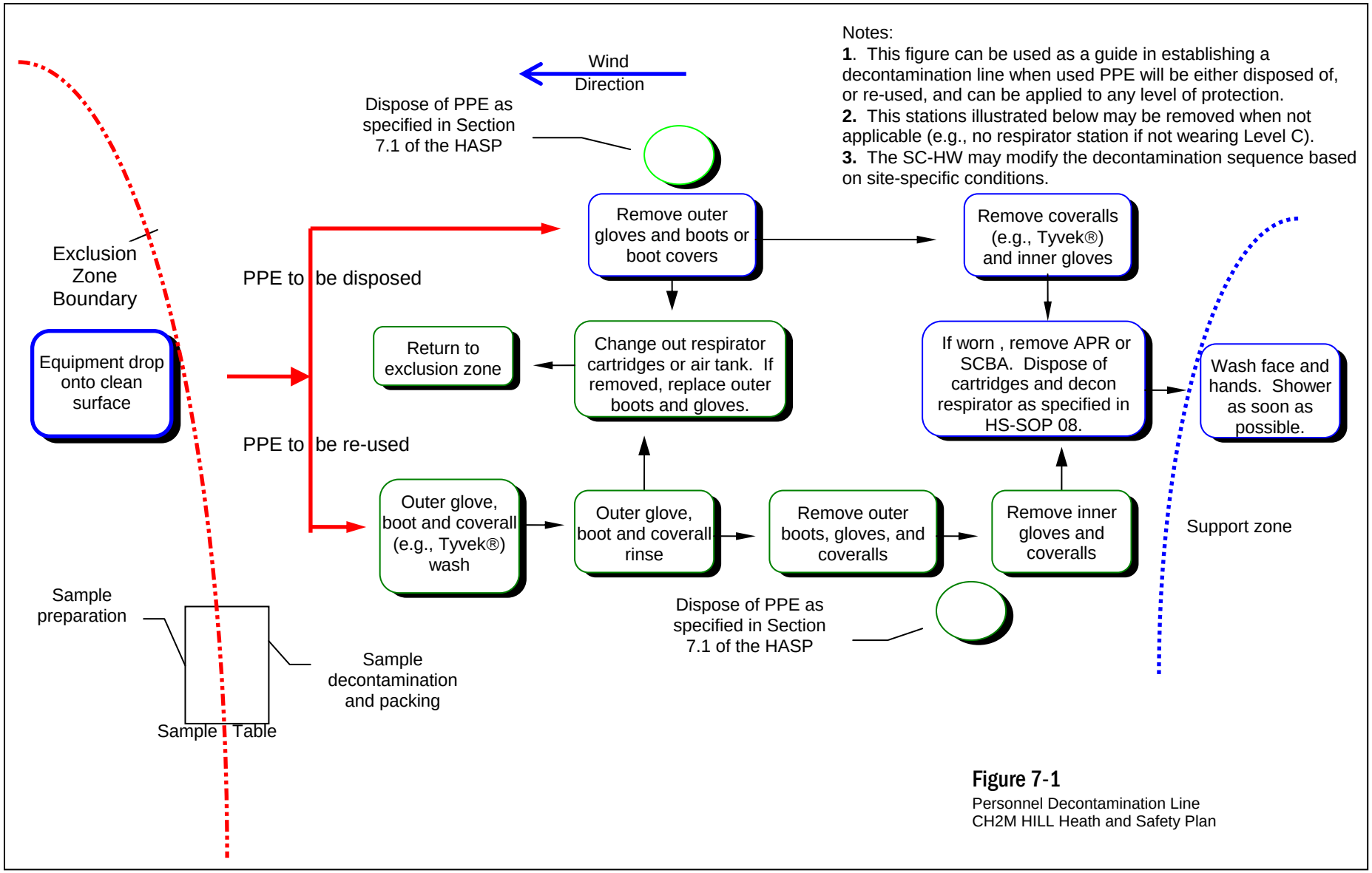


Figure 7-1
Personnel Decontamination Line
CH2M HILL Heath and Safety Plan

9. CONFINED-SPACE ENTRY

(Reference CH2M HILL SOP HS-17, *Confined Space Entry*)

No confined-space entry will be permitted. Confined-space entry requires additional health and safety procedures, training, and a permit. If conditions change such that confined-space entry is necessary, contact the HSM to develop the required entry permit.

When planned activities will not include confined-space entry, permit-required confined spaces accessible to CH2M HILL personnel are to be identified before the task begins. The SC-HW is to confirm that permit spaces are properly posted or that employees are informed of their locations and informed of their hazards.

10. SITE-CONTROL PLAN

10.1 SITE-CONTROL PROCEDURES

(Reference CH2M HILL SOP HS-11, *Site Control*)

- The site safety coordinator (SC-HW) will conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Topics for briefing on site safety: general discussion of health and safety plan, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies.
- The SC-HW records attendance at safety briefings in a logbook and documents the topics discussed.
- Post the OSHA job-site poster in a central and conspicuous location at sites where project field offices, trailers, or equipment storage boxes are established. Posters can be obtained by calling either 800/548-4776 or 800/999-9111.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Determine wind direction.
- Establish work zones: support, decontamination, and exclusion zones. Delineate work zones with flags or cones as appropriate. Support zone should be upwind of the site.
- Establish decontamination procedures, including respirator-decontamination procedures, and test the procedures.
- Use access control at the entry and exit from each work zone.
- Store chemicals in appropriate containers.
- Make MSDSs available for onsite chemicals to which employees are exposed.
- Establish onsite communication consisting of the following:
    - Line-of-sight and hand signals
    - Air horn
    - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."
- Establish procedures for disposing of material generated on the site.
- Initial air monitoring is conducted by the SC-HW in appropriate level of protection.
- The SC-HW is to conduct periodic inspections of work practices to determine the effectiveness of this plan–refer to CH2M HILL SOP HS-18, Health and Safety Checklist. Deficiencies are to be noted, reported to the HSM, and corrected.

10.2 HAZWOPER COMPLIANCE PLAN

(Reference CH2M HILL SOP HS-19, *Written Plans*)

This section outlines procedures to be followed when certain activities do not require 24- or 40-hour training. *Note, prior approval from the HSM is required before these tasks are conducted on regulated hazardous waste sites.*

- Certain parts of the site work may be covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated tasks must be included in subsection 2.1.1.
- Air sampling must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed on the site. Other data (e.g., soil) also must document that there is no potential for exposure. The HSM must approve the interpretation of these data. Refer to subsections 3.8 and 6.2 for contaminant data and air sampling requirements, respectively.
- Non-Hazwoper-trained personnel must be informed of the nature of the existing contamination and its locations, the limits of their access, and the emergency action plan for the site. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements, including 29 CFR 1910.1200 (HAZCOM). Refer to subsection 3.7.1 for hazard communication requirements.
- Air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to volatile contaminants. Non-Hazwoper-trained personnel should be monitored whenever the belief is that there may be a possibility of exposure (e.g., change in site conditions), or at some reasonable frequency to confirm that there is no exposure. Refer to Section 6.1 for air monitoring requirements.
- Treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is, for the purposes of applying the Hazwoper standard, considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hours of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must leave the site.

If Hazwoper-regulated tasks are conducted concurrently with nonregulated tasks, non-Hazwoper-trained subcontractors must be removed from areas of exposure. If non-Hazwoper-trained personnel remain on the site while a Hazwoper-regulated task is conducted, the contaminant/exposure area (exclusion zone) must be posted, non-Hazwoper-trained personnel must be reminded of the locations of restricted areas and the limits of their access, and real-time monitoring must be conducted. Non-Hazwoper-trained personnel at risk of exposure must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.

11. EMERGENCY ACTION PLAN (Reference CH2M HILL SOP HS-12, *Emergency Planning*)

11.1 PRE-EMERGENCY PLANNING

The SC-HW performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with the facility and local emergency-service providers as appropriate.

- Review the facility emergency and contingency plans where applicable.
- Locate the nearest telephone; determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Identify and communicate chemical, safety, radiological, and biological hazards.
- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- Post site map marked with locations of emergency equipment and supplies, and post OSHA job-site poster. The OSHA job-site poster is required at sites where project field offices, trailers, or equipment-storage boxes are established. Posters can be obtained by calling either 800/548-4776 or 800/999-9111.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Evaluate capabilities of local response teams where applicable.
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, chemical and vapor releases.
- Review notification procedures for contacting CH2M HILL's medical consultant and team member's occupational physician.
- Rehearse the emergency response plan once before site activities begin, including driving the route to the hospital.
- Brief new workers on the emergency response plan.
- The SC-HW will evaluate emergency response actions and initiate appropriate follow-up actions.

11.2 EMERGENCY EQUIPMENT AND SUPPLIES

The SC-HW should mark the locations of emergency equipment on the site map and should post the map.

Emergency Equipment and Supplies	Location
20 lb (or two 10-lb) fire extinguisher (A, B, and C classes)	CH2M HILL Field Vehicle
First aid kit	CH2M HILL Field Vehicle
Potable water	CH2M HILL Field Vehicle
Bloodborne-pathogen kit	CH2M HILL Field Vehicle
Cellular phone	CH2M HILL Field Vehicle

11.3 EMERGENCY MEDICAL TREATMENT

- Notify appropriate emergency response authorities listed in section 12 (e.g., 911).
- During a time of no emergency, contact CH2M HILL's medical consultant for advice and guidance on medical treatment.
- The SC-HW will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury.
- Initiate first aid and CPR where feasible.
- Get medical attention immediately.
- Perform decontamination where feasible; lifesaving and first aid or medical treatment take priority.
- Notify the field team leader and the project manager of the injury.
- Make certain that the injured person is accompanied to the emergency room.
- Notify the health and safety manager.
- Notify the injured person's human resources department within 24 hours.
- Prepare an incident report -- refer to CH2M HILL SOP HS-12, Emergency Planning, Submit the report to the corporate director of health and safety and the corporate human resources department (COR) within 48 hours.
- When contacting the medical consultant, state that you are calling about a CH2M HILL matter, and give your name, your telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.

11. 4 NONEMERGENCY PROCEDURES

The procedures listed above may be applied to nonemergency incidents. Injuries and illnesses (including overexposure to contaminants) must be reported to Human Resources. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CH2M HILL medical consultant.

- When contacting the medical consultant, state that the situation is a CH2M HILL matter, and give your name, your telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Follow these procedures as appropriate.

11.5 INCIDENT RESPONSE

In fires, explosions, or chemical releases, actions to be taken include the following:

- Shut down CH2M HILL operations and evacuate the immediate work area.
- Account for personnel at the designated assembly area(s).
- Notify appropriate response personnel.
- Assess the need for site evacuation, and evacuate the site as warranted.

Instead of implementing a work-area evacuation, note that small fires or spills posing minimal safety or health hazards may be controlled.

11.6 EVACUATION

- Evacuation routes will be designated by the SC-HW before work begins.
- Onsite and offsite assembly points will be designated before work begins.
- Personnel will leave the exclusion zone and assemble at the onsite assembly point upon hearing the emergency signal for evacuation.
- Personnel will assemble at the offsite point upon hearing the emergency signal for a site evacuation.
- The SC-HW and a "buddy" will remain on the site after the site has been evacuated (if possible) to assist local responders and advise them of the nature and location of the incident.
- The SC-HW accounts for all personnel in the onsite assembly zone.
- A person designated by the SC-HW before work begins will account for personnel at the offsite assembly area.
- The SC-HW will write up the incident as soon as possible after it occurs and will submit a report to the corporate director of health and safety.

11.7 EVACUATION ROUTES AND ASSEMBLY POINTS

Refer to the Base map in Section 1. Evacuation routes (and alternative routes) are shown on the site map.

11.8 EVACUATION SIGNALS

Signal	Meaning
Grasping throat with hand	Emergency–help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.
Client/Facility:	

12 EMERGENCY CONTACTS

If an injury occurs, notify the injured person's personnel office as soon as possible after obtaining medical attention for the injured person. Notification MUST be made within 24 hours of the injury.

24-hour CH2M HILL Emergency Beeper – 800/756-1130

Medical Emergency – 911 or
Hospital ER (On-Base) #: (910) 451-4840
(910) 451-4841
(910) 451-4842
Onslow County ER (Off-Base) #: (910) 577-2240
Ambulance (On-Base) #: (910) 451-3004
(910) 451-3005
Ambulance (Public) #: (910) 451-9111
LEPC (Poison Control)#: (800) 222-1222

CH2M HILL Medical Consultant
Dr. Jerry Berke
Health Resources, Woburn, MA
888/631-0129
(After hours calls will be returned within 20 minutes)

Fire/Spill Emergency – 911 or
Base Fire Response #: (910) 451-9111

Local Occupational Physician
Occupational Medicine Specialists
4815 Oleander Dr.
Wilmington, NC 28403
910 452-1111

Security & Police – 911 or
Base Security #: (910) 451-2555

Corporate Director Health and Safety
Name: Angelo Liberatore
Phone: 770/604-9182

On-Scene Coordinator
Name: Fire Chief
Phone: (910) 451-5815

Environmental Management Division (EMD)
Names: Bob Lowder
Phone: (910) 451-9607

Utilities Emergency
Water:
Gas: Contact Base EMD
Electric:

Health and Safety Manager (HSM)
Name: Michael Goldman/ATL
Phone: (770) 604-9182 x 54133
Cell: 770/331-3127

Designated Safety Coordinator (DSC) see Site-Specific HASP
Name:
Phone:

Regional Human Resources Department
Name: Jennifer Plauche
Phone: 770/604-9182

Project Manager see Site-Specific HASP
Name:
Phone:

Corporate Human Resources Department
Name: John Monark/COR
Phone: 303/771-0900

Federal Express Dangerous Goods Shipping
Phone: 800/238-5355

CH2M HILL Emergency Number for Shipping Dangerous Goods
Phone: 800/255-3924

Worker's Compensation and Auto Claims
Sterling Administration Services
Phone: 800/420-8926 After hours: 800/497-4566

Report fatalities AND report vehicular accidents involving pedestrians, motorcycles, or more than two cars.

Contact the Project Manager. Generally, the Project Manager will contact relevant government agencies.

Facility Alarms: TBD

Evacuation Assembly Area(s): TBD by the SC-HW; will probably be the local hotel where the field team is staying

Facility/Site Evacuation Route(s): follow main roads towards access gates and off the Base

Route to Hospital: (Refer to Figure 12-1) Depends on location within base area

Contact the project manager. Generally, the project manager will contact relevant government agencies.

Nearest On-Base hospital:
Base Naval Hospital (only to be used in extreme emergency)
Building NH100
100 Brewster Blvd.
Camp Lejeune, NC 28547
Phone: (910) 451-4840, (910) 451-4841, (910) 451-4842

Local hospital:
Onslow County Memorial Hospital
317 Western Boulevard
Jacksonville, NC 28546
Phone: (910) 577-2240

Local ambulance service:
Base Ambulance: (910) 451-3004, (910) 451-3005
Public Ambulance: (910) 451-9111

From MCB Camp Lejeune

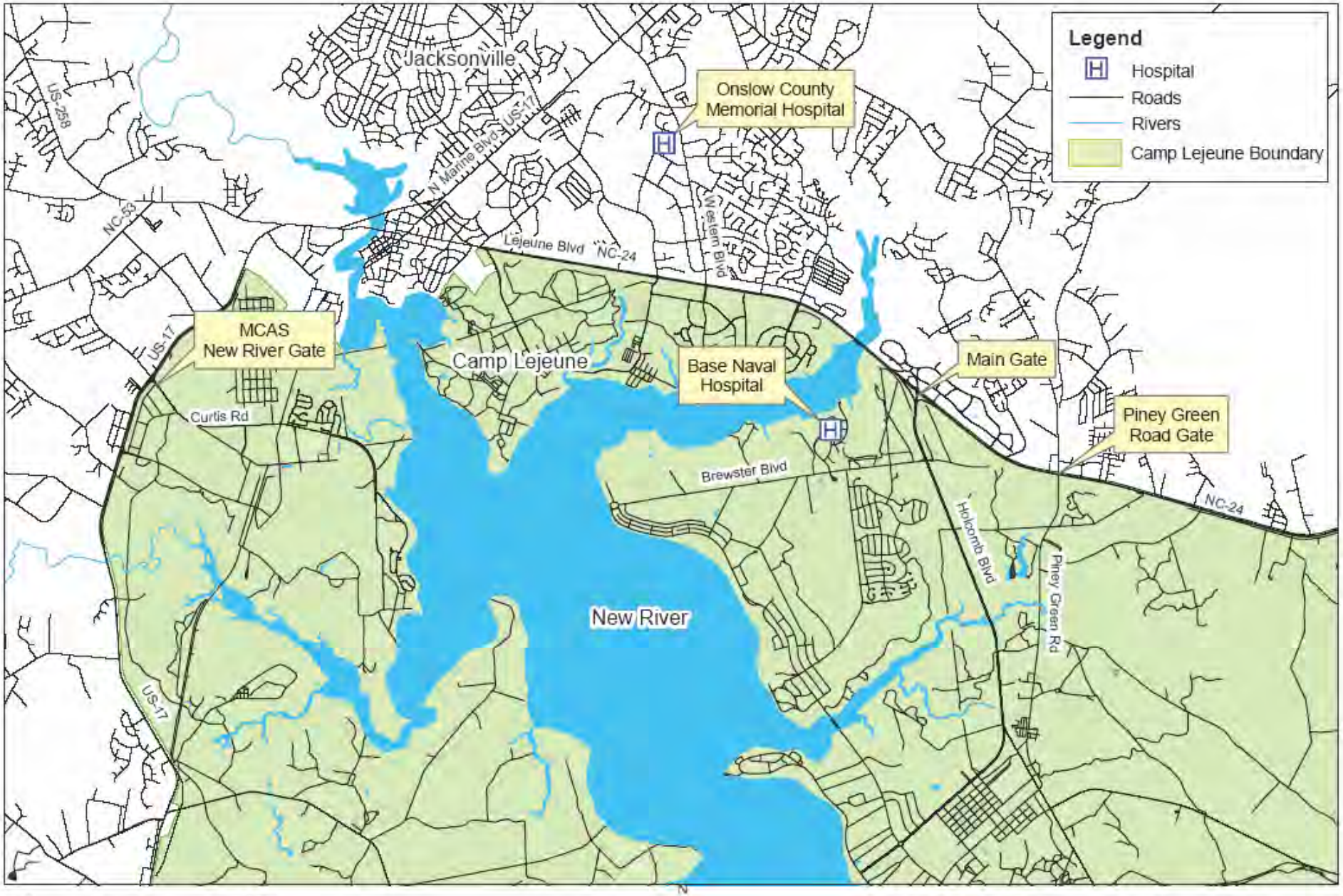
Directions to the Base Naval Hospital (Building NH100)
(nearest hospital; only to be used in an extreme emergency)

1. Proceed north to Holcomb Boulevard (towards Highway 24).
2. Turn left onto Brewster Boulevard (heading west)
3. Continue on Brewster Boulevard until intersection with the driveway to the Naval Hospital.
4. Turn onto Hospital driveway, and proceed to emergency room.

Directions to Onslow County Memorial Hospital :
1. From Holcomb Boulevard, exit Base through main gate.
2. Follow Highway 24 west until intersecting with Western Boulevard.
3. Turn right onto Western Boulevard.
4. The Onslow County Memorial Hospital is on the left, approximately 2 miles (fifth stop light) from Highway 24.
5. Follow the signs to the emergency room.

From Air Station and Camp Geiger

Directions to Onslow County Memorial Hospital:
1. Proceed through the main gate, turn right, and head north on Ocean Highway 17.
2. Follow Ocean Highway 17 north to Highway 24 and head east.
3. Travel east until Western Boulevard, turn left onto Western Boulevard.
4. The Onslow County Memorial Hospital is on the left, approximately 2 miles (fifth stop light) from Highway 24.
5. Follow the signs to the emergency room.



CH2MHILL

Figure 12-1
Route to Hospitals
Marine Corps Base, Camp Lejeune
North Carolina

P:/Proj/EBL/Navy Clean/Clean 2/CTO 139/Master Plans/Master HASP/Figures

13 APPROVAL

This site-specific health and safety plan has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

13.1 ORIGINAL PLAN

WRITTEN BY: Jessica Skeean **DATE:** June 21, 2004

APPROVED BY: Michael Goldman CIH **DATE:** June 21, 2004

14.2 REVISIONS

REVISIONS MADE BY: Michael Goldman **DATE: April 25, 2008**

REVISIONS TO PLAN: Updated the emergency contact numbers.

REVISIONS APPROVED BY: Michael Goldman DATE: April 25, 2008

15 ATTACHMENTS

Attachment 1: Site Specific Health and Safety Plan Template
Attachment 2: Employee Signoff
Attachment 3: Material Safety Data Sheets
Attachment 4: Health and Safety Self Assessment Checklist; Use referenced SOPs for other relevant checklists
Attachment 5: References (CH2M HILL SOPs and Procedures for Transporting Dangerous Goods)

Attachment 1

Site Specific Health and Safety Plan Template

Site Specific Health and Safety Plan
Site 40

Marine Corps Base
Camp Lejeune, North Carolina

Task Order 09

November 2007

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

Under the

NAVFAC Multi-Media Program
Contract N62470-D-0501

Prepared by

CH2MHILL

Charlotte, North Carolina

Introduction

The health and safety of site personnel and the public are a primary concern during investigative and remedial activities at potentially hazardous sites. This Site Specific Health and Safety Plan (HASP) template is to be used in the formation of site specific HASP's.

CH2M HILL SITE SPECIFIC HEALTH AND SAFETY PLAN

(Reference CH2M HILL SOP 19, *Health and Safety Plans*)

This health and safety plan will be kept on the site during field activities and will be reviewed and updated as necessary. The plan adopts, by reference, the standards of practice (SOP) in the CH2M HILL *Corporate Health and Safety Program,* as appropriate. The site safety coordinator (SC-HW) is to be familiar with these SOPs and the content of this plan. Site personnel must sign Attachment 1. In addition, this plan adopts procedures in the work plan for the project.

1. PROJECT INFORMATION AND DESCRIPTION

CLIENT OR OWNER: Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

PROJECT NO: 363366.04.04.01

CH2M HILL PROJECT MANAGER:

OFFICE:

SITE NAME: Marine Corps Base, Camp Lejeune

SITE ADDRESS: Jacksonville, North Carolina

DATE HEALTH AND SAFETY PLAN PREPARED:

DATE(S) OF INITIAL VISIT:

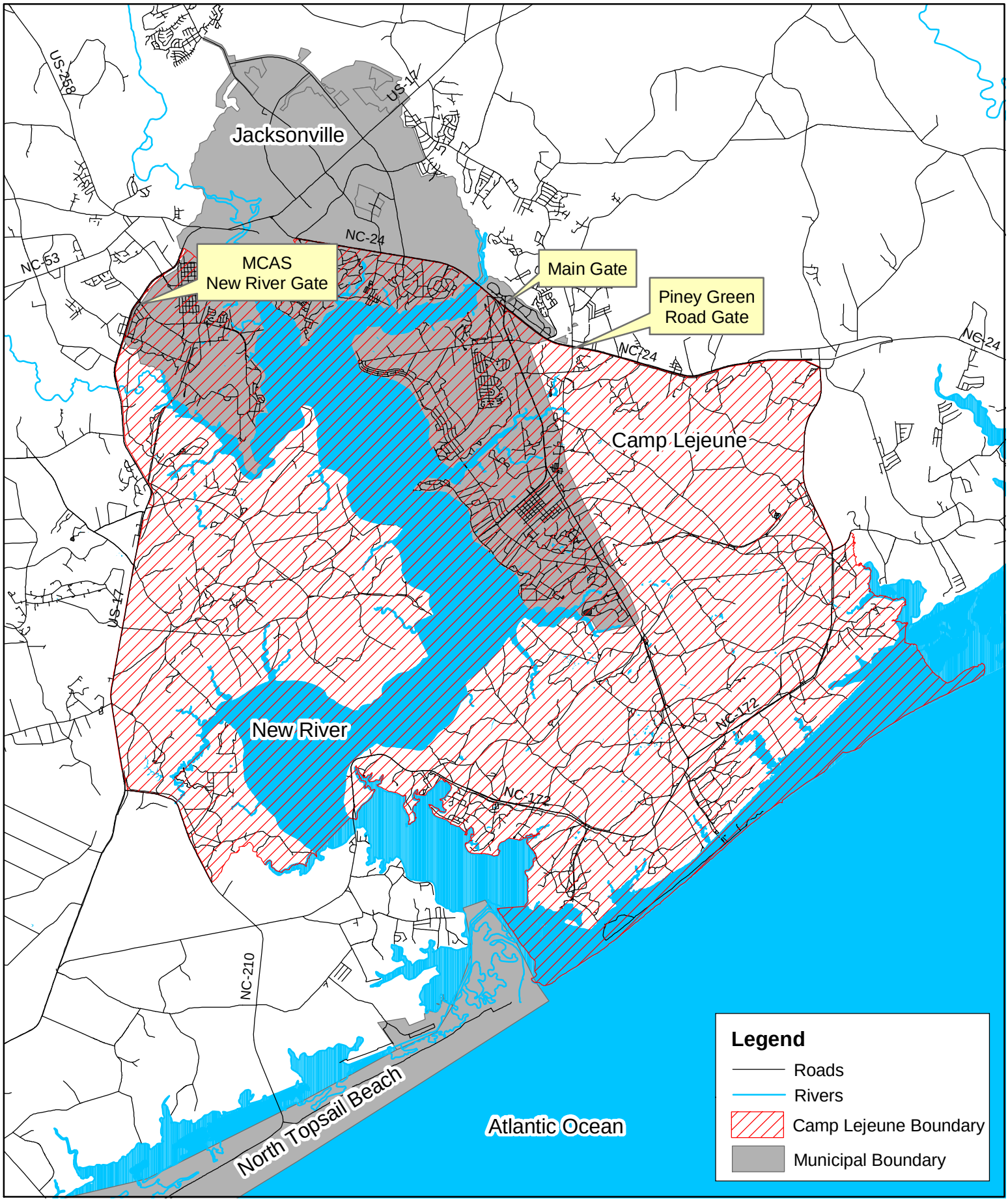
DATE(S) OF SITE WORK:

SITE ACCESS:

SITE SIZE:

SITE TOPOGRAPHY:

SITE DESCRIPTION AND HISTORY:



2.5 0 2.5 Miles

N

CH2MHILL

Figure 1-1
Location Map
Marine Corps Base, Camp Lejeune
North Carolina

2. PROJECT ORGANIZATION AND TASKS TO BE PERFORMED UNDER THIS PLAN

2.1 PROJECT ORGANIZATION

CLIENT: Daniel Hood
Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

CH2M HILL: Activity Manager:
Project Manager:
Health and Safety Manager:
Field Team Leader:
Field Staff.:

CONTRACTORS and SUBCONTRACTORS:

2.2 DESCRIPTION OF TASKS (Reference CH2M HILL SOP HS-19, *Written Plans*)

Refer to site-specific addenda (i.e., work plan, field sampling plan) for detailed task information. A health and safety risk analysis has been performed for each task and is incorporated into this HASP through task-specific hazard controls and requirements for monitoring and protection. Tasks in addition to those listed below and in the Master HASP require an approved amendment before additional work begins.

2.2.1 HAZWOPER-REGULATED TASKS

-
-

2.2.2 NON-HAZWOPER-REGULATED TASKS

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the HSM is required before these tasks are conducted on regulated hazardous waste sites.**

-
-

2.3 TASK HAZARD ANALYSIS

Engineering and administrative controls are to be implemented by the party in control of the site or the hazard (i.e., CH2M HILL, subcontractor, or contractor). CH2M HILL employees and subcontractors must, at a minimum, remain aware of hazards affecting them regardless of who is responsible for controlling the hazards. Specialty subcontractors are responsible for the safe operation of their equipment (e.g., drill rig, heavy equipment). CH2M HILL employees are not to operate, or assist in the operation of, any subcontractor or contractor equipment.

		Tasks								
Potential Hazard (Refer to SOP, or HSP Section)	**Engineering Controls, Administrative Controls, and Work Practices**	**Drilling, Geoprobe Installation, Well Installation and Abandonment**	**Groundwater Monitoring , Aquifer Testing, and Video Surveying of Wells**	**Surface Water and Sediment Sampling Using a Boat**	**Surface Water and Sediment Sampling from the Shore or Water**	**Hand Augering**	**Surveying**	**IDW Drum Sampling and Disposal[a]**	**Observation of Loading of Material for Offsite Disposal**	**Remediation and Construction Oversight**

3.1 HAZARDS POSED BY CHEMICALS BROUGHT ON THE SITE

This section discusses hazards posed by chemicals commonly used during RI/FS and other environmental investigation activities. Additional chemicals may be needed for future tasks.

3.1.1 HAZARD COMMUNICATION

(Reference CH2M HILL SOP HS-05, *Hazard Communication*)

The project manager is to request Material Safety Data Sheets (MSDSs) from the client or from the contractors and the subcontractors for chemicals to which CH2M HILL employees potentially are exposed. The SC-HW is to do the following:

- Give employees required site-specific HAZCOM training.
- Confirm that the inventory of chemicals brought on the site by subcontractors is available.
- Before or as the chemicals arrive on the site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, if any.

The chemical products listed below will be used on the site. Refer to Master HASP for MSDSs.

Chemical	Quantity	Location

3.1.2 SHIPPING AND TRANSPORTATION OF CHEMICAL PRODUCTS

(Reference CH2M HILL's *Procedures for Shipping and Transporting Dangerous Goods*)

Nearly all chemicals brought to the site are considered hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive the CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

3.2 CONTAMINANTS OF CONCERN

Contaminant	Location and Highest Concentration (ppm)	Exposure Limit[a]	IDLH[b]	Symptoms and Effects of Exposure	PIP[c] (eV)

Footnotes:
a: Appropriate value of PEL, REL, or TLV listed
b: IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant)
c: PIP = photoionization potential
GW – Groundwater
SD - Sediment
SW – Surface Water
J – Estimated concentration
D – Compound identified in analysis at a secondary dilution factor
B – Analyte found in associated blank as well as in sample

3.3 POTENTIAL ROUTES OF EXPOSURE

DERMAL: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 5.	INHALATION: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in sections 5 and 6, respectively.	OTHER: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before eating, drinking, or smoking).

4 PERSONNEL

4.1 FIELD TEAM CHAIN OF COMMAND AND COMMUNICATION PROCEDURES

4.1.1 CLIENT

Client Contact	Base Contact
Daniel Hood, PE	Bob Lowder
NAVFAC Engineering Command	Camp Lejeune - EMD
Code: OPCEV	Building 12
6506 Hampton Blvd	Marine Corps Base
Norfolk, Virginia 23508-1278	Camp Lejeune, NC 28542-0004
757-322-4630	(910) 451-9607
757-322-4805 fax	(910) 451-5997
daniel.r.hood@navy.mil	robert.a.lowder@usmc.mil

4.1.2 CH2M HILL

Activity Manager/Phone:
Project Manager/Phone:
Health and Safety Manager (HSM)/Phone:
Field Team Leader/Phone:
Site Safety Coordinator/Phone:

The SC-HW is responsible for contacting the field team leader and the project manager. In general, the project manager either will contact or will identify the client contact. The Health and Safety Manager (HSM) should be contacted as appropriate. The SC-HW or the project manager must notify the client and the HSM when a serious injury or a death occurs or when health and safety inspections by OSHA or other agencies are conducted. Refer to Master HASP sections 11 and 12 for emergency procedures and phone numbers.

4.1.3 SUBCONTRACTORS

(Reference CH2M HILL SOP HS-55, *Subcontractor, Contractor, and Owner)*

When specified in the project documents (e.g., contract), this plan may cover CH2M HILL subcontractors. However, this plan does not address hazards associated with tasks and equipment that the subcontractor has expertise in (e.g., operation of drill rig). Specialty subcontractors are responsible for health and safety procedures and plans specific to their work. Specialty subcontractors are to submit plans to CH2M HILL for review and approval before the start of fieldwork. Subcontractors must comply with the established health and safety plan(s). CH2M HILL must monitor and enforce compliance with the established plan(s).

Subcontractor:
Subcontractor Contact:
Telephone:

4.1.4 CONTRACTORS

(Reference CH2M HILL SOP HS-55, *Subcontractor, Contractor, and Owner*)

This plan does not cover contractors that are contracted directly to the client or the owner. CH2M HILL is not responsible for directing contractor personnel and is not to assume responsibility through their actions. When the contractor is in control of the site, ask the contractor to conduct a briefing of their health and safety practices and to describe how they apply to CH2M HILL's activities. Request a copy of the contractor's health and safety plan.

Contractor:
Contact Name:
Telephone:

5 PERSONAL PROTECTIVE EQUIPMENT (PPE)

(Reference CH2M HILL SOPs HS-07, *Personal Protective Equipment*, and HS-08, *Respiratory Protection*)

5.1 PPE SPECIFICATIONS

Task	Level	Body	Head	Respirator[b]

[a] CH2M HILL will provide PPE to only CH2M HILL employees.
[b] No facial hair that would interfere with respirator fit is permitted.

5.2 REASONS FOR UPGRADING OR DOWNGRADING LEVEL OF PROTECTION

Upgrade*	Downgrade
• Request from individual performing task. • Change in work task that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels (Section 6) exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decreases the hazard. • Change in work task that will reduce contact with hazardous materials.

*Performing a task that requires an upgrade to a higher level of protection (e.g., level D to level C) is permitted only when the PPE requirements have been specified in Section 5 and an SC-HW who meets the requirements specified in the Master HASP 4.1 is present.

6. AIR MONITORING SPECIFICATIONS

(Reference CH2M HILL SOP HS-06, *Air Monitoring*)

Instrument	Tasks	Action Levels[a]	Frequency[b]	Calibration

Notes:

a: Action levels apply to sustained breathing-zone measurements above background.

b: The exact frequency of monitoring depends on field conditions and is to be determined by the SC-HW; generally, every 5 to 15 minutes is acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time and measurement result, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3," "at surface/SB-2," etc.).

6.1 CALIBRATION SPECIFICATIONS

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Instrument	**Gas**	**Span**	**Reading**	**Method**

6.2 AIR SAMPLING

Sampling may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, and certain volatile organic compounds. Contact the HSM immediately if these contaminants are encountered.

Method Description:

Results must be sent immediately to the HSM. Regulations may require reporting to monitored personnel. Results reported to:

HSM: Michael Goldman CIH
Other:

7 APPROVAL

This site-specific health and safety plan has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

7.1 ORIGINAL PLAN

WRITTEN BY: **DATE:**

APPROVED BY: DATE:

7.2 REVISIONS

REVISIONS MADE BY: **DATE:**

REVISIONS TO PLAN:

REVISIONS APPROVED BY: **DATE:**

8 ATTACHMENTS

Attachment 1: Employee Signoff

EMPLOYEE SIGNOFF

The employees listed below have been given a copy of this health and safety plan, have read and understood it, and agree to abide by its provisions.

EMPLOYEE NAME	EMPLOYEE SIGNATURE AND DATE

Attachment 2

Employee Signoff Form

EMPLOYEE SIGNOFF

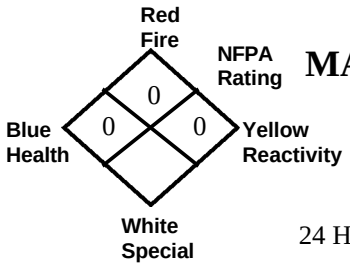
The employees listed below have been given a copy of this health and safety plan, have read and understood it, and agree to abide by its provisions.

EMPLOYEE NAME	EMPLOYEE SIGNATURE AND DATE

Attachment 3

Material Safety Data Sheets

Alconox ®



MATERIAL SAFETY DATA SHEET

Alconox, Inc.
30 Glenn Street
White Plains, NY 10603

24 Hour Emergency Number – Chem-Tel (800) 255-3924

I. IDENTIFICATION

Product Name (as appears on label)	ALCONOX
CAS Registry Number:	Not Applicable
Effective Date:	January 1, 2001
Chemical Family:	Anionic Powdered Detergent
Manufacturer Catalog Numbers for sizes	1104, 1125, 1150, 1101, 1103 and 1112

II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

There are no hazardous ingredients in ALCONOX as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

III. PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point (F):	Not Applicable
Vapor Pressure (mm Hg):	Not Applicable
Vapor Density (AIR=1):	Not Applicable
Specific Gravity (Water=1):	Not Applicable
Melting Point:	Not Applicable
Evaporation Rate (Butyl Acetate=1):	Not Applicable
Solubility in Water:	Appreciable-Soluble to 10% at ambient conditions
Appearance:	White powder interspersed with cream colored flakes.
pH:	9.5 (1%)

IV. FIRE AND EXPLOSION DATA

Flash Point (Method Used):	None
Flammable Limits:	LEL: No Data UEL: No Data
Extinguishing Media:	Water, dry chemical, CO_2, foam
Special Fire fighting Procedures:	Self-contained positive pressure breathing apparatus and protective clothing should be worn when fighting fires involving chemicals.
Unusual Fire and Explosion Hazards:	None

V. REACTIVITY DATA

Stability:	Stable
Hazardous Polymerization:	Will not occur
Incompatibility (Materials to Avoid):	None
Hazardous Decomposition or Byproducts:	May release CO_2 on burning

VI. HEALTH HAZARD DATA

Route(s) of Entry:	Inhalation? Yes Skin? No Ingestion? Yes
Health Hazards (Acute and Chronic):	Inhalation of powder may prove locally irritating to mucous membranes. Ingestion may cause discomfort and/or diarrhea. Eye contact may prove irritating.
Carcinogenicity:	NTP? No IARC Monographs? No OSHA Regulated? No
Signs and Symptoms of Exposure:	Exposure may irritate mucous membranes. May cause sneezing.
Medical Conditions Generally Aggravated by Exposure:	Not established. Unnecessary exposure to this product or any industrial chemical should be avoided. Respiratory conditions may be aggravated by powder.
Emergency and First Aid Procedures:	Eyes: Immediately flush eyes with water for at least 15 minutes. Call a physician. Skin: Flush with plenty of water. Ingestion: Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs administer fluids. See a physician for discomfort.

VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material is Released or Spilled:	Material foams profusely. Recover as much as possible and flush remainder to sewer. Material is biodegradable.
Waste Disposal Method:	Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.
Precautions to be Taken in Storing and Handling:	Material should be stored in a dry area to prevent caking.
Other Precautions:	No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

VIII. CONTROL MEASURES

Respiratory Protection (Specify Type):	Dust mask - Recommended
Ventilation:	Local Exhaust-Normal Special-Not Required Mechanical-Not Required Other-Not Required
Protective Gloves:	Impervious gloves are useful but not required.
Eye Protection:	Goggles are recommended when handling solutions.
Other Protective Clothing or Equipment:	None
Work/Hygienic Practices:	No special practices required

THE INFORMATION HEREIN IS GIVEN IN GOOD FAITH BUT NO WARRANTY IS EXPRESSED OR IMPLIED.

MSDS Number: **H2381** * * * * * *Effective Date:* ***11/02/01*** * * * * * *Supercedes:* ***04/15/99***

MSDS Material Safety Data Sheet

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300
National Response in Canada
CANUTEC: 613-996-6666
Outside U.S. And Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

J.T.Baker®

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HEXANE

1. Product Identification

Synonyms: Hexanes,Normal Hexane; Hexyl Hydride; Hexane 95%
CAS No.: 110-54-3 (n-hexane)
Molecular Weight: 86.18
Chemical Formula: CH3(CH2)4CH3 n-hexane
Product Codes: 9262, 9304, 9308, N168

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hexane	110-54-3	85 - 100%	Yes
Methylcyclopentane	96-37-7	1 - 2%	Yes
Trace amount of Benzene (10 ppm)	071-43-2	*	No

3. Hazards Identification

Emergency Overview

DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY

CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 0 - None
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

The health hazards addressed are for the major component: n-hexane.

Inhalation:
Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Greater exposure may cause muscle weakness, numbness of the extremities, unconsciousness and death.
Ingestion:
May produce abdominal pain, nausea. Aspiration into lungs can produce severe lung damage and is a medical emergency. Other symptoms expected to parallel inhalation.
Skin Contact:
May cause redness, irritation, with dryness, cracking.
Eye Contact:
Vapors may cause irritation. Splashes may cause redness and pain.
Chronic Exposure:
Repeated or prolonged skin contact may defat the skin and produce irritation and dermatitis. Chronic inhalation may cause peripheral nerve disorders and central nervous system effects.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance. May affect the developing fetus.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
Aspiration hazard. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:
Remove any contaminated clothing. Wipe off excess from skin. Wash skin with soap and water for at least 15 minutes. Get medical attention if irritation develops or persists.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
BEI=2,5-hexadione in urine, sample at end of shift at workweeks end, 5 mg/g creatine. Also, measure n-hexane in expired air. Analgesics may be necessary for pain management, there is no specific antidote. Monitor arterial blood gases in cases of severe aspiration.

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5. Fire Fighting Measures

Fire:
Flash point: -23C (-9F) CC
Autoignition temperature: 224C (435F)
Flammable limits in air % by volume:
lel: 1.2; uel: 7.7
Extremely Flammable Liquid and Vapor! Vapor may cause flash fire. Dangerous fire hazard when exposed to heat or flame.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with oxidizing materials may cause extremely violent combustion.Explodes when mixed @ 28C with dinitrogen tetraoxide. Sensitive to static discharge.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water may be ineffective.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water spray may be used to keep fire exposed containers cool. Vapors can flow along surfaces to distant ignition source and flash back. Vapor explosion hazard exists indoors, outdoors, or in sewers.

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6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

---

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from direct sunlight and any area where the fire hazard may be acute. Store in tightly closed containers (preferably under nitrogen atmosphere). Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
N-Hexane [110-54-3]:
-OSHA Permissible Exposure Limit (PEL): 500 ppm (TWA)
-ACGIH Threshold Limit Value (TLV): 50 ppm (TWA), Skin
other isomers of hexane
-ACGIH Threshold Limit Value (TLV): 500 ppm (TWA),1000ppm (STEL)
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134).
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Light odor.
Solubility:
Insoluble in water.
Specific Gravity:
0.66
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
ca. 68C (ca. 154F)
Melting Point:
ca. -95C (ca. -139F)
Vapor Density (Air=1):
3.0
Vapor Pressure (mm Hg):
130 @ 20C (68F)
Evaporation Rate (BuAc=1):
9

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Heat will contribute to instability.
Hazardous Decomposition Products:
May produce acrid smoke and irritating fumes when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizers.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

---

11. Toxicological Information

N-Hexane: Oral rat LD50: 28710 mg/kg. Irritation eye rabbit: 10 mg mild. Investigated as a tumorigen, mutagen and reproductive effector.

```
--------\Cancer Lists\-------------------------------------------------------
                                        ---NTP Carcinogen---
Ingredient                              Known    Anticipated    IARC Category
------------------------------------    -----    -----------    -------------
```

Hexane (110-54-3)	No	No	None
Methylcyclopentane (96-37-7)	No	No	None
Trace amount of Benzene (10 ppm) (071-43-2)	Yes	No	1

---

12. Ecological Information

Environmental Fate:
When released into the soil, this material may biodegrade to a moderate extent. When released into the soil, this material is not expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into water, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. This material has an estimated bioconcentration factor (BCF) of less than 100. This material has a log octanol-water partition coefficient of greater than 3.0. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days.
Environmental Toxicity:
No information found.

---

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HEXANES
Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 52L

International (Water, I.M.O.)

Proper Shipping Name: HEXANES

Hazard Class: 3
UN/NA: UN1208
Packing Group: II
Information reported for product/size: 52L

---

15. Regulatory Information

```
--------\Chemical Inventory Status - Part 1\---------------------------------
Ingredient                                        TSCA  EC   Japan  Australia
----------------------------------------------  ----  ---  -----  ---------
Hexane (110-54-3)                                 Yes  Yes   Yes      Yes
Methylcyclopentane (96-37-7)                      Yes  Yes   No       Yes
Trace amount of Benzene  (10 ppm) (071-43-2)      Yes  Yes   Yes      Yes

--------\Chemical Inventory Status - Part 2\---------------------------------
                                                         --Canada--
Ingredient                                        Korea  DSL   NDSL  Phil.
----------------------------------------------  -----  ---   ----  -----
Hexane (110-54-3)                                 Yes   Yes   No     Yes
Methylcyclopentane (96-37-7)                      Yes   Yes   No     Yes
Trace amount of Benzene  (10 ppm) (071-43-2)      Yes   Yes   No     Yes

--------\Federal, State & International Regulations - Part 1\----------------
                                            -SARA 302-    ------SARA 313------
Ingredient                                  RQ    TPQ     List  Chemical Catg.
----------------------------------------  ---   -----   ----  --------------
Hexane (110-54-3)                           No    No      Yes        No
Methylcyclopentane (96-37-7)                No    No      No         No
Trace amount of Benzene  (10 ppm)           No    No      Yes        No
(071-43-2)

--------\Federal, State & International Regulations - Part 2\----------------
                                                         -RCRA-    -TSCA-
Ingredient                                  CERCLA     261.33     8(d)
----------------------------------------  ------     ------    ------
Hexane (110-54-3)                           5000       No         No
Methylcyclopentane (96-37-7)                No         No         No
Trace amount of Benzene  (10 ppm)           10         U019       No
(071-43-2)


Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: Yes Pressure: No
Reactivity: No          (Mixture / Liquid)
```

WARNING:
THIS PRODUCT CONTAINS A CHEMICAL(S) KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

Australian Hazchem Code: 3[Y]E
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
DANGER! EXTREMELY FLAMMABLE LIQUID AND VAPOR. VAPOR MAY CAUSE FLASH FIRE. HARMFUL OR FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor or mist.
Avoid contact with eyes, skin and clothing.
Label First Aid:
Aspiration hazard. If swallowed, vomiting may occur spontaneously, but DO NOT INDUCE. If vomiting occurs, keep head below hips to prevent aspiration into lungs. Never give anything by mouth to an unconscious person. Call a physician immediately. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. In all cases call a physician.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8.
Disclaimer:
****

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Number: **H3880** * * * * * *Effective Date:* ***05/07/03*** * * * * * *Supercedes:* ***05/10/01***

MSDS Material Safety Data Sheet

From: **Mallinckrodt Baker, Inc.**
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

HYDROCHLORIC ACID, 33 - 40%

1. Product Identification

Synonyms: Muriatic acid; hydrogen chloride, aqueous
CAS No.: 7647-01-0
Molecular Weight: 36.46
Chemical Formula: HCl
Product Codes:
J.T. Baker: 5367, 5537, 5575, 5800, 5814, 5821, 5839, 5894, 5962, 5972, 5994, 6900, 7831, 9529, 9530, 9534, 9535, 9536, 9537, 9538, 9539, 9540, 9544, 9548
Mallinckrodt: 2062, 2515, 2612, 2624, 2626, 3861, 5587, H611, H613, H987, H992, H999, V078, V628

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Hydrogen Chloride	7647-01-0	33 - 40%	Yes
Water	7732-18-5	60 - 67%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED. INHALATION MAY CAUSE LUNG DAMAGE.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 3 - Severe (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Corrosive! Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death.
Ingestion:
Corrosive! Swallowing hydrochloric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract. May cause nausea, vomiting, and diarrhea. Swallowing may be fatal.
Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and discolor skin.
Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never

give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Extreme heat or contact with metals can release flammable hydrogen gas.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
If involved in a fire, use water spray. Neutralize with soda ash or slaked lime.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving hydrochloric acid. Stay away from ends of tanks. Cool tanks with water spray until well after fire is out.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB® or TEAM® 'Low Na+' acid neutralizers are recommended for spills of this product.

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7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and

incompatible materials. Do not wash out container and use it for other purposes. When diluting, the acid should always be added slowly to water and in small amounts. Never use hot water and never add water to the acid. Water added to acid can cause uncontrolled boiling and splashing. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Hydrochloric acid:
- OSHA Permissible Exposure Limit (PEL):
5 ppm (Ceiling)
- ACGIH Threshold Limit Value (TLV):
2 ppm (Ceiling), A4 Not classifiable as a human carcinogen

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a full facepiece respirator with an acid gas cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Colorless, fuming liquid.

Odor:
Pungent odor of hydrogen chloride.

Solubility:
Infinite in water with slight evolution of heat.

Density:
1.18

pH:
For HCL solutions: 0.1 (1.0 N), 1.1 (0.1 N), 2.02 (0.01 N)
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
53C (127F) Azeotrope (20.2%) boils at 109C (228F)
Melting Point:
-74C (-101F)
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
190 @ 25C (77F)
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Containers may burst when heated.
Hazardous Decomposition Products:
When heated to decomposition, emits toxic hydrogen chloride fumes and will react with water or steam to produce heat and toxic and corrosive fumes. Thermal oxidative decomposition produces toxic chlorine fumes and explosive hydrogen gas.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
A strong mineral acid, concentrated hydrochloric acid is incompatible with many substances and highly reactive with strong bases, metals, metal oxides, hydroxides, amines, carbonates and other alkaline materials. Incompatible with materials such as cyanides, sulfides, sulfites, and formaldehyde.
Conditions to Avoid:
Heat, direct sunlight.

---

11. Toxicological Information

Inhalation rat LC50: 3124 ppm/1H; oral rabbit LD50: 900 mg/kg (Hydrochloric acid concentrated); investigated as a tumorigen, mutagen, reproductive effector.

```
--------\Cancer Lists\-------------------------------------------------------
                                        ---NTP Carcinogen---
Ingredient                              Known    Anticipated    IARC Category
------------------------------------    -----    -----------    -------------
Hydrogen Chloride (7647-01-0)            No          No              3
Water (7732-18-5)                        No          No            None
```

---

12. Ecological Information

Environmental Fate:
When released into the soil, this material is not expected to biodegrade. When released into the soil, this material may leach into groundwater.
Environmental Toxicity:
This material is expected to be toxic to aquatic life.

---

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 475LB

International (Water, I.M.O.)

Proper Shipping Name: HYDROCHLORIC ACID
Hazard Class: 8
UN/NA: UN1789
Packing Group: II
Information reported for product/size: 475LB

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15. Regulatory Information

```
--------\Chemical Inventory Status - Part 1\----------------------------------
Ingredient                                        TSCA  EC   Japan  Australia
-----------------------------------------------   ----  ---  -----  ---------
Hydrogen Chloride (7647-01-0)                      Yes  Yes   Yes      Yes
Water (7732-18-5)                                  Yes  Yes   Yes      Yes

--------\Chemical Inventory Status - Part 2\----------------------------------
                                                            --Canada--
```

Ingredient	Korea	DSL	NDSL	Phil.
Hydrogen Chloride (7647-01-0)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Hydrogen Chloride (7647-01-0)	5000	500*	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Hydrogen Chloride (7647-01-0)	5000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: Yes
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: No (Mixture / Liquid)

Australian Hazchem Code: 2R
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR INHALED. INHALATION MAY CAUSE LUNG DAMAGE.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor or mist.
Use only with adequate ventilation.
Wash thoroughly after handling.
Store in a tightly closed container.
Remove and wash contaminated clothing promptly.
Label First Aid:
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases get

medical attention immediately.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8.
Disclaimer:
****

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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

BOC GASES

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: ISOBUTYLENE

1. Chemical Product and Company Identification

BOC Gases,
Division of,
The BOC Group, Inc.
575 Mountain Avenue
Murray Hill, NJ 07974

TELEPHONE NUMBER: (908) 464-8100
24-HOUR EMERGENCY TELEPHONE NUMBER: CHEMTREC (800) 424-9300

BOC Gases
Division of
BOC Canada Limited
5975 Falbourne Street, Unit 2
Mississauga, Ontario L5R 3W6

TELEPHONE NUMBER: (905) 501-1700
24-HOUR EMERGENCY TELEPHONE NUMBER: (905) 501-0802
EMERGENCY RESPONSE PLAN NO: 2-0101

PRODUCT NAME: ISOBUTYLENE
CHEMICAL NAME: Isobutylene
COMMON NAMES/SYNONYMS: 2-Methylpropene, Isobutene
TDG (Canada) CLASSIFICATION: 2.1
WHMIS CLASSIFICATION: A, B1, D2B

PREPARED BY: Loss Control (908)464-8100/(905)501-1700
PREPARATION DATE: 6/1/95
REVIEW DATES: 6/1/99

2. Composition, Information on Ingredients

EXPOSURE LIMITS[1]:

INGREDIENT	% VOLUME	PEL-OSHA[2]	TLV-ACGIH[3]	LD_{50} or LC_{50} Route/Species
Isobutylene FORMULA: C_4H_8 CAS: 115-11-7 RTECS #: UD0890000	99.0 to 99.8	None Established	Simple Asphyxiant	No Data

[1] Refer to individual state of provincial regulations, as applicable, for limits which may be more stringent than those listed here.
[2] As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)
[3] As stated in the ACGIH 1998-1999 Threshold Limit Values for Chemical Substances and Physical Agents.

OSHA Regulatory Status: This material is classified as hazardous under OSHA regulations.

3. Hazards Identification

EMERGENCY OVERVIEW

Flammable colorless gas with unpleasant odor. Dangerous fire and explosion hazard. Avoid heat, sparks, and flames. This product does not contain oxygen and may cause asphyxia if released in a confined area. Simple hydrocarbons can cause irritation and central nervous system depression at high concentrations. Contents under pressure. Use and store below 125 °F.

ROUTE OF ENTRY:

Skin Contact	Skin Absorption	Eye Contact	Inhalation	Ingestion
No	No	No	Yes	No

HEALTH EFFECTS:

Exposure Limits	Irritant	Sensitization
No	Yes	No
Teratogen	Reproductive Hazard	Mutagen
No	No	No
Synergistic Effects None Reported		

Carcinogenicity: -- NTP: No IARC: No OSHA: No

EYE EFFECTS:
High concentrations may cause minor irritation.

SKIN EFFECTS:
None anticipated.

INGESTION EFFECTS:
Ingestion is unlikely.

INHALATION EFFECTS:
Product is relatively nontoxic. May cause minor eye, mucous membrane and respiratory irritation at high concentrations.

Inhalation of high concentrations may cause dizziness, disorientation, incoordination, narcosis, nausea or narcotic effects.

This product may displace oxygen if released in a confined space. Maintain oxygen levels above 19.5% at sea level to prevent asphyxiation.

Effects of oxygen deficiency resulting from simple asphyxiants may include: rapid breathing, diminished mental alertness, impaired muscular coordination, faulty judgement, depression of all sensations, emotional instability, and fatigue. As asphyxiation progresses, nausea, vomiting, prostration, and loss of consciousness may result, eventually leading to convulsions, coma, and death.

Oxygen deficiency during pregnancy has produced developmental abnormalities in humans and experimental animals.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: None known.

NFPA HAZARD CODES	HMIS HAZARD CODES	RATINGS SYSTEM
Health: 2	Health: 1	0 = No Hazard
Flammability: 4	Flammability: 4	1 = Slight Hazard
Instability: 1	Reactivity: 1	2 = Moderate Hazard
		3 = Serious Hazard
		4 = Severe Hazard

4. First Aid Measures

EYES:
None normally required. If irritation occurs, flush eyes with water for 15 minutes. If irritation persists, seek medical attention.

SKIN:
None normally required. If irritation occurs, remove contaminated clothing and wash affected area with soap and water. If irritation persists, seek medical attention.

INGESTION:
Not normally required. Seek immediate medical attention.

INHALATION:
PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO PRODUCT. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Conscious persons should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. Unconscious persons should be moved to an uncontaminated area, given assisted (artificial) respiration and supplemental oxygen. Further treatment should be symptomatic and supportive.

5. Fire Fighting Measures

Conditions of Flammability: Flammable liquid and vapor		
Flash point: -105 ^{o}F (-76 ^{o}C)	Method: Closed Cup	Autoignition Temperature: 869 ^{o}F (465 ^{o}C)
LEL(%): 1.8	UEL(%): 9.6	
Hazardous combustion products: Carbon monoxide, Carbon dioxide		
Sensitivity to mechanical shock: None		
Sensitivity to static discharge: Not Available		

FIRE AND EXPLOSION HAZARDS:
Isobutylene is heavier than air and may travel a considerable distance along the ground to an ignition source and flash back. Isobutylene is a flammable gas! Keep away from open flame and other sources of ignition. Do not allow smoking in storage areas or when handling. Cylinder may rupture violently from pressure when involved in a fire situation.

EXTINGUISHING MEDIA:
Water, carbon dioxide, dry chemical.

FIRE FIGHTING INSTRUCTIONS:
If possible, stop the flow of gas. Inerting the atmosphere to reduce oxygen levels may extinguish flame, allowing capping of leaking container. Do not attempt this unless specifically trained. Reduce the rate of flow and inject an inert gas, if possible, before completely stopping the flow to prevent flashback. Do not extinguish the fire until the supply is shut off as otherwise an explosive re-ignition may occur. If the fire is extinguished and the flow of gas continues, use increased ventilation to prevent build-up of explosive atmosphere. Use non-sparking tools to close container valves.

Use water spray to cool surrounding containers. Be cautious of a Boiling Liquid Evaporating Vapor Explosion, BLEVE, if flame is impinging on surrounding containers. Direct 500 GPM water stream onto containers above liquid level with remote monitors. Limit the number of personnel in proximity of fire and evacuate surrounding areas in all directions.

Firefighters should wear respiratory protection (SCBA) and full turnout or Bunker gear. Continue to cool fire-exposed cylinders until well after flames are extinguished.

6. Accidental Release Measures

Extinguish all ignition sources. No smoking, flames, flares or sparks in hazard area. Evacuate all personnel from affected area. Use appropriate protective equipment. Increase ventilation to prevent build up of a flammable/explosive atmosphere. If leak is in user's equipment, be certain to purge piping with inert gas prior to attempting repairs. If leak is in container or container valve, contact the appropriate emergency telephone number listed in Section 1 or call your closest BOC location.

7. Handling and Storage

Electrical classification:
Not available.

Earth bond and ground all lines and equipment associated with the product system. **All** equipment should be non-sparking and explosion proof.

Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure regulator when connecting cylinder to lower pressure (<250 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.

Protect cylinders from physical damage. Store in cool, dry, well-ventilated area away from heavily trafficked areas, emergency exits, flammables and combustibles. Do not allow the temperature where cylinders are stored to exceed 125°F (52°C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time.

Post "No Smoking" signs in storage or use areas. There should be no sources of ignition in storage and use areas. Outside or detached storage preferred.

For additional recommendations consult Compressed Gas Association Pamphlet P-1 and Safety Bulletin SB-2.

Never carry a compressed gas cylinder or a container of a gas in cryogenic liquid form in an enclosed space such as a car trunk, van or station wagon. A leak can result in a fire, explosion, asphyxiation or a toxic exposure.

8. Exposure Controls, Personal Protection

ENGINEERING CONTROLS:
Use local exhaust to prevent accumulation. Use general ventilation to prevent build up of flammable concentrations. May use hood with forced ventilation when handling small quantities. If product is handled routinely where the potential for leaks exists, all electrical equipment must be rated for use in potentially flammable atmospheres. Consult the National Electrical Code for details.

EYE/FACE PROTECTION:
Safety goggles or glasses.

SKIN PROTECTION:
Protective gloves made of plastic or rubber.

RESPIRATORY PROTECTION:
Positive pressure air line with full-face mask and escape bottle or self-contained breathing apparatus should be available for emergency use.

OTHER/GENERAL PROTECTION:
Safety shoes

9. Physical and Chemical Properties

PARAMETER	VALUE	UNITS
Physical state (gas, liquid, solid)	: Gas	
Vapor pressure at 70°F	: 39	psia
Vapor density at STP (Air = 1)	: 1.98	
Evaporation point	: Not Available	
Boiling point	: 19.5	°F
	: -6.9	°C
Freezing point	: -220.6	°F
	: -140.3	°C
pH	: Not Available	
Specific gravity	: Not Available	
Oil/water partition coefficient	: Not Available	
Solubility (H_20)	: Insoluble	
Odor threshold	: Not Available	
Odor and appearance	: A colorless gas with an unpleasant odor similar to that of burning coal.	

10. Stability and Reactivity

STABILITY:
Stable

INCOMPATIBLE MATERIALS:
Oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS:
Carbon monoxide

11. Toxicological Information

Oxygen deficiency during pregnancy has produced developmental abnormalities in humans and experimental animals.

No chronic effects data given in the Registry of Toxic Effects of Chemical Substances (RTECS) or Sax, Dangerous Properties of Industrial Materials, 7th ed.

12. Ecological Information

No data given.

13. Disposal Considerations

Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED, WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to BOC Gases or authorized distributor for proper disposal.

14. Transport Information

PARAMETER	United States DOT	Canada TDG
PROPER SHIPPING NAME:	Isobutylene	Isobutylene
HAZARD CLASS:	2.1	2.1
IDENTIFICATION NUMBER:	UN 1055	UN 1055
SHIPPING LABEL:	FLAMMABLE GAS	FLAMMABLE GAS

15. Regulatory Information

Isbutylene is listed under the accident prevention provisions of section 112(r) of the Clean Air Act (CAA) with a threshold quantity (TQ) of 10,000 pounds.

SARA TITLE III NOTIFICATIONS AND INFORMATION
SARA TITLE III - HAZARD CLASSES:
Fire Hazard
Sudden Release of Pressure Hazard

16. Other Information

ACGIH	American Conference of Governmental Industrial Hygienists
DOT	Department of Transportation
IARC	International Agency for Research on Cancer
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
SARA	Superfund Amendments and Reauthorization Act
STEL	Short Term Exposure Limit
TDG	Transportation of Dangerous Goods
TLV	Threshold Limit Value
WHMIS	Workplace Hazardous Materials Information System

Compressed gas cylinders shall not be refilled without the express written permission of the owner. Shipment of a compressed gas cylinder which has not been filled by the owner or with his/her (written) consent is a violation of transportation regulations.

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES:
Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained herein, and assume no responsibility regarding the suitability of this information for the user's intended purposes or for the consequences of its use. Each individual should make a determination as to the suitability of the information for their particular purpose(s).

MSDS Number: **I8840** * * * * * *Effective Date:* ***05/07/03*** * * * * * *Supercedes:* ***01/14/02***

MSDS **Material Safety Data Sheet**

From: **Mallinckrodt Baker, Inc.**
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

ISOPROPYL ALCOHOL (90 - 100%)

1. Product Identification

Synonyms: 2-Propanol; sec-propyl alcohol; isopropanol; sec-propanol; dimethylcarbinol
CAS No.: 67-63-0
Molecular Weight: 60.10
Chemical Formula: (CH3)2 CHOH
Product Codes:
J.T. Baker: 5082, 9037, 9080, U298
Mallinckrodt: 0562, 3027, 3031, 3032, 3035, 3037, 3043, 4359, 6569, H604, H982, V555, V566, V681

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Isopropyl Alcohol	67-63-0	90 - 100%	Yes
Water	7732-18-5	0 - 10%	No

3. Hazards Identification

Emergency Overview

WARNING! FLAMMABLE LIQUID AND VAPOR. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. MAY CAUSE IRRITATION TO SKIN.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 2 - Moderate
Contact Rating: 3 - Severe
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
Inhalation of vapors irritates the respiratory tract. Exposure to high concentrations has a narcotic effect, producing symptoms of dizziness, drowsiness, headache, staggering, unconsciousness and possibly death.
Ingestion:
Can cause drowsiness, unconsciousness, and death. Gastrointestinal pain, cramps, nausea, vomiting, and diarrhea may also result. The single lethal dose for a human adult = about 250 mls (8 ounces).
Skin Contact:
May cause irritation with redness and pain. May be absorbed through the skin with possible systemic effects.
Eye Contact:
Vapors cause eye irritation. Splashes cause severe irritation, possible corneal burns and eye damage.
Chronic Exposure:
Chronic exposure may cause skin effects.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or impaired liver, kidney, or pulmonary function may be more susceptible to the effects of this agent.

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4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion:
Give large amounts of water to drink. Never give anything by mouth to an unconscious person. Get medical attention.

Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes. Call a physician if irritation develops.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Flash point: 12C (54F) CC
Autoignition temperature: 399C (750F)
Flammable limits in air % by volume:
lel: 2.0; uel: 12.7
Listed fire data is for Pure Isopropyl Alcohol.
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire or explosion. Vapors can flow along surfaces to distant ignition source and flash back. Sensitive to static discharge.
Fire Extinguishing Media:
Water spray, dry chemical, alcohol foam, or carbon dioxide. Water spray may be used to keep fire exposed containers cool, dilute spills to nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

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6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

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7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Small quantities of peroxides can form on prolonged storage. Exposure to light and/or air significantly increases the rate of peroxide formation. If evaporated to a residue, the mixture of peroxides and isopropanol may explode when exposed to heat or shock.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Isopropyl Alcohol (2-Propanol):
-OSHA Permissible Exposure Limit (PEL):
400 ppm (TWA)

-ACGIH Threshold Limit Value (TLV):
200 ppm (TWA), 400 ppm (STEL), A4 - not classifiable as a human carcinogen.
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a full facepiece respirator with organic vapor cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Neoprene and nitrile rubber are recommended materials.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

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9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:

Rubbing alcohol.
Solubility:
Miscible in water.
Specific Gravity:
0.79 @ 20C/4C
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
82C (180F)
Melting Point:
-89C (-128F)
Vapor Density (Air=1):
2.1
Vapor Pressure (mm Hg):
44 @ 25C (77F)
Evaporation Rate (BuAc=1):
2.83

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Heat and sunlight can contribute to instability.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Heat, flame, strong oxidizers, acetaldehyde, acids, chlorine, ethylene oxide, hydrogen-palladium combination, hydrogen peroxide-sulfuric acid combination, potassium tert-butoxide, hypochlorous acid, isocyanates, nitroform, phosgene, aluminum, oleum and perchloric acid.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

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11. Toxicological Information

Oral rat LD50: 5045 mg/kg; skin rabbit LD50: 12.8 gm/kg; inhalation rat LC50: 16,000 ppm/8-hour; investigated as a tumorigen, mutagen, reproductive effector.

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--------\Cancer Lists\-----------------------------------------------------
                                        ---NTP Carcinogen---
Ingredient                              Known    Anticipated    IARC Category
```

Isopropyl Alcohol (67-63-0)	No	No	3
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to quickly evaporate. When released into the soil, this material may leach into groundwater. When released into the soil, this material may biodegrade to a moderate extent. When released to water, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. When released into water, this material may biodegrade to a moderate extent. This material is not expected to significantly bioaccumulate. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into the air, this material is expected to have a half-life between 1 and 10 days. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition.
Environmental Toxicity:
The LC50/96-hour values for fish are over 100 mg/l. This material is not expected to be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: ISOPROPANOL
Hazard Class: 3
UN/NA: UN1219
Packing Group: II
Information reported for product/size: 355LB

International (Water, I.M.O.)

Proper Shipping Name: ISOPROPANOL

Hazard Class: 3
UN/NA: UN1219
Packing Group: II
Information reported for product/size: 355LB

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15. Regulatory Information

```
--------\Chemical Inventory Status - Part 1\---------------------------------
Ingredient                                        TSCA  EC   Japan  Australia
----------------------------------------------  ----  ---  -----  ---------
Isopropyl Alcohol (67-63-0)                       Yes  Yes   Yes      Yes
Water (7732-18-5)                                 Yes  Yes   Yes      Yes

--------\Chemical Inventory Status - Part 2\---------------------------------
                                                         --Canada--
Ingredient                                        Korea  DSL   NDSL  Phil.
----------------------------------------------  -----  ---   ----  -----
Isopropyl Alcohol (67-63-0)                       Yes   Yes   No     Yes
Water (7732-18-5)                                 Yes   Yes   No     Yes

--------\Federal, State & International Regulations - Part 1\----------------
                                            -SARA 302-    ------SARA 313------
Ingredient                                  RQ    TPQ     List  Chemical Catg.
----------------------------------------  ---   -----   ----  --------------
Isopropyl Alcohol (67-63-0)                 No    No      Yes        No
Water (7732-18-5)                           No    No      No         No

--------\Federal, State & International Regulations - Part 2\----------------
                                                         -RCRA-    -TSCA-
Ingredient                                  CERCLA     261.33     8(d)
----------------------------------------  ------     ------    ------
Isopropyl Alcohol (67-63-0)                 No         No         No
Water (7732-18-5)                           No         No         No


Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  Yes
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: Yes Pressure: No
Reactivity: No          (Mixture / Liquid)
```

Australian Hazchem Code: 2[S]2
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

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16. Other Information

NFPA Ratings: Health: **2** Flammability: **3** Reactivity: **0**

Label Hazard Warning:
WARNING! FLAMMABLE LIQUID AND VAPOR. HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM. MAY BE HARMFUL IF ABSORBED THROUGH SKIN. MAY CAUSE IRRITATION TO SKIN.
Label Precautions:
Keep away from heat, sparks and flame.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Avoid breathing vapor or mist.
Avoid contact with eyes, skin and clothing.
Label First Aid:
If swallowed, give large amounts of water to drink. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes. Wash clothing before reuse. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 8.
Disclaimer:
****

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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

BOC GASES

MATERIAL SAFETY DATA SHEET

PRODUCT NAME: METHANE

1. Chemical Product and Company Identification

BOC Gases,
Division of,
The BOC Group, Inc.
575 Mountain Avenue
Murray Hill, NJ 07974

TELEPHONE NUMBER: (908) 464-8100
24-HOUR EMERGENCY TELEPHONE NUMBER: CHEMTREC (800) 424-9300

BOC Gases
Division of
BOC Canada Limited
5975 Falbourne Street, Unit 2
Mississauga, Ontario L5R 3W6

TELEPHONE NUMBER: (905) 501-1700
24-HOUR EMERGENCY TELEPHONE NUMBER: (905) 501-0802
EMERGENCY RESPONSE PLAN NO: 2-0101

PRODUCT NAME: METHANE
CHEMICAL NAME: CH4
COMMON NAMES/SYNONYMS: Methyl Hydride
TDG (Canada) CLASSIFICATION: 2.1
WHMIS CLASSIFICATION: A, B1

PREPARED BY: Loss Control (908)464-8100/(905)501-1700
PREPARATION DATE: 6/1/95
REVIEW DATES: 6/1/99

2. Composition, Information on Ingredients

EXPOSURE LIMITS[1]:

INGREDIENT	% VOLUME	PEL-OSHA[2]	TLV-ACGIH[3]	LD_{50} or LC_{50} Route/Species
Methane FORMULA: CH_4 CAS: 74-82-8 RTECS #: PA1490000	100	None Established	Simple Asphyxiant	Not Available

[1] Refer to individual state of provincial regulations, as applicable, for limits which may be more stringent than those listed here.
[2] As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)
[3] As stated in the ACGIH 1998-1999 Threshold Limit Values for Chemical Substances and Physical Agents.

OSHA Regulatory Status: This material is classified as hazardous under OSHA regulations.

3. Hazards Identification

EMERGENCY OVERVIEW

Odorless, colorless flammable gas. Dangerous fire and explosion hazard. Avoid heat, sparks and flames. Simple Asphyxiant – This product does not contain oxygen and may cause asphyxia if released in a confined area. Maintain oxygen levels above 19.5%. Contents under pressure. Use and store below 125 °F.

ROUTE OF ENTRY:

Skin Contact	Skin Absorption	Eye Contact	Inhalation	Ingestion
No	No	No	Yes	No

HEALTH EFFECTS:

Exposure Limits	Irritant	Sensitization
No	No	No
Teratogen	Reproductive Hazard	Mutagen
No	No	No
Synergistic Effects None reported		

Carcinogenicity: -- NTP: No IARC: No OSHA: No

EYE EFFECTS:
None anticipated.

SKIN EFFECTS:
None anticipated.

INGESTION EFFECTS:
None known. Ingestion is unlikely.

INHALATION EFFECTS:
Methane and nitrogen are simple asphyxiants. Exposure to high concentrations of this gas mixture may exclude an adequate supply of oxygen. Oxygen levels should be maintained at greater than 19.5% at normal atmospheric pressure.

Effects of oxygen deficiency resulting from simple asphyxiants may include: rapid breathing, diminished mental alertness, impaired muscular coordination, faulty judgement, depression of all sensations, emotional instability, and fatigue. As asphyxiation progresses, nausea, vomiting, prostration, and loss of consciousness may result, eventually leading to convulsions, coma, and death.

Oxygen deficiency during pregnancy has produced developmental abnormalities in humans and experimental animals.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: None known.

NFPA HAZARD CODES	HMIS HAZARD CODES	RATINGS SYSTEM
Health: 2	Health: 0	0 = No Hazard
Flammability: 4	Flammability: 4	1 = Slight Hazard
Instability: 0	Reactivity: 0	2 = Moderate Hazard
		3 = Serious Hazard
		4 = Severe Hazard

4. First Aid Measures

EYES:
None required.

SKIN:
None required.

INGESTION:
Not normally required.

INHALATION:
PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF OVEREXPOSURE TO THIS PRODUCT. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Victims should be assisted to an uncontaminated area and inhale fresh air. Quick removal from the contaminated area is most important. If breathing has stopped administer artificial resuscitation and supplemental oxygen. Further treatment should be symptomatic and supportive. Keep victim warm and quiet.

5. Fire Fighting Measures

Conditions of Flammability: Flammable gas		
Flash point: -306°F (-188°C)	Method: Closed cup	Autoignition Temperature: 1076°F (580°C)
LEL(%): 5	UEL(%): 15	
Hazardous combustion products: Carbon dioxide, Carbon monoxide		
Sensitivity to mechanical shock: None		
Sensitivity to static discharge: Not Available		

FIRE AND EXPLOSION HAZARDS:
Flammable gas. Cylinder may rupture violently from pressure when involved in a fire situation.

EXTINGUISHING MEDIA:
Carbon dioxide, dry chemical or water spray.

FIRE FIGHTING INSTRUCTIONS:
If possible, stop the flow of gas. Inerting the atmosphere to reduce oxygen levels may extinguish flame, allowing capping of leaking container. Do not attempt this unless specifically trained. Reduce the rate of flow and inject an inert gas, if possible, before completely stopping the flow to prevent flashback. Do not extinguish the fire until the supply is shut off as otherwise an explosive re-ignition may occur. If the fire is extinguished and the flow of gas continues, use increased ventilation to prevent build-up of explosive atmosphere. Use non-sparking tools to close container valves.

Use water spray to cool surrounding containers. Be cautious of a Boiling Liquid Evaporating Vapor Explosion, BLEVE, if flame is impinging on surrounding containers. Direct 500 GPM water stream onto containers above liquid level with remote monitors. Limit the number of personnel in proximity of fire and evacuate surrounding areas in all directions.

Firefighters should wear respiratory protection (SCBA) and full turnout or Bunker gear. Continue to cool fire-exposed cylinders until well after flames are extinguished.

6. Accidental Release Measures

Immediately extinguish all ignition sources. No smoking, flames, sparks or flares in hazard area. Evacuate all personnel from affected area. Use appropriate protective equipment. If leak is in user's equipment, be certain to purge piping with inert gas prior to attempting repairs. If leak is in container or container valve, contact the appropriate emergency telephone number listed in Section 1 or call your closest BOC location.

7. Handling and Storage

Electrical Classification:
Not Available

Earth ground and bond all lines and equipment associated with the system. All equipment should be non sparking or explosion-proof.

Methane is non-corrosive and may be used with any common structural material.

Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure regulator when connecting cylinder to lower pressure piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder.

Protect cylinders from physical damage. Store in cool, dry, well-ventilated area of non-combustible construction away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 125°F (52°C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time. Post "NO SMOKING" signs in use or storage areas. There should be no sources of ignition in areas where this product is being used or stored. Outside or detached storage is preferred.

For additional storage recommendations, consult Compressed Gas Association's Pamphlets P-1, P-14, and Safety Bulletin SB-2.

8. Exposure Controls, Personal Protection

ENGINEERING CONTROLS:
Hood with forced ventilation. Local exhaust to prevent dilution of oxygen levels below 19.5%. Mechanical in accordance with electrical codes.

EYE/FACE PROTECTION:
Safety goggles or glasses.

SKIN PROTECTION:
Plastic or rubber gloves. Protective gloves made of any suitable material.

RESPIRATORY PROTECTION:
Positive pressure air line with mask and escape bottle or self-contained breathing apparatus should be available for emergency use.

OTHER/GENERAL PROTECTION:
Safety shoes.

9. Physical and Chemical Properties

PARAMETER	VALUE	UNITS
Physical state (gas, liquid, solid)	: Gas	
Vapor pressure	: Not Available	
Vapor density (Air = 1)	: Not Available	
Evaporation point	: Not Available	
Boiling point	: -285.7	^oF
	: -161.5	^oC
Freezing point	: -296.5	^oF
	: -182.5	^oC
pH	: Not Applicable	
Specific gravity	: 0.55	
Oil/water partition coefficient	: Not Available	
Solubility (H_20)	: Negligible	
Odor threshold	: Not Applicable	
Odor and appearance	: Odorless, colorless gas	

10. Stability and Reactivity

STABILITY:
Stable

INCOMPATIBLE MATERIALS:
Oxidizers

HAZARDOUS POLYMERIZATION:
Will not occur.

11. Toxicological Information

No data given in the Registry of Toxic Effects of Chemical Substances (RTECS) or Sax, Dangerous Properties of Industrial Materials, 7th ed.

Oxygen deficiency during pregnancy has produced developmental abnormalities in humans and experimental animals.

12. Ecological Information

No data given.

13. Disposal Considerations

Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED, WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to BOC Gases or authorized distributor for proper disposal.

14. Transport Information

PARAMETER	United States DOT	Canada TDG
PROPER SHIPPING NAME:	Methane, compressed	Methane, compressed
HAZARD CLASS:	2.1	2.1
IDENTIFICATION NUMBER:	UN 1971	UN 1971
SHIPPING LABEL:	FLAMMABLE GAS	FLAMMABLE GAS

15. Regulatory Information

Methane is listed under the accident prevention provisions of section 112(r) of the Clean Air Act (CAA) with a threshold quantity (TQ) of 10,000 pounds.

SARA TITLE III NOTIFICATIONS AND INFORMATION

SARA TITLE III - HAZARD CLASSES:
Fire Hazard
Sudden Release of Pressure Hazard

16. Other Information

ACGIH	American Conference of Governmental Industrial Hygienists
DOT	Department of Transportation
IARC	International Agency for Research on Cancer
NTP	National Toxicology Program
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
SARA	Superfund Amendments and Reauthorization Act
STEL	Short Term Exposure Limit
TDG	Transportation of Dangerous Goods
TLV	Threshold Limit Value
WHMIS	Workplace Hazardous Materials Information System

Compressed gas cylinders shall not be refilled without the express written permission of the owner. Shipment of a compressed gas cylinder which has not been filled by the owner or with his/her (written) consent is a violation of transportation regulations.

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES:
Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained herein, and assume no responsibility regarding the suitability of this information for the user's intended purposes or for the consequences of its use. Each individual should make a determination as to the suitability of the information for their particular purpose(s).

MSDS Number: **M2015** * * * * * *Effective Date:* ***11/12/01*** * * * * * *Supercedes:* ***12/14/00***

MSDS **Material Safety Data Sheet**

From: **Mallinckrodt Baker, Inc.**
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

METHYL ALCOHOL

1. Product Identification

Synonyms: Wood alcohol; methanol; carbinol
CAS No.: 67-56-1
Molecular Weight: 32.04
Chemical Formula: CH3OH
Product Codes:
J.T. Baker: 5217, 5370, 5794, 5811, 5842, 5869, 9049, 9063, 9065, 9066, 9067, 9069, 9070, 9071, 9073, 9075, 9076, 9077, 9091, 9093, 9096, 9097, 9098, 9263, 9822, 9830, V654
Mallinckrodt: 3004, 3006, 3016, 3017, 3018, 3024, 3041, 3701, 4295, 5160, 8814, H080, H488, H603, H985, V079, V571

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Methyl Alcohol	67-56-1	100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS. FLAMMABLE LIQUID AND VAPOR. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM AND LIVER.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 1 - Slight
Contact Rating: 3 - Severe (Life)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER
Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Once absorbed into the body, it is very slowly eliminated. Symptoms of overexposure may include headache, drowsiness, nausea, vomiting, blurred vision, blindness, coma, and death. A person may get better but then worse again up to 30 hours later.
Ingestion:
Toxic. Symptoms parallel inhalation. Can intoxicate and cause blindness. Usual fatal dose: 100-125 milliliters.
Skin Contact:
Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure.
Eye Contact:
Irritant. Continued exposure may cause eye lesions.
Chronic Exposure:
Marked impairment of vision has been reported. Repeated or prolonged exposure may cause skin irritation.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired liver or kidney function may be more susceptible to the effects of the substance.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Flash point: 12C (54F) CC
Autoignition temperature: 464C (867F)
Flammable limits in air % by volume:
lel: 6.0; uel: 36
Flammable Liquid and Vapor!
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Moderate explosion hazard and dangerous fire hazard when exposed to heat, sparks or flames. Sensitive to static discharge.
Fire Extinguishing Media:
Use alcohol foam, dry chemical or carbon dioxide. (Water may be ineffective.)
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Use water spray to blanket fire, cool fire exposed containers, and to flush non-ignited spills or vapors away from fire. Vapors can flow along surfaces to distant ignition source and flash back.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker SOLUSORB® solvent adsorbent is recommended for spills of this product.

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7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do Not attempt to clean empty containers since residue is difficult to remove. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, sparks, flame, static electricity or other sources of ignition: they may explode and cause injury or death.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Methyl Alcohol:
- OSHA Permissible Exposure Limit (PEL):
200 ppm (TWA)
- ACGIH Threshold Limit Value (TLV):
200 ppm (TWA), 250 ppm (STEL) skin
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details. Use explosion-proof equipment.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134). This substance has poor warning properties.
Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure.
Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.
Odor:
Characteristic odor.
Solubility:
Miscible in water.
Specific Gravity:
0.8
pH:
No information found.
% Volatiles by volume @ 21C (70F):
100
Boiling Point:
64.5C (147F)
Melting Point:
-98C (-144F)
Vapor Density (Air=1):
1.1
Vapor Pressure (mm Hg):
97 @ 20C (68F)
Evaporation Rate (BuAc=1):
5.9

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
May form carbon dioxide, carbon monoxide, and formaldehyde when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizing agents such as nitrates, perchlorates or sulfuric acid. Will attack some forms of plastics, rubber, and coatings. May react with metallic aluminum and generate hydrogen gas.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

---

11. Toxicological Information

Methyl Alcohol (Methanol) Oral rat LD50: 5628 mg/kg; inhalation rat LC50: 64000 ppm/4H; skin rabbit LD50: 15800 mg/kg; Irritation data-standard Draize test: skin, rabbit: 20mg/24 hr. Moderate; eye, rabbit: 100 mg/24 hr. Moderate. Investigated as a mutagen, reproductive effector.

```
--------\Cancer Lists\-------------------------------------------------------
                                        ---NTP Carcinogen---
Ingredient                              Known    Anticipated    IARC Category
-------------------------------------   -----    -----------    -------------
Methyl Alcohol (67-56-1)                 No          No            None
```

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12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. When released into water, this material is expected to readily biodegrade. When released into the air, this material is expected to exist in the aerosol phase with a short half-life. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into air, this material is expected to have a half-life between 10 and 30 days. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.
Environmental Toxicity:
This material is expected to be slightly toxic to aquatic life.

---

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: METHANOL
Hazard Class: 3
UN/NA: UN1230
Packing Group: II
Information reported for product/size: 358LB

International (Water, I.M.O.)

Proper Shipping Name: METHANOL

Hazard Class: 3, 6.1
UN/NA: UN1230
Packing Group: II
Information reported for product/size: 358LB

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15. Regulatory Information

```
--------\Chemical Inventory Status - Part 1\---------------------------------
Ingredient                                        TSCA  EC   Japan  Australia
-----------------------------------------------  ----  ---  -----  ---------
Methyl Alcohol (67-56-1)                          Yes  Yes   Yes      Yes

--------\Chemical Inventory Status - Part 2\---------------------------------
                                                         --Canada--
Ingredient                                        Korea  DSL   NDSL  Phil.
-----------------------------------------------  -----  ---   ----  -----
Methyl Alcohol (67-56-1)                          Yes   Yes   No     Yes

--------\Federal, State & International Regulations - Part 1\----------------
                                            -SARA 302-    ------SARA 313------
Ingredient                                  RQ    TPQ     List  Chemical Catg.
----------------------------------------  ---   -----   ----  --------------
Methyl Alcohol (67-56-1)                    No    No      Yes        No

--------\Federal, State & International Regulations - Part 2\----------------
                                                        -RCRA-    -TSCA-
Ingredient                                  CERCLA     261.33     8(d)
----------------------------------------  ------     ------    ------
Methyl Alcohol (67-56-1)                    5000       U154       No


Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: Yes Pressure: No
Reactivity: No          (Pure / Liquid)
```

Australian Hazchem Code: 2PE
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**
Label Hazard Warning:
POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS. FLAMMABLE LIQUID AND VAPOR.

CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM AND LIVER.

Label Precautions:

Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.
Wash thoroughly after handling.
Keep container closed.
Use only with adequate ventilation.
Keep away from heat, sparks and flame.

Label First Aid:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 3, 8.

Disclaimer:

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Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Number: **N3666** * * * * * *Effective Date:* ***05/25/01*** * * * * * *Supercedes:* ***11/17/99***

MSDS Material Safety Data Sheet

From: Mallinckrodt Baker, Inc.
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

NITRIC ACID 10% R. S.

1. Product Identification

Synonyms: Aqua Fortis; Azotic Acid
CAS No.: 7697-37-2
Molecular Weight: 63.01
Chemical Formula: HNO3 (10% solution)
Product Codes: Product Codes: H262

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Nitric Acid	7697-37-2	10%	Yes
Water	7732-18-5	90%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS

TO ALL BODY TISSUE. OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG AND TOOTH DAMAGE.

Potential Health Effects

Nitric acid is extremely hazardous; it is corrosive, reactive, an oxidizer, and a poison.

Inhalation:
Corrosive! May cause irritation of the nose, throat, and respiratory tract including coughing and choking. Higher concentrations or prolonged exposure to vapors of nitric acid may lead to pneumonia or pulmonary edema.
Ingestion:
Corrosive. May cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract.
Skin Contact:
Corrosive! May cause redness, pain, and severe skin burns.
Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage.
Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders, eye disease, or cardiopulmonary diseases may be more susceptible to the effects of this substance.

---

4. First Aid Measures

Immediate first aid treatment reduces the health effects of this substance.
Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Call a physician.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

---

5. Fire Fighting Measures

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Can react with metals to release flammable hydrogen gas.
Explosion:
May react explosively with combustible organic or readily oxidizable materials such as: alcohols, turpentine, charcoal, organic refuse, metal powder, hydrogen sulfide, etc.
Fire Extinguishing Media:
Water or water spray.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Increases the flammability of combustible, organic and readily oxidizable materials.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

---

7. Handling and Storage

Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Separate from combustible, organic, or any other readily oxidizable materials. Protect from freezing.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Nitric Acid:
OSHA Permissible Exposure Limit (PEL):
2 ppm (TWA)
ACGIH Threshold Limit Value (TLV):
2 ppm (TWA); 4 ppm (STEL)
Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Canister-type respirators using sorbents are ineffective.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Clear to pale yellow solution.

Odor:
Suffocating, acrid.

Solubility:
Infinitely soluble.

Density:
1.054

pH:
No information found.

% Volatiles by volume @ 21C (70F):
100 (as water and acid)

Boiling Point:
ca. 101C (ca. 214F)

Melting Point:
ca. -3C (ca. 27F)

Vapor Density (Air=1):
No information found.

Vapor Pressure (mm Hg):
No information found.

Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:

When heated to decomposition, emits toxic nitrogen oxides fumes and hydrogen nitrate.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong bases, metallic powders, carbides, hydrogen sulfide, turpentine, and combustible organics.
Conditions to Avoid:
Heat and incompatibles.

---

11. Toxicological Information

For Nitric Acid: Investigated as a mutagen and reproductive effector.

```
--------\Cancer Lists\-------------------------------------------------------
                                        ---NTP Carcinogen---
Ingredient                              Known    Anticipated    IARC Category
------------------------------------    -----    -----------    -------------
Nitric Acid (7697-37-2)                  No          No            None
Water (7732-18-5)                        No          No            None
```

---

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

---

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste facility. Although not a listed RCRA hazardous waste, this material may exhibit one or more characteristics of a hazardous waste and require appropriate analysis to determine specific disposal requirements. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

---

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: NITRIC ACID (WITH 10% NITRIC ACID)
Hazard Class: 8
UN/NA: UN2031
Packing Group: II
Information reported for product/size: 20L

International (Water, I.M.O.)

Proper Shipping Name: NITRIC ACID (WITH 10% NITRIC ACID)
Hazard Class: 8
UN/NA: UN2031
Packing Group: II
Information reported for product/size: 20L

---

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia
Nitric Acid (7697-37-2)	Yes	Yes	Yes	Yes
Water (7732-18-5)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\----------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Nitric Acid (7697-37-2)	Yes	Yes	No	Yes
Water (7732-18-5)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Nitric Acid (7697-37-2)	1000	1000	Yes	No
Water (7732-18-5)	No	No	No	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Nitric Acid (7697-37-2)	1000	No	No
Water (7732-18-5)	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: No Pressure: No
Reactivity: Yes (Mixture / Liquid)

Australian Hazchem Code: 2PE
Poison Schedule: S6

WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **0** Other: **Oxidizer**
Label Hazard Warning:
POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG AND TOOTH DAMAGE.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe vapor or mist.
Use only with adequate ventilation.
Wash thoroughly after handling.
Store in a tightly closed container.
Remove and wash contaminated clothing promptly.
Label First Aid:
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 9, 16.
Disclaimer:
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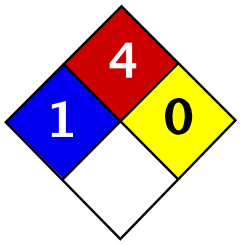
Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)



Health	2
Fire	4
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Pentane MSDS

Section 1: Chemical Product and Company Identification

Product Name: Pentane

Catalog Codes: SLP2077

CAS#: 109-66-0

RTECS: RZ9450000

TSCA: TSCA 8(b) inventory: Pentane

CI#: Not available.

Synonym: Amyl Hydride

Chemical Name: Pentane

Chemical Formula: C5-H12

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Pentane	109-66-0	100

Toxicological Data on Ingredients: Pentane: VAPOR (LC50): Acute: 364000 mg/m 4 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Potential Chronic Health Effects:
Hazardous in case of ingestion, of inhalation.
Slightly hazardous in case of skin contact (sensitizer).
CARCINOGENIC EFFECTS: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.
DEVELOPMENTAL TOXICITY: Not available.
The substance may be toxic to kidneys, the nervous system, liver, skin, central nervous system (CNS).
Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
If swallowed, do NOT induce vomiting. Never give anything by mouth to an unconscious person. Aspiration hazard if swallowed- can enter lungs and cause damage. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 260°C (500°F)

Flash Points: CLOSED CUP: -49°C (-56.2°F). (TAG)

Flammable Limits: LOWER: 1.5% UPPER: 7.8%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Extremely flammable in presence of open flames and sparks, of heat.
Flammable in presence of oxidizing materials.
Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of static discharge: Not available.
Slightly explosive in presence of heat, of oxidizing materials.
Non-explosive in presence of shocks.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water.
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
EXTREMELY FLAMMABLE.

Vapor may travel considerable distance to source of ignition and flash back.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid.
Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Do not store above 25°C (77°F).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 600 STEL: 750 from ACGIH (TLV) [United States]
TWA: 1800 STEL: 2210 from ACGIH (TLV) [United States]
Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Pleasant. Gasoline-like

Taste: Not available.

Molecular Weight: 72.15g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 36.1°C (97°F)

Melting Point: -130°C (-202°F)

Critical Temperature: 196.6°C (385.9°F)

Specific Gravity: 0.6262 (Water = 1)

Vapor Pressure: 56.8 kPa (@ 20°C)

Vapor Density: 2.49 (Air = 1)

Volatility: Not available.

Odor Threshold: 2.2 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.4

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Partially soluble in diethyl ether, acetone.
Very slightly soluble in cold water.
Solubility in water: 0.36g/l water @ 16 deg. C.
Solubility in water: 9.9 g in 100 kg water @ 25 deg. C.
Solubility in water: 0.04 g in 100 g of water @ 20 deg. C
Soluble in chloroform.
Solubility in acetone, benzene, ethanol > 10%

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatible materials.

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: It will attack some forms of plastics, rubber, and coatings.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE.
Acute toxicity of the vapor (LC50): 364000 mg/m3 4 hours [Rat].

Chronic Effects on Humans:
May cause damage to the following organs: kidneys, the nervous system, liver, skin, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation.
Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose:
LCL [Mouse] - Route: Inhalation; Dose 325 gm/m3/2H

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: It can cause skin irritaiton with itching, drying erythema, hyperpigmentation, hyperemia, dermatitis, burning sensations, followed by formation of blisters. It may be aborbed by the skin and cause systemic effects.
Eyes: It is a strong eye irritant. Symptoms may include pain, corneal irritation, and nystagmus
Inhalation: It is a mild respiratory tract (nose, throat, lungs) irritant causing causing coughing, wheezing, and/or shortness of breath. Inhalation exposure to an airborne concentration of 5,000 ppm for 10 minutes appears to have no ill effect in humans, while 90,000 to 120,000 ppm can affect behavior/central nervous system and cause symptoms of central nervous system depression and narcosis. Symptoms of central nervous system depression include nausea, headache, weakness, dizzness, excitement, confusion, lightheadedness, sleepiness, seizures, inability to concentrate, loss of coordination and judgement, coma, and death with exposure to large amounts. It may also affect the cardiovascular system (dysrhythmias), and metabolism (weight loss/loss of appetite/anorexia). Airborne concentration of approximately 130,000 ppm can be fatal by asphyxiation; therefore, there is not a wide margin of safety concentrations causing central nervous system effects and death.
Ingestion: Pulmonary aspiration of even a small amount can produce acute lung injury, potentially fatal chemical pneumonitis, and hemorrhage. In extreme cases, respiratory arrest secondary to hypoxia following pneumonitis may occur. It may also affect behavior/central nervous system (symptoms similar to acute inhalation), and cardiovascular system (symptoms similar to acute inhalation).
Chronic Potential Health Effects:
Skin: Prolonged or repeated skin contact can cause defatting dermatitis with dryness and cracking. Long-term dermal exposure may also cause kidney damage.
Ingestion or inhalation: Prolonged or repeated ingestion or inhalation Can cause central nervous system damage. Central nervous system damage symptoms may include numbess, "pins and needles", and weakness of arms and legs. It may also cause liver damage, adn kidney damage (renal tubular necrosis, glomerulonephritis, nephritis, proteinuria, hematuria) and may affect metabolism (weight loss).

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.

Identification: : Pentane UNNA: 1265 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Pentane
Illinois toxic substances disclosure to employee act: Pentane
Rhode Island RTK hazardous substances: Pentane
Pennsylvania RTK: Pentane
Minnesota: Pentane
Massachusetts RTK: Pentane
Massachusetts spill list: Pentane
New Jersey: Pentane
New Jersey toxic catastrophe prevention act: Pentane
California Director's list of Hazardous Substances: Pentane
TSCA 8(b) inventory: Pentane
TSCA 4(a) proposed test rules: Pentane
TSCA 8(a) PAIR: Pentane
TSCA 8(d) H and S data reporting: Pentane: Effective date: 1/26/94; Sunset Date: 6/30/98

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F).
CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 4

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 1

Flammability: 4

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves.
Lab coat.
Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.
Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:45 PM

Last Updated: 10/10/2005 08:45 PM

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Material Safety Data Sheet

Buffer pH 4 Red

ACC# 88865

Section 1 - Chemical Product and Company Identification

MSDS Name: Buffer pH 4 Red
Catalog Numbers: M-371, M371, MCC-031359
Synonyms: None
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
877-24-7	Potassium hydrogen phthalate	0.983	212-889-4
62-38-4	Phenyl mercuric acetate	0.007	200-532-5
7732-18-5	Water	Balance	231-791-2

Hazard Symbols: None listed.
Risk Phrases: None listed.

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: red liquid. **Caution!** Causes skin irritation. Causes eye irritation. Causes respiratory tract irritation. Causes digestive tract irritation.
Target Organs: None, no data found.

Potential Health Effects
Eye: Causes eye irritation.
Skin: Causes skin irritation.
Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea.
Inhalation: May cause respiratory tract irritation.
Chronic: No information found.

Section 4 - First Aid Measures

Eyes: Get medical aid. Gently lift eyelids and flush continuously with water.
Skin: Get medical aid if irritation develops or persists. Flush skin with plenty of soap and water.
Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Get medical aid.
Inhalation: Get medical aid immediately. Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Notes to Physician: Treat symptomatically and supportively.
Antidote: None reported.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. Runoff from fire control or dilution water may cause pollution.
Extinguishing Media: Substance is noncombustible; use agent most appropriate to extinguish surrounding fire.
Flash Point: Not applicable.
Autoignition Temperature: Not applicable.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 2; Flammability: 0; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Avoid runoff into storm sewers and ditches which lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section.

Section 7 - Handling and Storage

Handling: Use with adequate ventilation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.
Storage: Store in a cool, dry place.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Good general ventilation should be sufficient to control airborne levels. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Potassium hydrogen phthalate	none listed	none listed	none listed

Phenyl mercuric acetate	none listed	none listed	none listed
Water	none listed	none listed	none listed

OSHA Vacated PELs: Potassium hydrogen phthalate: No OSHA Vacated PELs are listed for this chemical. Phenyl mercuric acetate: No OSHA Vacated PELs are listed for this chemical. Water: No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin: Wear appropriate gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to minimize contact with skin.

Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance: red
Odor: none reported
pH: 4.
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: Not available.
Freezing/Melting Point: Not available.
Decomposition Temperature: Not available.
Solubility: Not available.
Specific Gravity/Density: Not available.
Molecular Formula:solution.
Molecular Weight: Not available.

Section 10 - Stability and Reactivity

Chemical Stability: Stable.
Conditions to Avoid: None reported.
Incompatibilities with Other Materials: There is no information for any incompatibilities for this substance.
Hazardous Decomposition Products: Irritating and toxic gases.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 877-24-7: CZ4326000
CAS# 62-38-4: OV6475000

CAS# 7732-18-5: ZC0110000
LD50/LC50:
CAS# 877-24-7:
Dermal, guinea pig: LD50 = >1 gm/kg;
Oral, rat: LD50 = >3200 mg/kg;
CAS# 62-38-4:
Draize test, rabbit, eye: 50 ug/24H Severe;
Oral, mouse: LD50 = 13250 ug/kg;
Oral, rat: LD50 = 41 mg/kg;
CAS# 7732-18-5:
Oral, rat: LD50 = >90 mL/kg;
Carcinogenicity:
CAS# 877-24-7: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. CAS# 62-38-4: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. CAS# 7732-18-5: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology: No data available.
Teratogenicity: No data available.
Reproductive Effects: No data available.
Neurotoxicity: No data available.
Mutagenicity: No data available.
Other Studies: No data available.

Section 12 - Ecological Information

Ecotoxicity: No data available. No information available.
Environmental: No information reported.
Physical: No information available.
Other: None.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: CAS# 62-38-4: waste number P092.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	No information available.				No information available.
Hazard Class:					
UN Number:					
Packing Group:					

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 877-24-7 is listed on the TSCA inventory.
CAS# 62-38-4 is listed on the TSCA inventory.
CAS# 7732-18-5 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA

CERCLA Hazardous Substances and corresponding RQs
CAS# 62-38-4: 100 lb final RQ; 45.4 kg final RQ
SARA Section 302 Extremely Hazardous Substances
CAS# 62-38-4: 500 lb TPQ (lower threshold); 10,000 lb TPQ (upper thres hold)
SARA Codes
CAS # 877-24-7: acute.
Section 313
This chemical is not at a high enough concentration to be reportable under Section 313.
Clean Air Act:
This material does not contain any hazardous air pollutants. This material does not contain any Class 1 Ozone depletors. This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA. None of the chemicals in this product are listed as Priority Pollutants under the CWA. None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
CAS# 877-24-7 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
CAS# 62-38-4 can be found on the following state right to know lists: New Jersey, Pennsylvania, Massachusetts.
CAS# 7732-18-5 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
WARNING: This product contains Phenyl mercuric acetate, listed as `Mercury compounds', a chemical known to the state of California to cause birth defects or other reproductive harm.
California No Significant Risk Level: None of the chemicals in this product are listed.

European / International Regulations

European Labeling in Accordance with EC Directives
Hazard Symbols:
Not available.
Risk Phrases:

Safety Phrases:

WGK (Water Danger / Protection)
CAS# 877-24-7: No information available.

CAS# 62-38-4: 3
CAS# 7732-18-5: No information available.

Canada - DSL/NDSL

CAS# 877-24-7 is listed on Canada's DSL List.
CAS# 62-38-4 is listed on Canada's DSL List.
CAS# 7732-18-5 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of D2B.

Canadian Ingredient Disclosure List

CAS# 62-38-4 is listed on the Canadian Ingredient Disclosure List.

Exposure Limits

CAS# 62-38-4: OEL-AUSTRALIA:TWA 0.05 mg(Hg)/m3;Skin JANUARY 1993 O
EL-BELGIUM:TWA 0.05 mg(Hg)/m3;Skin JANUARY 1993 OEL-CZECHOSLOVAKIA:T
WA 0.05 mg(Hg)/m3;STEL 0.15 mg(Hg)/m3 OEL-DENMARK:TWA 0.05 mg(Hg)/m3
JANUARY 1993 OEL-FINLAND:TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-FRANC
E:TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-GERMANY:TWA 0.01 ppm (0.1 mg(H
g)/m3) JANUARY 1993 OEL-HUNGARY:TWA 0.02 mg(Hg)/m3;STEL 0.04 mg(Hg)/
m JANUARY 1993 OEL-JAPAN:TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-THE NE
THERLANDS:TWA 0.05 mg(Hg)/m3;STEL 0.15 mg(Hg)/m3 OEL-THE PHILIPPINES:
TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-POLAND:TWA 0.01 mg(Hg)/m3 JANUA
RY 1993 OEL-RUSSIA:TWA 0.05 mg(Hg)/m3;STEL 0.01 mg(Hg)/m3 JANUARY 199
3 OEL-SWEDEN:TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-THAILAND:STEL 0.05
mg(Hg)/m3 JANUARY 1993 OEL-UNITED KINGDOM:TWA 0.05 mg(Hg)/m3;STEL 0
.15 mg(Hg)/m3 OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TL
V OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV OEL-AUSTRALI
A:TWA 0.01 mg(Hg)/m3;STEL 0.03 mg(Hg)/m3;Skin OEL-BELGIUM:TWA 0.01 mg
(Hg)/m3;STEL 0.03 mg(Hg)/m3;Skin OEL-DENMARK:TWA 0.01 mg(Hg)/m3;Skin
OEL-FINLAND:TWA 0.01 mg(Hg)/m3;Skin OEL-FRANCE:TWA 0.01 mg(Hg)/m3;Sk
in OEL-THE NETHERLANDS:TW

Section 16 - Additional Information

MSDS Creation Date: 9/02/1997
Revision #2 Date: 3/18/2003

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

Material Safety Data Sheet

Buffer pH 7 Yellow

ACC# 88866

Section 1 - Chemical Product and Company Identification

MSDS Name: Buffer pH 7 Yellow
Catalog Numbers: M-372, M372, MCC-031360
Synonyms: None
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
7758-11-4	Potassium phosphate dibasic anhydrous	0.475	231-834-5
7778-77-0	Potassium phosphate monobasic anhydrous	0.279	231-913-4
62-38-4	Phenyl mercuric acetate	0.007	200-532-5
0-00-0	Yellow keystone dye #5	0.002	unlisted
7732-18-5	Water	Balance	231-791-2

Hazard Symbols: None listed.
Risk Phrases: None listed.

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: yellow liquid. **Caution!** May cause irritation. This is expected to be a low hazard for usual industrial handling.
Target Organs: None.

Potential Health Effects
Eye: May cause mild eye irritation.
Skin: Non-irritating to the skin. Low hazard for usual industrial handling.
Ingestion: Low hazard for usual industrial handling. May cause gastric disturbances and electrolytic imbalance.
Inhalation: May cause respiratory tract irritation. Low hazard for usual industrial handling.
Chronic: No information found.

Section 4 - First Aid Measures

Eyes: Get medical aid. Gently lift eyelids and flush continuously with water.
Skin: Get medical aid if irritation develops or persists. Flush skin with plenty of soap and water.
Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Get medical aid.
Inhalation: Remove from exposure and move to fresh air immediately. Get medical aid if cough or other symptoms appear.
Notes to Physician: Treat symptomatically and supportively.
Antidote: None reported.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear.
Extinguishing Media: Substance is noncombustible; use agent most appropriate to extinguish surrounding fire.
Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 0; Flammability: 0; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container.

Section 7 - Handling and Storage

Handling: Use with adequate ventilation. Avoid contact with eyes. Keep container tightly closed.
Storage: Store in a cool, dry place.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Good general ventilation should be sufficient to control airborne levels.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Potassium phosphate dibasic anhydrous	none listed	none listed	none listed
Potassium phosphate monobasic anhydrous	none listed	none listed	none listed

Phenyl mercuric acetate	none listed	none listed	none listed
Yellow keystone dye #5	none listed	none listed	none listed
Water	none listed	none listed	none listed

OSHA Vacated PELs: Potassium phosphate dibasic anhydrous: No OSHA Vacated PELs are listed for this chemical. Potassium phosphate monobasic anhydrous: No OSHA Vacated PELs are listed for this chemical. Phenyl mercuric acetate: No OSHA Vacated PELs are listed for this chemical. Yellow keystone dye #5: No OSHA Vacated PELs are listed for this chemical. Water: No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin: Wear appropriate gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to minimize contact with skin.

Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance: yellow
Odor: none reported
pH: 7.
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: Not available.
Freezing/Melting Point: Not available.
Decomposition Temperature: Not available.
Solubility: Not available.
Specific Gravity/Density: Not available.
Molecular Formula: Solution
Molecular Weight: Not available.

Section 10 - Stability and Reactivity

Chemical Stability: Stable.
Conditions to Avoid: None reported.
Incompatibilities with Other Materials: None reported.
Hazardous Decomposition Products: None.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:

CAS# 7758-11-4 unlisted.
CAS# 7778-77-0: TC6615500
CAS# 62-38-4: OV6475000
CAS# 0-00-0 unlisted.
CAS# 7732-18-5: ZC0110000
LD50/LC50:
Not available.

CAS# 7778-77-0:
Skin, rabbit: LD50 = >4640 mg/kg;
CAS# 62-38-4:
Draize test, rabbit, eye: 50 ug/24H Severe;
Oral, mouse: LD50 = 13250 ug/kg;
Oral, rat: LD50 = 41 mg/kg;
CAS# 0-00-0:
CAS# 7732-18-5:
Oral, rat: LD50 = >90 mL/kg;
Carcinogenicity:
CAS# 7758-11-4: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. CAS# 7778-77-0: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. CAS# 62-38-4: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. CAS# 0-00-0: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. CAS# 7732-18-5: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology: No data available.
Teratogenicity: No data available.
Reproductive Effects: No data available.
Neurotoxicity: No data available.
Mutagenicity: No data available.
Other Studies: No data available.

Section 12 - Ecological Information

Ecotoxicity: No data available. No information available.
Environmental: No information reported.
Physical: No information available.
Other: None.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: CAS# 62-38-4: waste number P092.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG

Shipping Name:	No information available.	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 7758-11-4 is listed on the TSCA inventory.
CAS# 7778-77-0 is listed on the TSCA inventory.
CAS# 62-38-4 is listed on the TSCA inventory.
CAS# 0-00-0 is not listed on the TSCA inventory. It is for research and development use only.
CAS# 7732-18-5 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA

CERCLA Hazardous Substances and corresponding RQs
CAS# 62-38-4: 100 lb final RQ; 45.4 kg final RQ
SARA Section 302 Extremely Hazardous Substances
CAS# 62-38-4: 500 lb TPQ (lower threshold); 10,000 lb TPQ (upper thres hold)
SARA Codes
CAS # 7778-77-0: acute.
Section 313
This chemical is not at a high enough concentration to be reportable under Section 313.
Clean Air Act:
This material does not contain any hazardous air pollutants. This material does not contain any Class 1 Ozone depletors. This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA. None of the chemicals in this product are listed as Priority Pollutants under the CWA. None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
CAS# 7758-11-4 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
CAS# 7778-77-0 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
CAS# 62-38-4 can be found on the following state right to know lists: New Jersey, Pennsylvania, Massachusetts.
CAS# 0-00-0 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
CAS# 7732-18-5 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
WARNING: This product contains Phenyl mercuric acetate, listed as `Mercury compounds', a chemical known to the state of California to cause birth defects or other reproductive harm.

California No Significant Risk Level: None of the chemicals in this product are listed.

European / International Regulations

European Labeling in Accordance with EC Directives
Hazard Symbols:
Not available.
Risk Phrases:

Safety Phrases:

WGK (Water Danger/Protection)
CAS# 7758-11-4: 1
CAS# 7778-77-0: 1
CAS# 62-38-4: 3
CAS# 0-00-0: No information available.
CAS# 7732-18-5: No information available.
Canada - DSL/NDSL
CAS# 7758-11-4 is listed on Canada's DSL List.
CAS# 7778-77-0 is listed on Canada's DSL List.
CAS# 62-38-4 is listed on Canada's DSL List.
CAS# 7732-18-5 is listed on Canada's DSL List.
Canada - WHMIS
WHMIS: Not available.
Canadian Ingredient Disclosure List
CAS# 62-38-4 is listed on the Canadian Ingredient Disclosure List.
Exposure Limits
CAS# 62-38-4: OEL-AUSTRALIA:TWA 0.05 mg(Hg)/m3;Skin JANUARY 1993 O
EL-BELGIUM:TWA 0.05 mg(Hg)/m3;Skin JANUARY 1993 OEL-CZECHOSLOVAKIA:T
WA 0.05 mg(Hg)/m3;STEL 0.15 mg(Hg)/m3 OEL-DENMARK:TWA 0.05 mg(Hg)/m3
JANUARY 1993 OEL-FINLAND:TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-FRANC
E:TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-GERMANY:TWA 0.01 ppm (0.1 mg(H
g)/m3) JANUARY 1993 OEL-HUNGARY:TWA 0.02 mg(Hg)/m3;STEL 0.04 mg(Hg)/
m JANUARY 1993 OEL-JAPAN:TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-THE NE
THERLANDS:TWA 0.05 mg(Hg)/m3;STEL 0.15 mg(Hg)/m3 OEL-THE PHILIPPINES:
TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-POLAND:TWA 0.01 mg(Hg)/m3 JANUA
RY 1993 OEL-RUSSIA:TWA 0.05 mg(Hg)/m3;STEL 0.01 mg(Hg)/m3 JANUARY 199
3 OEL-SWEDEN:TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-THAILAND:STEL 0.05
mg(Hg)/m3 JANUARY 1993 OEL-UNITED KINGDOM:TWA 0.05 mg(Hg)/m3;STEL 0
.15 mg(Hg)/m3 OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TL
V OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV OEL-AUSTRALI
A:TWA 0.01 mg(Hg)/m3;STEL 0.03 mg(Hg)/m3;Skin OEL-BELGIUM:TWA 0.01 mg
(Hg)/m3;STEL 0.03 mg(Hg)/m3;Skin OEL-DENMARK:TWA 0.01 mg(Hg)/m3;Skin
OEL-FINLAND:TWA 0.01 mg(Hg)/m3;Skin OEL-FRANCE:TWA 0.01 mg(Hg)/m3;Sk
in OEL-THE NETHERLANDS:TW

Section 16 - Additional Information

MSDS Creation Date: 9/02/1997
Revision #2 Date: 3/18/2003

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the

possibility of such damages.

Material Safety Data Sheet
Buffer pH 10 Blue

ACC# 88867

Section 1 - Chemical Product and Company Identification

MSDS Name: Buffer pH 10 Blue
Catalog Numbers: M-373, MCC-031361
Synonyms: None
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
584-08-7	Potassium carbonate anhydrous	0.326	209-529-3
298-14-6	Potassium bicarbonate	0.250	206-059-0
62-38-4	Phenyl mercuric acetate	0.073	200-532-5
0-00-0	Keco direct turquiose HGL dye	0.001	unlisted
7732-18-5	Water	Balance	231-791-2

Hazard Symbols: XI
Risk Phrases: 36/38

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: blue liquid. May cause respiratory and digestive tract irritation. **Warning!** Causes eye and skin irritation. Irritant.
Target Organs: Eyes, skin.

Potential Health Effects
Eye: Causes eye irritation. May cause chemical conjunctivitis.
Skin: Causes skin irritation.
Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea. May cause gastric disturbances and electrolytic imbalance.
Inhalation: Causes respiratory tract irritation. Can produce delayed pulmonary edema.
Chronic: Effects may be delayed.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.
Ingestion: Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.
Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid. Do NOT use mouth-to-mouth resuscitation.
Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: Substance is noncombustible; use agent most appropriate to extinguish surrounding fire.
Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 2; Flammability: 0; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Avoid runoff into storm sewers and ditches which lead to waterways. Clean up spills immediately, observing precautions in the Protective Equipment section. Provide ventilation.

Section 7 - Handling and Storage

Handling: Use with adequate ventilation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation. Wash clothing before reuse.
Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an

eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Potassium carbonate anhydrous	none listed	none listed	none listed
Potassium bicarbonate	none listed	none listed	none listed
Phenyl mercuric acetate	none listed	none listed	none listed
Keco direct turquiose HGL dye	none listed	none listed	none listed
Water	none listed	none listed	none listed

OSHA Vacated PELs: Potassium carbonate anhydrous: No OSHA Vacated PELs are listed for this chemical. Potassium bicarbonate: No OSHA Vacated PELs are listed for this chemical. Phenyl mercuric acetate: No OSHA Vacated PELs are listed for this chemical. Keco direct turquiose HGL dye: No OSHA Vacated PELs are listed for this chemical. Water: No OSHA Vacated PELs are listed for this chemical.

Personal Protective Equipment

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin: Wear appropriate gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to minimize contact with skin.

Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Always use a NIOSH or European Standard EN 149 approved respirator when necessary.

Section 9 - Physical and Chemical Properties

Physical State: Liquid
Appearance: blue
Odor: none reported
pH: 10
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: Not available.
Freezing/Melting Point: Not available.
Decomposition Temperature: Not available.
Solubility: Not available.
Specific Gravity/Density: Not available.
Molecular Formula: Solution
Molecular Weight: Not available.

Section 10 - Stability and Reactivity

Chemical Stability: Stable. Stable at room temperature in closed containers under normal storage and handling conditions.

Conditions to Avoid: Incompatible materials, none reported, excess heat.

Incompatibilities with Other Materials: Not available.

Hazardous Decomposition Products: None.
Hazardous Polymerization: Has not been reported

Section 11 - Toxicological Information

RTECS#:
CAS# 584-08-7: TS7750000
CAS# 298-14-6 unlisted.
CAS# 62-38-4: OV6475000
CAS# 0-00-0 unlisted.
CAS# 7732-18-5: ZC0110000
LD50/LC50:
CAS# 584-08-7:
Oral, mouse: LD50 = 2570 mg/kg;
Oral, rat: LD50 = 1870 mg/kg;
CAS# 298-14-6:
CAS# 62-38-4:
Draize test, rabbit, eye: 50 ug/24H Severe;
Oral, mouse: LD50 = 13250 ug/kg;
Oral, rat: LD50 = 41 mg/kg;
CAS# 0-00-0:
CAS# 7732-18-5:
Oral, rat: LD50 = >90 mL/kg;
Carcinogenicity:
CAS# 584-08-7: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. CAS# 298-14-6: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. CAS# 62-38-4: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. CAS# 0-00-0: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA. CAS# 7732-18-5: Not listed by ACGIH, IARC, NIOSH, NTP, or OSHA.
Epidemiology: No information available.
Teratogenicity: No information available.
Reproductive Effects: No information available.
Neurotoxicity: No information available.
Mutagenicity: No information available.
Other Studies: No data available.

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: CAS# 62-38-4: waste number P092.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	IATA	RID/ADR	IMO	Canada TDG
Shipping Name:	No information available.				No information available.
Hazard Class:					
UN Number:					
Packing Group:					

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 584-08-7 is listed on the TSCA inventory.
CAS# 298-14-6 is listed on the TSCA inventory.
CAS# 62-38-4 is listed on the TSCA inventory.
CAS# 0-00-0 is not listed on the TSCA inventory. It is for research and development use only.
CAS# 7732-18-5 is listed on the TSCA inventory.
Health & Safety Reporting List
None of the chemicals are on the Health & Safety Reporting List.
Chemical Test Rules
None of the chemicals in this product are under a Chemical Test Rule.
Section 12b
None of the chemicals are listed under TSCA Section 12b.
TSCA Significant New Use Rule
None of the chemicals in this material have a SNUR under TSCA.
SARA

CERCLA Hazardous Substances and corresponding RQs
CAS# 62-38-4: 100 lb final RQ; 45.4 kg final RQ
SARA Section 302 Extremely Hazardous Substances
CAS# 62-38-4: 500 lb TPQ (lower threshold); 10,000 lb TPQ (upper thres hold)
SARA Codes
CAS # 584-08-7: acute.
Section 313
This chemical is not at a high enough concentration to be reportable under Section 313.
Clean Air Act:
This material does not contain any hazardous air pollutants. This material does not contain any Class 1 Ozone depletors. This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA. None of the chemicals in this product are listed as Priority Pollutants under the CWA. None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.
STATE
CAS# 584-08-7 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
CAS# 298-14-6 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
CAS# 62-38-4 can be found on the following state right to know lists: New Jersey, Pennsylvania,

Massachusetts.
CAS# 0-00-0 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
CAS# 7732-18-5 is not present on state lists from CA, PA, MN, MA, FL, or NJ.
WARNING: This product contains Phenyl mercuric acetate, listed as `Mercury compounds', a chemical known to the state of California to cause birth defects or other reproductive harm.
California No Significant Risk Level: None of the chemicals in this product are listed.

European / International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

XI

Risk Phrases:

R 36/38 Irritating to eyes and skin.

Safety Phrases:

S 24/25 Avoid contact with skin and eyes.

WGK (Water Danger / Protection)

CAS# 584-08-7: 1
CAS# 298-14-6: 0
CAS# 62-38-4: 3
CAS# 0-00-0: No information available.
CAS# 7732-18-5: No information available.

Canada - DSL / NDSL

CAS# 584-08-7 is listed on Canada's DSL List.
CAS# 298-14-6 is listed on Canada's DSL List.
CAS# 62-38-4 is listed on Canada's DSL List.
CAS# 7732-18-5 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of D2B.

Canadian Ingredient Disclosure List

CAS# 584-08-7 is listed on the Canadian Ingredient Disclosure List.
CAS# 62-38-4 is listed on the Canadian Ingredient Disclosure List.

Exposure Limits

CAS# 62-38-4: OEL-AUSTRALIA:TWA 0.05 mg(Hg)/m3;Skin JANUARY 1993 O
EL-BELGIUM:TWA 0.05 mg(Hg)/m3;Skin JANUARY 1993 OEL-CZECHOSLOVAKIA:T
WA 0.05 mg(Hg)/m3;STEL 0.15 mg(Hg)/m3 OEL-DENMARK:TWA 0.05 mg(Hg)/m3
JANUARY 1993 OEL-FINLAND:TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-FRANC
E:TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-GERMANY:TWA 0.01 ppm (0.1 mg(H
g)/m3) JANUARY 1993 OEL-HUNGARY:TWA 0.02 mg(Hg)/m3;STEL 0.04 mg(Hg)/
m JANUARY 1993 OEL-JAPAN:TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-THE NE
THERLANDS:TWA 0.05 mg(Hg)/m3;STEL 0.15 mg(Hg)/m3 OEL-THE PHILIPPINES:
TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-POLAND:TWA 0.01 mg(Hg)/m3 JANUA
RY 1993 OEL-RUSSIA:TWA 0.05 mg(Hg)/m3;STEL 0.01 mg(Hg)/m3 JANUARY 199
3 OEL-SWEDEN:TWA 0.05 mg(Hg)/m3 JANUARY 1993 OEL-THAILAND:STEL 0.05
mg(Hg)/m3 JANUARY 1993 OEL-UNITED KINGDOM:TWA 0.05 mg(Hg)/m3;STEL 0
.15 mg(Hg)/m3 OEL IN BULGARIA, COLOMBIA, JORDAN, KOREA check ACGIH TL
V OEL IN NEW ZEALAND, SINGAPORE, VIETNAM check ACGI TLV OEL-AUSTRALI
A:TWA 0.01 mg(Hg)/m3;STEL 0.03 mg(Hg)/m3;Skin OEL-BELGIUM:TWA 0.01 mg
(Hg)/m3;STEL 0.03 mg(Hg)/m3;Skin OEL-DENMARK:TWA 0.01 mg(Hg)/m3;Skin
OEL-FINLAND:TWA 0.01 mg(Hg)/m3;Skin OEL-FRANCE:TWA 0.01 mg(Hg)/m3;Sk
in OEL-THE NETHERLANDS:TW

Section 16 - Additional Information

MSDS Creation Date: 9/02/1997
Revision #2 Date: 10/23/2001

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

MSDS Number: **S4034** * * * * * *Effective Date:* ***08/02/01*** * * * * * *Supercedes:* ***08/20/98***

MSDS **Material Safety Data Sheet**

From: **Mallinckrodt Baker, Inc.**
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SODIUM HYDROXIDE

1. Product Identification

Synonyms: Caustic soda; lye; sodium hydroxide solid; sodium hydrate
CAS No.: 1310-73-2
Molecular Weight: 40.00
Chemical Formula: NaOH
Product Codes:
J.T. Baker: 3717, 3718, 3721, 3722, 3723, 3728, 3734, 3736, 5045, 5565
Mallinckrodt: 7001, 7680, 7708, 7712, 7772, 7798

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Hydroxide	1310-73-2	99 - 100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES BURNS TO ANY AREA OF CONTACT. REACTS WITH WATER, ACIDS AND OTHER MATERIALS.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 2 - Moderate
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES; LAB COAT; PROPER GLOVES
Storage Color Code: White Stripe (Store Separately)

Potential Health Effects

Inhalation:
Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of exposure. Symptoms may include sneezing, sore throat or runny nose. Severe pneumonitis may occur.
Ingestion:
Corrosive! Swallowing may cause severe burns of mouth, throat, and stomach. Severe scarring of tissue and death may result. Symptoms may include bleeding, vomiting, diarrhea, fall in blood pressure. Damage may appears days after exposure.
Skin Contact:
Corrosive! Contact with skin can cause irritation or severe burns and scarring with greater exposures.
Eye Contact:
Corrosive! Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent impairment of vision, even blindness.
Chronic Exposure:
Prolonged contact with dilute solutions or dust has a destructive effect upon tissue.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

---

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.
Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician, immediately. Wash clothing before

reuse.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:
Perform endoscopy in all cases of suspected sodium hydroxide ingestion. In cases of severe esophageal corrosion, the use of therapeutic doses of steroids should be considered. General supportive measures with continual monitoring of gas exchange, acid-base balance, electrolytes, and fluid intake are also required.

---

5. Fire Fighting Measures

Fire:
Not considered to be a fire hazard. Hot or molten material can react violently with water. Can react with certain metals, such as aluminum, to generate flammable hydrogen gas.
Explosion:
Not considered to be an explosion hazard.
Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire. Adding water to caustic solution generates large amounts of heat.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Keep unnecessary and unprotected people away from area of spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust. Do not flush caustic residues to the sewer. Residues from spills can be diluted with water, neutralized with dilute acid such as acetic, hydrochloric or sulfuric. Absorb neutralized caustic residue on clay, vermiculite or other inert substance and package in a suitable container for disposal.
US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

---

7. Handling and Storage

Keep in a tightly closed container. Protect from physical damage. Store in a cool, dry,

ventilated area away from sources of heat, moisture and incompatibilities. Always add the caustic to water while stirring; never the reverse. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product. Do not store with aluminum or magnesium. Do not mix with acids or organic materials.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
- OSHA Permissible Exposure Limit (PEL):
2 mg/m3 Ceiling
- ACGIH Threshold Limit Value (TLV):
2 mg/m3 Ceiling

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a half facepiece particulate respirator (NIOSH type N95 or better filters) may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest.. A full-face piece particulate respirator (NIOSH type N100 filters) may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P filter. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
White, deliquescent pellets or flakes.

Odor:
Odorless.

Solubility:
111 g/100 g of water.

Specific Gravity:
2.13
pH:
13 - 14 (0.5% soln.)
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
1390C (2534F)
Melting Point:
318C (604F)
Vapor Density (Air=1):
> 1.0
Vapor Pressure (mm Hg):
Negligible.
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage. Very hygroscopic. Can slowly pick up moisture from air and react with carbon dioxide from air to form sodium carbonate.
Hazardous Decomposition Products:
Sodium oxide. Decomposition by reaction with certain metals releases flammable and explosive hydrogen gas.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Sodium hydroxide in contact with acids and organic halogen compounds, especially trichloroethylene, may causes violent reactions. Contact with nitromethane and other similar nitro compounds causes formation of shock-sensitive salts. Contact with metals such as aluminum, magnesium, tin, and zinc cause formation of flammable hydrogen gas. Sodium hydroxide, even in fairly dilute solution, reacts readily with various sugars to produce carbon monoxide. Precautions should be taken including monitoring the tank atmosphere for carbon monoxide to ensure safety of personnel before vessel entry.
Conditions to Avoid:
Moisture, dusting and incompatibles.

---

11. Toxicological Information

Irritation data: skin, rabbit: 500 mg/24H severe; eye rabbit: 50 ug/24H severe; investigated as a mutagen.

```
--------\Cancer Lists\-----------------------------------------------------
                                        ---NTP Carcinogen---
```

Ingredient	Known	Anticipated	IARC Category
Sodium Hydroxide (1310-73-2)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: SODIUM HYDROXIDE, SOLID
Hazard Class: 8
UN/NA: UN1823
Packing Group: II
Information reported for product/size: 300LB

International (Water, I.M.O.)

Proper Shipping Name: SODIUM HYDROXIDE, SOLID
Hazard Class: 8
UN/NA: UN1823
Packing Group: II
Information reported for product/size: 300LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\----------

Ingredient	TSCA	EC	Japan	Australia

```
  ----------------------------------------------  ----  ---  -----  ---------
  Sodium Hydroxide (1310-73-2)                     Yes  Yes   Yes      Yes

  --------\Chemical Inventory Status - Part 2\----------------------------------
                                                          --Canada--
  Ingredient                                        Korea  DSL   NDSL  Phil.
  ----------------------------------------------  -----  ---   ----  -----
  Sodium Hydroxide (1310-73-2)                     Yes   Yes   No     Yes

  --------\Federal, State & International Regulations - Part 1\----------------
                                             -SARA 302-    ------SARA 313------
  Ingredient                                 RQ    TPQ     List  Chemical Catg.
  ----------------------------------------  ---   -----   ----  --------------
  Sodium Hydroxide (1310-73-2)               No    No      No         No

  --------\Federal, State & International Regulations - Part 2\----------------
                                                         -RCRA-    -TSCA-
  Ingredient                                 CERCLA     261.33     8(d)
  ----------------------------------------  ------     ------    ------
  Sodium Hydroxide (1310-73-2)               1000       No         No


Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  No
SARA 311/312:  Acute: Yes      Chronic: No   Fire: No  Pressure: No
Reactivity: Yes         (Pure / Solid)
```

Australian Hazchem Code: 2R
Poison Schedule: S6
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **1**
Label Hazard Warning:
POISON! DANGER! CORROSIVE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. CAUSES BURNS TO ANY AREA OF CONTACT. REACTS WITH WATER, ACIDS AND OTHER MATERIALS.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe dust.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. If inhaled, remove to fresh air. If not breathing give

artificial respiration. If breathing is difficult, give oxygen. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 8.

Disclaimer:

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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

MSDS Number: **S8237** * * * * * *Effective Date:* ***05/08/03*** * * * * * *Supercedes:* ***09/14/00***

MSDS **Material Safety Data Sheet**

From: **Mallinckrodt Baker, Inc.**
222 Red School Lane
Phillipsburg, NJ 08865

Mallinckrodt CHEMICALS J.T.Baker

24 Hour Emergency Telephone: 908-859-2151
CHEMTREC: 1-800-424-9300

National Response in Canada
CANUTEC: 613-996-6666

Outside U.S. and Canada
Chemtrec: 703-527-3887

NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SULFURIC ACID, 10 - 51%

1. Product Identification

Synonyms: Oil of vitriol; Babcock acid; sulphuric acid
CAS No.: 7664-93-9
Molecular Weight: 98.07
Chemical Formula: H2SO4 in H2O
Product Codes:
J.T. Baker: 0331, 4700, 4701, 5253, 5691, 5951, 9696, S8237
Mallinckrodt: H378, H379, H390, V011, V029, V487, V581

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sulfuric Acid	7664-93-9	10 - 51%	Yes
Water	7732-18-5	49 - 90%	No

3. Hazards Identification

Emergency Overview

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR CONTACTED WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH. WATER REACTIVE. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 0 - None
Reactivity Rating: 3 - Severe (Water Reactive)
Contact Rating: 4 - Extreme (Corrosive)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES
Storage Color Code: White (Corrosive)

Potential Health Effects

Inhalation:
Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. Symptoms may include irritation of the nose and throat, and labored breathing. May cause lung edema, a medical emergency.
Ingestion:
Corrosive. Swallowing can cause severe burns of the mouth, throat, and stomach, leading to death. Can cause sore throat, vomiting, diarrhea. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow ingestion or skin contact. Circulatory shock is often the immediate cause of death.
Skin Contact:
Corrosive. Symptoms of redness, pain, and severe burn can occur. Circulatory collapse with clammy skin, weak and rapid pulse, shallow respirations, and scanty urine may follow skin contact or ingestion. Circulatory shock is often the immediate cause of death.
Eye Contact:
Corrosive. Contact can cause blurred vision, redness, pain and severe tissue burns. Can cause blindness.
Chronic Exposure:
Long-term exposure to mist or vapors may cause damage to teeth. Chronic exposure to mists containing sulfuric acid is a cancer hazard.
Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

---

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician immediately.
Ingestion:
DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Call a physician immediately.
Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Excess acid on skin can be neutralized with a 2% solution of bicarbonate of soda. Call a physician immediately.
Eye Contact:
Immediately flush eyes with gentle but large stream of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Call a physician immediately.

---

5. Fire Fighting Measures

Fire:
Concentrated material is a strong dehydrating agent. Reacts with organic materials and may cause ignition of finely divided materials on contact.
Explosion:
Contact with most metals causes formation of flammable and explosive hydrogen gas.
Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Do not use water on material. However, water spray may be used to keep fire exposed containers cool.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Structural firefighter's protective clothing is ineffective for fires involving this material. Stay away from sealed containers.

---

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Neutralize with alkaline material (soda ash, lime), then absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

J. T. Baker NEUTRASORB® or TEAM® 'Low Na+' acid neutralizers are recommended for spills of this product.

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7. Handling and Storage

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, always add the acid to water; never add water to the acid. When opening metal containers, use non-sparking tools because of the possibility of hydrogen gas being present. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

---

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Sulfuric Acid:
- OSHA Permissible Exposure Limit (PEL) -
1 mg/m3 (TWA)
- ACGIH Threshold Limit Value (TLV) -
1 mg/m3(TWA), 3 mg/m3 (STEL), A2 - suspected human carcinogen for sulfuric acid contained in strong inorganic acid mists.
Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.
Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, a full facepiece respirator with an acid gas cartridge and particulate filter (NIOSH type N100 filter) may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. If oil particles (e.g. lubricants, cutting fluids, glycerine, etc.) are present, use a NIOSH type R or P particulate filter. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres. Where respirators are required, you must have a written program covering the basic requirements in the OSHA respirator standard. These include training, fit testing, medical approval, cleaning, maintenance, cartridge change schedules, etc. See 29CFR1910.134 for details.
Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

---

9. Physical and Chemical Properties

Appearance:
Clear oily liquid.
Odor:
Odorless.
Solubility:
Miscible with water, liberates much heat.
Specific Gravity:
1.40 (50%), 1.07 (10%)
pH:
1 N solution (ca. 5% w/w) = 0.3; 0.1 N solution (ca. 0.5% w/w) = 1.2; 0.01 N solution (ca. 0.05% w/w) = 2.1.
% Volatiles by volume @ 21C (70F):
No information found.
Boiling Point:
ca. 290C (ca. 554F) (decomposes at 340C)
Melting Point:
3C (100%), -32C (93%), -38C (78%), -64C (65%).
Vapor Density (Air=1):
3.4
Vapor Pressure (mm Hg):
1 @ 145.8C (295F)
Evaporation Rate (BuAc=1):
No information found.

---

10. Stability and Reactivity

Stability:
Concentrated solutions react violently with water, spattering and liberating heat.
Hazardous Decomposition Products:
Toxic fumes of oxides of sulfur when heated to decomposition. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas, and with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Water, potassium chlorate, potassium perchlorate, potassium permanganate, sodium, lithium, bases, organic material, halogens, metal acetylides, oxides and hydrides, metals (yields hydrogen gas), strong oxidizing and reducing agents and many other reactive substances.
Conditions to Avoid:
Heat, moisture, incompatibles.

---

11. Toxicological Information

Toxicological Data:

Oral rat LD50: 2140 mg/kg; inhalation rat LC50: 510 mg/m3/2H; standard Draize, eye rabbit, 250 ug (severe); investigated as a tumorigen, mutagen, reproductive effector.
Carcinogenicity:
Cancer Status: The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mists containing sulfuric acid" as a known human carcinogen, (IARC category 1). This classification applies only to mists containing sulfuric acid and not to sulfuric acid or sulfuric acid solutions.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Sulfuric Acid (7664-93-9)	No	No	None
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material may leach into groundwater. When released into the air, this material may be removed from the atmosphere to a moderate extent by wet deposition. When released into the air, this material may be removed from the atmosphere to a moderate extent by dry deposition.
Environmental Toxicity:
LC50 Flounder 100 to 330 mg/l/48 hr aerated water/Conditions of bioassay not specified; LC50 Shrimp 80 to 90 mg/l/48 hr aerated water /Conditions of bioassay not specified; LC50 Prawn 42.5 ppm/48 hr salt water /Conditions of bioassay not specified.
This material may be toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: SULFURIC ACID (WITH NOT MORE THAN 51% ACID)
Hazard Class: 8
UN/NA: UN2796

Packing Group: II
Information reported for product/size: 20L

International (Water, I.M.O.)

Proper Shipping Name: SULPHURIC ACID (WITH NOT MORE THAN 51% ACID)
Hazard Class: 8
UN/NA: UN2796
Packing Group: II
Information reported for product/size: 20L

International (Air, I.C.A.O.)

Proper Shipping Name: SULPHURIC ACID (WITH NOT MORE THAN 51% ACID)
Hazard Class: 8
UN/NA: UN2796
Packing Group: II
Information reported for product/size: 20L

---

15. Regulatory Information

```
--------\Chemical Inventory Status - Part 1\---------------------------------
Ingredient                                        TSCA  EC   Japan  Australia
-----------------------------------------------  ----  ---  -----  ---------
Sulfuric Acid (7664-93-9)                         Yes  Yes   Yes      Yes
Water (7732-18-5)                                 Yes  Yes   Yes      Yes

--------\Chemical Inventory Status - Part 2\---------------------------------
                                                          --Canada--
Ingredient                                        Korea  DSL   NDSL  Phil.
-----------------------------------------------  -----  ---   ----  -----
Sulfuric Acid (7664-93-9)                         Yes   Yes   No     Yes
Water (7732-18-5)                                 Yes   Yes   No     Yes

--------\Federal, State & International Regulations - Part 1\----------------
                                            -SARA 302-    ------SARA 313------
Ingredient                                  RQ    TPQ     List  Chemical Catg.
----------------------------------------  ---   -----   ----  --------------
Sulfuric Acid (7664-93-9)                 1000  1000    Yes        No
Water (7732-18-5)                         No    No      No         No

--------\Federal, State & International Regulations - Part 2\----------------
                                                        -RCRA-    -TSCA-
Ingredient                                CERCLA     261.33     8(d)
----------------------------------------  ------     ------    ------
Sulfuric Acid (7664-93-9)                 1000       No         No
Water (7732-18-5)                         No         No         No


Chemical Weapons Convention:  No     TSCA 12(b):  No     CDTA:  Yes
SARA 311/312:  Acute: Yes      Chronic: Yes  Fire: No  Pressure: No
Reactivity: Yes         (Pure / Liquid)
```

Australian Hazchem Code: 2P
Poison Schedule: None allocated.
WHMIS:
This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

---

16. Other Information

NFPA Ratings: Health: **3** Flammability: **0** Reactivity: **2** Other: **Water reactive**
Label Hazard Warning:
POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR CONTACTED WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH. WATER REACTIVE. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.
Label Precautions:
Do not get in eyes, on skin, or on clothing.
Do not breathe mist.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
Do not contact with water.
Label First Aid:
In all cases call a physician immediately. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before re-use. Excess acid on skin can be neutralized with a 2% bicarbonate of soda solution. If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 14.
Disclaimer:
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****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

Attachment 4

Health & Safety Self Assessment Checklist

Attachment 4

CH2MHILL

Health and Safety Self Assessment Checklist Page 1 of 2
DRILLING

This self assessment is only to be used at locations where CH2M HILL controls the work. It is not to be used at locations where others control the work.

Project Name: _____ Project No.: _____
Location: _____ PM: _____
Auditor: _____ Title: _____ Date: _____

If an assessment item is complete/correct the "Yes" box should be checked. If an item is incomplete or deficient the "No" box should be checked. Items that are considered to be imminently dangerous must be corrected immediately or all exposed personnel must be removed from the hazard. All deficiencies shall be brought to the attention of the appropriate party that is responsible for correcting the deficiency. If an item is not applicable, the "N/A" box should be checked. If an item is applicable but was not observed during the assessment, the "N/O" box should be checked.

	Yes	No	N/A	N/O
GENERAL				
1. Daily safety briefing/meeting conducted with crew (3.1.1.1)	☐	☐	☐	☐
2. Daily inspection of drill rig and equipment conducted before use (3.1.1.2)	☐	☐	☐	☐
3. Fire extinguisher available (3.1.1.3)	☐	☐	☐	☐
4. First aid kit available (3.1.1.4)	☐	☐	☐	☐
DRILL RIG PLACEMENT				
5. Location of underground utilities identified (3.1.2.1)	☐	☐	☐	☐
6. Overhead power lines deenergized and grounded, insulating barriers installed or safe clearance maintained (3.1.2.2)	☐	☐	☐	☐
7. Drilling pad established, when necessary (3.1.2.3)	☐	☐	☐	☐
8. Drill rig leveled and stabilized (3.1.2.4)	☐	☐	☐	☐
DRILL RIG TRAVEL				
9. Rig shut down and mast lowered and secured prior to rig movement (3.1.3.1)	☐	☐	☐	☐
10. Tools and equipment secured prior to rig movement (3.1.3.2)	☐	☐	☐	☐
11. Only personnel seated in cab are riding on rig during movement (3.1.3.3)	☐	☐	☐	☐
12. Safe distance is maintained with traveling under power lines (3.1.3.4)	☐	☐	☐	☐
13. Backup alarm or spotter used when backing rig (3.1.3.5)	☐	☐	☐	☐
DRILL RIG OPERATION				
14. Personnel cleared during rig start-up (3.1.4.1)	☐	☐	☐	☐
15. Kill switch clearly identified and operational (3.1.4.2)	☐	☐	☐	☐
16. Personnel wearing appropriate PPE (3.1.4.3)	☐	☐	☐	☐

CH2MHILL

Health and Safety Self Assessment Checklist

DRILLING

	Yes	No	N/A	N/O
DRILL RIG OPERATION (Continued)				
17. Loose clothing and jewelry removed (3.1.4.4)	☐	☐	☐	☐
18. All machine guards are in place (3.1.4.5)	☐	☐	☐	☐
19. Personnel clear of rotating parts (3.1.4.6)	☐	☐	☐	☐
20. Rig ropes not wrapped around body parts (3.1.4.7)	☐	☐	☐	☐
21. Pressurized lines and hoses secured from whipping hazards (3.1.4.8)	☐	☐	☐	☐
22. Safe distance is maintained from overhead power lines (3.1.4.9)	☐	☐	☐	☐
23. Drill operation stopped during inclement weather (3.1.4.10)	☐	☐	☐	☐
24. Rig places in neutral when operator not at controls (3.1.4.11)	☐	☐	☐	☐
25. Loads are not hoisted overhead of personnel (3.1.4.12)	☐	☐	☐	☐
26. Smoking is prohibited around drilling operation (3.1.4.13)	☐	☐	☐	☐
DRILL RIG MAINTENANCE				
27. Defective components repaired immediately (3.1.5.1)	☐	☐	☐	☐
28. Lockout/tagout procedures used prior to maintenance (3.1.5.2)	☐	☐	☐	☐
29. Cathead in clean, sound condition (3.1.5.3)	☐	☐	☐	☐
30. Drill rig ropes in clean, sound condition (3.1.5.4)	☐	☐	☐	☐
31. Fall protection used for fall exposures of 6 feet or greater (3.1.5.5)	☐	☐	☐	☐
32. Rig in neutral and augers stopped rotating before cleaning (3.1.5.6)	☐	☐	☐	☐
33. Good housekeeping maintained on and around rig (3.1.5.7)	☐	☐	☐	☐
DRILLING HAZARDOUS WASTES				
34. Waste disposed off according to Health and Safety Plan (3.1.6.1)	☐	☐	☐	☐
35. Appropriate decontamination procedures being followed (3.1.6.2)	☐	☐	☐	☐

XXVII. HAZARDOUS WASTE

Certification and Training of CH2M HILL Personnel

1. Medical exam within last 12 months
2. 40-hour initial training, 3 days supervised field activities, 8-hour annual refresher
3. First aid and CPR certification
4. Quantitatively fit tested (preferred method per NIOSH Publication 87-116, Appendix B.3)
5. Attend pre-entry safety meeting
6. Site Safety Coordinator with appropriate training

Certification and Training of Subcontractor Personnel

1. Medical exam within last 12 months
2. 40-hour initial training, 3 days supervised field activities, 8-hour annual refresher
3. First aid and CPR certification
4. Quantitatively fit tested (preferred method per NIOSH Publication 87-116, Appendix B.3)
5. Attend pre-entry safety meeting

Site Safety Documentation

1. Site safety plan (SSP) prepared and approved
2. SSP onsite
3. All personnel onsite identified in SSP
4. Documentation of safety briefing
5. Hospital map posted
6. Phone numbers posted
7. Emergency vehicle identified
8. Material Safety Data Sheets (MSDSs) onsite
9. Work zones delineated (How?_____)
10. Wind direction flags in use
11. Documentation of calibration of monitoring equipment in clean environment
12. Monitoring conducted and recorded as specified in SSP (Frequency?_____)
13. Monitoring for heat/cold stress
14. Buddy system in use
15. Decontamination procedures established as specified in SSP
16. No eating, drinking, or smoking in exclusion and contamination reduction zones
17. Toilet facilities provided
18. 533 Forms completed
19. No contact lenses
20. Work conducted during daylight hours only

    Emergency equipment available as specified in SSP (What?_____)

JOBSITE SAFETY INSPECTION CHECKLIST

Revision No.: _____

Safety Briefing					
1.	All personnel attended (including new personnel)	☐	☐	☐	☐
2.	Documentation of meetings	☐	☐	☐	☐
3.	Chemical hazards and toxicology reviewed	☐	☐	☐	☐
4.	Physical hazards reviewed	☐	☐	☐	☐
5.	Biological hazards reviewed	☐	☐	☐	☐
6.	Heat/cold stress information reviewed	☐	☐	☐	☐
7.	Air monitoring requirements	☐	☐	☐	☐
8.	Levels of protection reviewed	☐	☐	☐	☐
9.	Work zones reviewed	☐	☐	☐	☐
10.	Decontamination procedures reviewed	☐	☐	☐	☐
11.	Emergency response procedures reviewed	☐	☐	☐	☐
12.	Site communications	☐	☐	☐	☐
Personal Protective Equipment (PPE)					
1.	Levels of protection being worn as specified in SSP	☐	☐	☐	☐
2.	All appropriate PPE available onsite	☐	☐	☐	☐
3.	Hard hats being worn	☐	☐	☐	☐
4.	Appropriate hand protection begin used (What?_____)	☐	☐	☐	☐
5.	Appropriate body protection being used (What?_____)	☐	☐	☐	☐
6.	Appropriate eye protection begin used (What?_____)	☐	☐	☐	☐
7.	Appropriate ear protection being used	☐	☐	☐	☐
8.	Appropriate respirator protection being used	☐	☐	☐	☐
9.	Respirators donned correctly	☐	☐	☐	☐
10.	TLD badges being used	☐	☐	☐	☐
11.	If air purifying respirators (APRs) are being used, correct cartridges (Type?_____)	☐	☐	☐	☐
12.	If self contained breathing apparatuses (SCBAs) are being used, is grade D air being used	☐	☐	☐	☐
13.	If SCBAs are being used, are cylinders stored correctly	☐	☐	☐	☐
14.	If personal protective equipment (PPE) is not onsite, prepared to halt work	☐	☐	☐	☐
15.	Disposal methods in place for disposable PPE	☐	☐	☐	☐
Decontamination Procedures					
1.	Decontamination procedure established as specified in the SSP	☐	☐	☐	☐
2.	Decontamination zone clearly defined	☐	☐	☐	☐
3.	PPE properly decontaminated (How?_____)	☐	☐	☐	☐
4.	Sampling equipment properly decontaminated (How?_____)	☐	☐	☐	☐
5.	Monitoring equipment properly decontaminated (How?_____)	☐	☐	☐	☐

6.	Heavy equipment properly decontaminated (How?_____)	☐	☐	☐	☐
7.	Samples properly decontaminated (How?_____)	☐	☐	☐	☐
8.	Decontamination fluids appropriately disposed of	ß	ß	ß	ß

XXVIII CONSTRUCTION INSPECTIONS

1.	Are the following inspected frequently:				
	a. Jobsite	☐	☐	☐	☐
	b. Materials	☐	☐	☐	☐
	c. Equipment	☐	☐	☐	☐
2.	Are first aid kits inspected before being sent to a jobsite and weekly thereafter?	☐	☐	☐	☐
3.	When noise levels are suspected to exceeded 85 db(A) is noise monitoring conducted?	☐	☐	☐	☐
4.	When exposure limits for gases, vapors, fumes, and/or mists might be exceeded, is monitoring conducted?	☐	☐	☐	☐
5.	When asbestos is present, is the enclosure inspected by a competent person before removal prior to each work shift?	☐	☐	☐	☐
6.	When methylenedianiline is present are the following done:				
	a. Initially monitoring	☐	☐	☐	☐
	b. Monitoring every 6 months	☐	☐	☐	☐
	c. Monitoring when changes in potential exposure	☐	☐	☐	☐
	d. Work clothing inspected periodically	☐	☐	☐	☐
	e. Spills and leak inspections conducted regularly	☐	☐	☐	☐
7.	When onsite, are respirators inspected regularly?	☐	☐	☐	☐
8.	When working near or over water, are buoyant work vests and preservers inspected regularly?	☐	☐	☐	☐
9.	Is all fire fighting equipment, including portable fire extinguishers periodically inspected?	☐	☐	☐	☐
10.	Is rigging equipment inspected prior to each use and as necessary?	☐	☐	☐	☐
11.	Are abrasive wheels inspected and ring tested before mounting?	☐	☐	☐	☐
12.	Are joints in structures and pipelines used as ground return circuits bonded/inspected periodically?	☐	☐	☐	☐
13.	Is each cord set; attachment cap, plug, and receptacle of cord sets; and equipment connected by cord and plug inspected for electrical grounding before each day's use?	☐	☐	☐	☐
14.	Are lockout/tagout procedures in place whenever equipment is being repaired or maintained?	☐	☐	☐	☐
15.	Are single point suspended scaffolds type hoists, cables, and related equipment regularly serviced and inspected?	☐	☐	☐	☐
16.	Are cranes and derricks inspected by a competent person prior to each use and during use?	☐	☐	☐	☐
17.	Is hoisting machinery for cranes and derricks inspected annually?	☐	☐	☐	☐
18.	Are trial lift of personnel baskets visually inspected by a competent person immediately after a trial lift?	☐	☐	☐	☐

19.	Are hoists inspected and tested at not more than 3 month intervals?	☐	☐	☐	☐
20.	Are hoist towers inspected and maintained on a weekly basis?	☐	☐	☐	☐
21.	Before moving, are booms on aerial lifts inspected, properly cradled, and outriggers stowed?	☐	☐	☐	☐
22.	Are excavation inspected by a competent person after every rainstorm or other hazard-increasing occurrence?	☐	☐	☐	☐
23.	Are excavations inspected daily by a competent person?	☐	☐	☐	☐
24.	Are roof face and walls of tunnels inspected at the start of each shift and frequently thereafter?	☐	☐	☐	☐
25.	Does a competent person inspect all drilling and associated equipment prior to blasting?	☐	☐	☐	☐
26.	Prior to blasting, are drilling areas inspected?	☐	☐	☐	☐
27.	During demolition, are stairs, passage ways, and ladders periodically inspected?	☐	☐	☐	☐
28.	Are electrical systems of vehicles transporting explosive underground checked weekly?	☐	☐	☐	☐
29.	Are electrical transmission and distribution equipment inspected prior to starting work?	☐	☐	☐	☐
30.	Are lockout/tagout designated switched and disconnectors visually inspected and tested prior to operation?	☐	☐	☐	☐
31.	When working on energized lines, is rubber protective equipment visually inspected prior to use?	☐	☐	☐	☐
32.	Are body belts and straps inspected before use?	☐	☐	☐	☐
33.	Are live line tools visually inspected before each work day?	☐	☐	☐	☐
34.	Is power transmission equipment visually inspected daily?	☐	☐	☐	☐
35.	Are inspections of overhead lines made prior to climbing to determine that structures are capable of sustaining additional stresses?	☐	☐	☐	☐
36.	Are ladders inspected periodically and after any occurrence which could affect their safety?	☐	☐	☐	☐

XXIX. OFFICE TRAILERS/BUILDINGS

Employer Posting

1.	Is the OSHA (or state) job safety poster displayed in a prominent location where all employees are likely to see it?	☐	☐	☐	☐
2.	Are emergency telephone numbers posted where they can be readily found in case of emergency?	☐	☐	☐	☐
3.	Where employees may be exposed to any toxic substances or harmful physical agents, has appropriate information concerning employee access to medical and exposure records and Material Safety Data Sheets been posted or otherwise mad readily available to affected employees?	☐	☐	☐	☐
4.	Are signs concerning exiting from buildings, room capacities, floor loading, exposures to x-ray, microwave, or other harmful radiation or substances posted where appropriate?	☐	☐	☐	☐
5.	Are other required posters properly displayed, such as:				
	a. Industrial Welfare Commission orders regulating wages, hours, and working conditions?	☐	☐	☐	☐

b. Discrimination in employment prohibited by law?	☐	☐	☐	☐
c. Notice to employees of unemployment and disability insurance.	☐	☐	☐	☐
d. Payday notice?	☐	☐	☐	☐
Emergency Action Plan				
1. Are alarm systems properly maintained and tested regularly?	☐	☐	☐	☐
2. Is the emergency action plan reviewed and revised periodically?	☐	☐	☐	☐
3 Do employees know their responsibilities:	☐	☐	☐	☐
a. For reporting emergencies?	☐	☐	☐	☐
b. During an emergency?	☐	☐	☐	☐
c. For conducting rescue and medical duties?	☐	☐	☐	☐
Fire Protection				
1. Is there a current fire prevention plan?	☐	☐	☐	☐
2. Does the plan describe the type of fire protection equipment and/or system?	☐	☐	☐	☐
3. Are practices and procedures established to control potential fire hazards and ignition sources?	☐	☐	☐	☐
4. Is local fire department well acquainted with facilities, location, and specific hazards?	☐	☐	☐	☐
5. Is there a fire alarm system and is it certified as required?	☐	☐	☐	☐
6. If you have a fire alarm system, is it tested at least annually?	☐	☐	☐	☐
7. Are fire doors and shutters in good operating condition?	☐	☐	☐	☐
8. Are automatic sprinkler system water control valves, air and water pressures checked weekly/periodically as required?	☐	☐	☐	☐
9. Is maintenance of automatic sprinkler systems assigned to responsible persons or to a sprinkler contractor?	☐	☐	☐	☐
10. Is an earthquake preparedness kit on site?	☐	☐	☐	☐
Exiting or Egress				
1. Are all exits marked with an exit sign and illuminated by a reliable light source?	☐	☐	☐	☐
2. Are the directions to exits, when not immediately apparent, marked with visible signs?	☐	☐	☐	☐
3. Are doors, passageways, or stairways that are neither exits nor access to exits and which could be mistaken for exits, appropriately marked "NOT AN EXIT," "TO BASEMENT," "STOREROOM," etc.?	☐	☐	☐	☐
4. Are exit doors side-hinged?	☐	☐	☐	☐
5. Are all exits kept free of obstructions?	☐	☐	☐	☐
6. Are there sufficient exits to permit prompt escape in case of emergency?	☐	☐	☐	☐
7. Are special precautions taken to protect employees during construction and repair operations?	☐	☐	☐	☐
8. Where exiting will be through frameless glass door, glass exit doors, etc., are the doors fully tempered, and do they meet the safety requirements for human impact?	☐	☐	☐	☐
General Work Environment				

1.	Are all work sites clean and orderly?	☐	☐	☐	☐
2.	Are work surfaces kept dry or appropriate means taken to assure the surfaces are slip-resistant?	☐	☐	☐	☐
3.	Are all spilled materials or liquids cleaned up immediately?	☐	☐	☐	☐
4.	Are the minimum number of toilets and washing facilities provided?	☐	☐	☐	☐
5.	Are all toilets and washing facilities clean and sanitary?	☐	☐	☐	☐
6.	Are all work areas adequately illuminated?	☐	☐	☐	☐
Walkways					
1.	Are aisles and passageways kept clear?	☐	☐	☐	☐
2.	Are aisles and walkways marked as appropriate?	☐	☐	☐	☐
3.	Are wet surfaces covered with nonslip materials?	☐	☐	☐	☐
4.	Are holes in the floor, sidewalk, or other walking surface repaired properly, covered, or otherwise made safe?	☐	☐	☐	☐
Medical Services And First Aid					
1.	If medical and first aid facilities are not in proximity to your workplace, is at least one employee on each shift currently qualified to render first aid?	☐	☐	☐	☐
2.	Are medical personnel readily available for advice and consultation on matters of employee health?	☐	☐	☐	☐
3.	Are emergency phone numbers posted?	☐	☐	☐	☐
4.	Are first aid kits easily accessible to each work area, with necessary supplies available, periodically inspected, and replenished as needed?	☐	☐	☐	☐
5.	Have first aid kit supplies been approved by a physician, indicating they are adequate for a particular area or operation?	☐	☐	☐	☐