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Project Plans for Groundwater Monitoring at Site 5, 9, 10, and 11 Naval Amphibious Base Little Creek Virginia Beach, Virginia

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command
Norfolk, Virginia

Contract No. N62470-95-D-6007
CTO-0024

November 1996

Prepared by

CH2MHILL

Baker
Environmental, Inc.

CDM
Federal Programs Corp.

03.03-11/01/96-00118

Final

Work Plan and Sampling and Analysis Plan for Groundwater Monitoring at Sites 5, 9, 10, and 11

Naval Amphibious Base Little Creek
Virginia Beach, Virginia

Contract Task Order 024

November 19, 1996

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

Under the

LANTDIV CLEAN II Program
Contract N62470-95-D-6007

Prepared by

CH2M HILL

Herndon, Virginia

WDCR1043/018.DOC/1

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Virginia Beach, Virginia

Contract Task Order Number - 0024
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Navy CLEAN II Program

Prepared by

CH2M HILL, Ltd.

November 19, 1996

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Approved by: _____ Date: 11.19.96
Bob Root
Senior Reviewer

WDCR1043/019.DOC/1

Preface

This document contains the following plans:

- Work Plan
- Sampling and Analysis Plan (SAP) ; consisting of:
    - Quality Assurance Project Plan (QAPP)
    - Field Sampling Plan (FSP)
    - Health and Safety Plan (HSP)
    - Investigation-Derived Waste Management Plan (IDWMP)

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SECTION 1

Introduction

This work plan describes the work necessary to conduct Groundwater Monitoring at Sites 5, 9, 10, and 11, Naval Amphibious Base (NAB) Little Creek, Virginia Beach, Virginia. The work plan is based upon the Scope of Work provided by Naval Facilities Engineering Command (NFEC) LANTDIV on July 26, 1996, as part of Navy contract N62470-95-D-6007, Navy Comprehensive Long-Term Environmental Action Navy (C.L.E.A.N.), District III, Contract Task Order - 024, and the technical approach as documented in CH2M HILL's implementation plan (IP) submitted to LANTDIV on August 19, 1996.

In 1993 Foster Wheeler performed an Remedial Investigation and Feasibility Study (RI/FS) and Site Inspection (SI) at NAB Little Creek. Six RI sites and two SI sites were investigated at the facility and evaluated with regard to contamination characteristics, migration pathways, and pollutant receptors. Although none of these sites was found to pose an immediate threat to human health or the environment, four sites were recommended for further monitoring of groundwater quality. They are:

- Site 5 - Buildings 9-11 Motor Oil Disposal Area
- Site 9 - Driving Range Landfill
- Site 10 - Sewage Treatment Plant Landfill
- Site 11 - School of Music Plating Shop

The specific objectives of this CTO are to: (1) prepare project plans for conducting groundwater monitoring at Sites 5, 9, 10, and 11; (2) conduct groundwater sampling at the four sites; (3) analyze the analytical data; and (4) prepare and submit periodic reports.

The general background and physical setting of NAB Little Creek are described in Section 2 of this work plan. Section 3 presents historic environmental data for the four sites as determined from previous investigations and an initial site visit, and discusses the rationale that supports the sampling tasks. Section 4 describes the technical approach to the groundwater monitoring program work plan tasks, and Section 5 presents general information on project management and staff organization. Section 6 documents the anticipated subcontract services required for completing tasks documented in this work plan, and Section 7 presents the schedule for completing the tasks. A list of project-related acronyms is presented in Table 1-1.

Table 1-1 NAB Little Creek List of Acronyms	
BOA	Basic Ordering Agreements
CERCLA	Comprehensive Environmental Response, Compensation, And Liability Act
DRMO	Defense Reutilization and Marketing Office
HSP	Health and Safety Plan
HSWA	Hazardous And Solid Waste Amendments
IAS	Initial Assessment Study
IDWMP	Investigation Derived Waste Management Plan
IRI	Interim Remedial Investigation
IRP	Installation Restoration Program
NAB	Naval Amphibious Base
NPDES	National Pollutant Discharge Elimination System
PCB	Polychlorinated Biphenyl
POL	Petroleum, Oil, And Lubricants
POTW	Publically Owned Treatment Works
PSI	Preliminary Site Inspection
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation And Recovery Act
RFA	RCRA Facility Assessment
RI/FS	Remedial Investigation/Feasibility Study
RVS	Round 1 Verification Step
SAP	Sampling and Analysis Plan
SI	Site Inspection
SQL	Sample Quantitation Limit
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VDEQ	Virginia Department of Environmental Quality
VHWMR	Virginia Hazardous Waste Management Regulations

SECTION 2

Site Background and Physical Setting

Available site-background information is documented in this section. Information was obtained primarily from the NAB Little Creek RI/FS for Sites 7 and 9-13 prepared by Foster Wheeler Environmental Services (FWES), November 1994, the SI for Sites 5 and 16 prepared by FWES, November 1994, the Site Management Plan (SMP) prepared by FWES May 26, 1995, and the Draft Final Groundwater Monitoring Plan for Sites 5, 9, 10, and 11 prepared by FWES, May 9, 1996.

Location and Surrounding Land Use

NAB Little Creek is on 2,147 acres of land within the city of Virginia Beach, Virginia. The base is in the northwest corner of Virginia Beach and it's western border abuts the city of Norfolk, Virginia. The facility is bounded on the north by the Chesapeake Bay, on the west by residential communities and several marinas, on the south by Shore Drive, Lake Whitehurst, the Norfolk International Airport industrial park, Little Creek Reservoir/Lake Smith, and a residential development, and on the east by Lake Bradford. Figure 2-1 shows the location of the base.

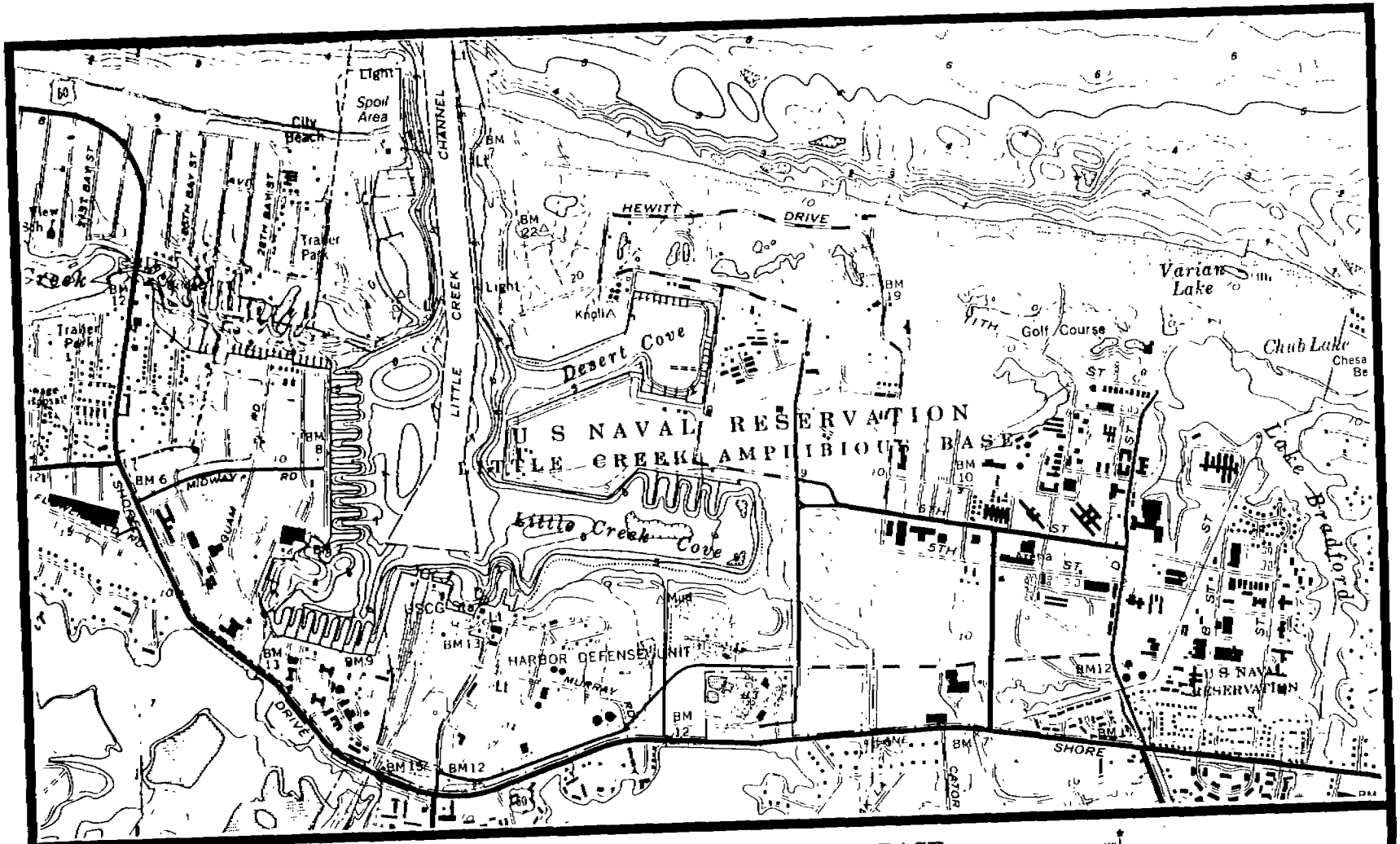
NAB Little Creek is primarily an industrial facility that centers around three bodies of water: Little Creek Cove, Desert Cove, and Little Creek Channel that connects the coves with the Chesapeake Bay. The southwest corner of the base has been developed for residential use. Figure 2-2 shows the layout of the base.

Land use surrounding NAB Little Creek is primarily residential and industrial. Little Creek Reservoir serves as a drinking water supply for parts of the city of Norfolk.

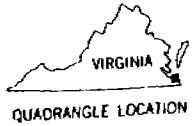
A large concentration of military installations is within a 25-mile radius of NAB Little Creek. They include Fort Monroe and Langley Air Force Base to the north, Fort Story to the east, Naval Air Station Oceana to the southeast, Norfolk Naval Shipyard and St. Juliens Creek Annex to the south, and Norfolk Naval Base and Naval Supply Center-Craney Island Fuel Terminal to the southwest.

Facility History and Mission

NAB Little Creek provides logistical facilities and support services for local commands, organizations, homeported ships, and other units to meet the amphibious warfare training requirements of the United States Armed Forces. The base was commissioned in June 1945 by combining four contiguous activities. The Navy began purchasing land in the area from private estates and the Pennsylvania Railroad just prior to World War II. The first activity to be commissioned was the Amphibious Training Base in the southwestern corner of the present base near Little Creek Harbor. The base's mission was the training of landing craft personnel for operational assignments. Over the last fifty years, NAB Little Creek has expanded in both area and diversity of its mission.

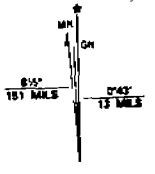


LITTLE CREEK AMPHIBIOUS BASE
VIRGINIA BEACH, VIRGINIA
SITE LOCATION MAP



QUADRANGLE LOCATION

Little Creek, VA Quadrangle
7.5 Minute Series (Topographic)



UTM GRID AND 1986 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Figure 2-1
Scale: 1" = 2000'

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Foster Wheeler Enviresponse, Inc.

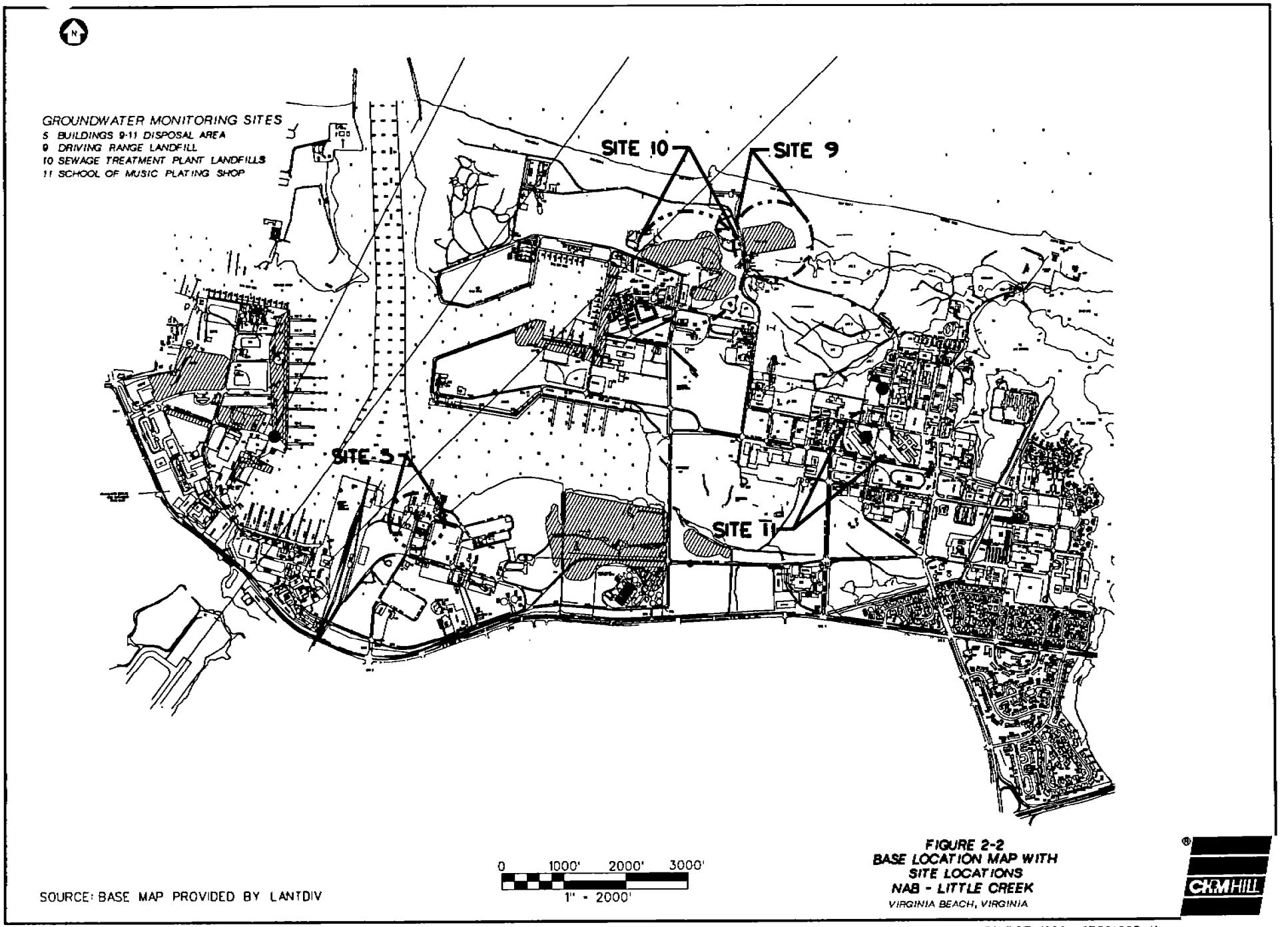

FIGURE 2-2
BASE LOCATION MAP WITH
SITE LOCATIONS
NAB - LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

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Processes and Operations

Processes and operations conducted at the sites addressed by the groundwater monitoring program are discussed in Section 3. Detailed descriptions of past activities conducted at the base and the types of wastes generated can be found in the Initial Assessment Study (IAS) prepared by Rogers, Golden & Halpern (RGH), December 1984.

Climate and Meteorology

The Virginia Beach/Norfolk region has a maritime climate that is characterized by long, temperate summers and mild winters. The average annual temperature is 60.7° Fahrenheit (F). July is the warmest month, temperatures averaging 78.7°F; January is the coolest month, temperatures averaging 43.1°F. Freezing temperatures are infrequent in the region. Precipitation averages 43 inches annually and is distributed evenly over the year. Precipitation increases slightly from June to August because of the prevalence of convective thunderstorms. The average annual snowfall is 8.8 inches. Winds are generally easterly and are moderate, ranging from 6 to 11 knots.

Topography, Surface Drainage, and Soil

The topography of NAB Little Creek and the surrounding area is low lying and nearly level, with several fresh water lakes surrounding the base and several saltwater coves and channels within the boundaries of the base. Surface elevations at the base range from sea level to 10 feet.

The majority of surface water on the base, including that which originates from the areas of Sites 5, 9, 10, and 11, flows to the Chesapeake Bay, either directly or by way of the coves and channel. Surface water runoff from the far eastern side of the base flows to Lake Braddock. Surface water runoff from small areas along the southern edge of the base may flow to Little Creek Reservoir.

The reported 100-year static-water flood elevation throughout NAB Little Creek is 8.5 feet mean sea level (MSL). Therefore, parts of the base adjacent to the Chesapeake Bay, the coves, and the channel are within the 100-year floodplain.

The surface soil over 90 percent of the base consists of dredge spoils and imported fill. The hydraulic conductivity of this fill material varies significantly but primarily is relatively high. The soil underlying the fill material generally consists of fine sands and silts at a thickness of 20 to 40 feet with low to moderate permeability. This upper layer of soil typically is underlain by relatively impermeable sediment composed of silt, clay, and sandy clay. Together, these strata have a combined thickness of approximately 60 feet. The average permeability of soil in Norfolk County is less than 2.5 inches per hour.

Geology and Hydrogeology

NAB Little Creek is located in the outer Atlantic Coastal Plain Physiographic Province which is characterized by low elevations and gently sloping relief. The base is underlain by over 2,000 feet of gently dipping sandy sediments, ranging in age from Recent to Lower

Cretaceous. Table 2-1 contains a stratigraphic column and hydrogeologic units of southeast Virginia.

The uppermost geologic unit is the Columbia Group, composed of Holocene deposits and undifferentiated Pleistocene deposits. The Columbia Group is approximately 60 feet thick. The upper 20 to 40 feet consist of unconsolidated fine sands and silts. These sediments possess low to moderate permeabilities and comprise the unconfined Columbia aquifer. The lower 20 to 40 feet consist of relatively impermeable silt, clay, and sandy clay.

The Chesapeake Group underlies the Columbia Group. The uppermost unit in the Chesapeake Group is the Yorktown Formation. It is capped by the Yorktown confining unit that separates the Columbia aquifer from underlying Yorktown aquifer. The Yorktown formation is approximately 90 to 100 feet thick in the vicinity of the base and is composed of marine silt and clay and moderately consolidated coarse sand and gravel with abundant shell fragments. The Chesapeake Group is composed of several additional older formations that comprise deeper aquifers and confining units. These overlie the Tertiary Pamunkey Group and Cretaceous stratigraphy.

The two significant shallow aquifer systems in the area are the Columbia aquifer located in the upper 20 to 40 feet of the Columbia Group, and the underlying Yorktown Aquifer. The Columbia aquifer that comprises the water table aquifer is reportedly thin and consists of discontinuous heterogeneous sand and shell lenses. The depth to the water table ranges from zero to 8 feet below the ground surface. The Yorktown Aquifer is semi-confined beneath a clay layer in the upper Yorktown Formation. Water bearing zones in the Yorktown Aquifer consist of fine to coarse sand, gravel, and shells.

Environmental History

Information on previous and ongoing basewide hazardous waste investigations pertaining to Sites 5, 9, 10, and 11 is documented below.

Installation Restoration Program

Environmental characterization and remediation activities at NAB Little Creek are being conducted under the United States Department of Defense (DOD) Installation Restoration Program (IRP). The IRP at NAB Little Creek is being conducted in accordance with applicable federal and state environmental regulations and requirements. In addition, the Navy solicits involvement and comments from federal and state regulatory agencies such as the US environmental Protection Agency (USEPA) and the Virginia Department of Environmental Quality (VDEQ) throughout the IRP process by submitting documents for their review.

Table 2-1
Stratigraphic and Hydrogeologic Units of Southeast Virginia
(From Harsh and Laczniak, 1990)

Geologic Age		Stratigraphic Formation	Hydrogeologic Unit
Period	Epoch		
Quaternary	Holocene	Holocene Deposits	Columbia Aquifer
	Pleistocene	Undifferentiated Deposits	
Tertiary	Pliocene	Yorktown Formation	Yorktown Confining Unit
	Miocene	Eastover Formation	Yorktown- Eastover Aquifer
		St. Mary's Formation	St. Mary's Confining Unit
		Choptank Formation	St. Mary's-Choptank Aquifer
		Calvert Formation	Calvert Confining Unit
	Oligocene	Old Church Formation	Chickahominy-Piney Point Aquifer
	Eocene	Chickahominy Formation	
		Piney Point Formation	
		Nanjemoy Formation	Nanjemoy-Marlboro Clay Confining Unit
		Marlboro Clay	
	Paleocene	Aquia Formation	Aquia Aquifer
		Brightseat Formation	Brightseat-Upper Potomac Confining Unit
Cretaceous	Late Cretaceous	Potomac Formation	Brightseat-Upper Potomac Aquifer
			Middle Potomac Confining Unit
	Early Cretaceous		Middle Potomac Aquifer
			Lower Potomac Confining Unit
			Lower Potomac Aquifer

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Previous Basewide Investigations

Environmental investigation activities were initiated at NAB Little Creek in 1984 with the IAS conducted by RGH. The purpose of the IAS was to identify and assess sites that posed a potential threat to human health or the environment because of contamination from past handling of and operations involving hazardous materials. A total of 17 potentially contaminated sites were identified on the basis of information obtained from historical records, photographs, site inspections, and personnel interviews. Each of the sites was evaluated for type of contamination, migration pathways, and pollutant receptors. The IAS concluded that six of the sites; Sites 9, 10, and 11, as well as Site 7 (Amphibious Base Landfill), Site 12 (Exchange Laundry Waste Disposal Area), and Site 13 (Public Works PCP Dip Tank and Wash Rack), posed sufficient threats to human health or the environment to warrant further evaluation in a confirmation study. Four other sites; Site 5, Site 4 (Reserve Center Motor Oil Disposal Area), Site 15 (PCB Capacitor Spill–Fire Station 1), and Site 16 (PCB Capacitor Spill–Pole No. 425) were recommended for mitigation measures. Sampling and analyses were not performed as part of the IAS.

A confirmation study subsequently was performed for the six sites that were recommended for further investigation in the IAS. The confirmation study was conducted in two rounds consisting of the Round 1 Verification Step (RVS) conducted by CH2M HILL and dated October 1986, and the Interim Remedial Investigation (IRI) conducted by Ebasco and dated November 1991. During the confirmation study, sampling and monitoring were performed at the sites to confirm or refute the existence of the suspected contamination. Approximately 31 groundwater monitoring wells were installed during this phase of the work.

A Preliminary Site Inspection (PSI) was conducted at Sites 4, 5, 15, 16, and 17 (Building 1256 Motor Oil Disposal Area) by Ebasco in July 1991 to assess any threats to human health and the environment. Chemical constituents were detected in the groundwater at Site 5 and further sampling was recommended.

A background groundwater quality study was conducted by Applied Environmental Inc. and is documented in a report dated December 1992. Eight background monitoring wells were installed and sampled as part of this study.

An RI/FS and Risk Assessment were conducted for Sites 7, 9, 10, 11, 12, and 13 by FWES in 1993. This effort coincided with a Site Inspection (SI) at Sites 5 and 16. The work included the installation of additional monitoring wells and the sampling of soil, sediment, groundwater, surface water, and soil gas. Results are documented in two reports both dated November 1994.

In 1996, a removal action was undertaken at Site 11 to excavate and dispose of the neutralization tank, piping and surrounding soil.

The current status of Sites 5, 9, 10, and 11 is summarized in Table 2-2.

Table 2-2
Current Status of Sites 5, 9, 10, and 11
NAB Little Creek

Site	IAS	CS		PSI	RI/FS	SI	Remvl. Act.	Proposed Actions
		RVS	IRI					
Site 5: Buildings 9-11 Motor Oil Disposal Area	12/84	--	--	7/91	--	11/94	--	Two rounds of groundwater monitoring to verify no-risk
Site 9: Driving Range Landfill	12/84	10/86	11/91	--	11/94	--	--	Three to five years of semi-annual groundwater monitoring
Site 10: Sewage Treatment Plant Landfill	12/84	10/86	11/91	--	11/94	--	--	Three to five years of semi-annual groundwater monitoring
Site 11: School of Music Plating Shop	12/84	10/86	11/91	--	11/94	--	1996	Two rounds of groundwater monitoring to confirm effectiveness of removal action

Legend:

Dates shown are dates of report
IAS - Initial Assessment Study
CS Confirmation Study
RVS Round 1 Verification Step
IRI - Interim Remedial Investigation
PSI - Preliminary Site Inspection
SI - Site Inspection
Remvl. Act. Removal Action
RI - Remedial Investigation
FS - Feasibility Study

SECTION 3

Results of Previous Investigations and Work Plan Rationale

This section presents a discussion of available background information and existing conditions for Site 5, Site 11, Site 9, and Site 10. The results and conclusions of previous investigations of these sites are documented in this section to explain the basis for the scope of the groundwater monitoring program at the sites. Sampling techniques and analytical methods proposed for the sites are discussed in Section 4.

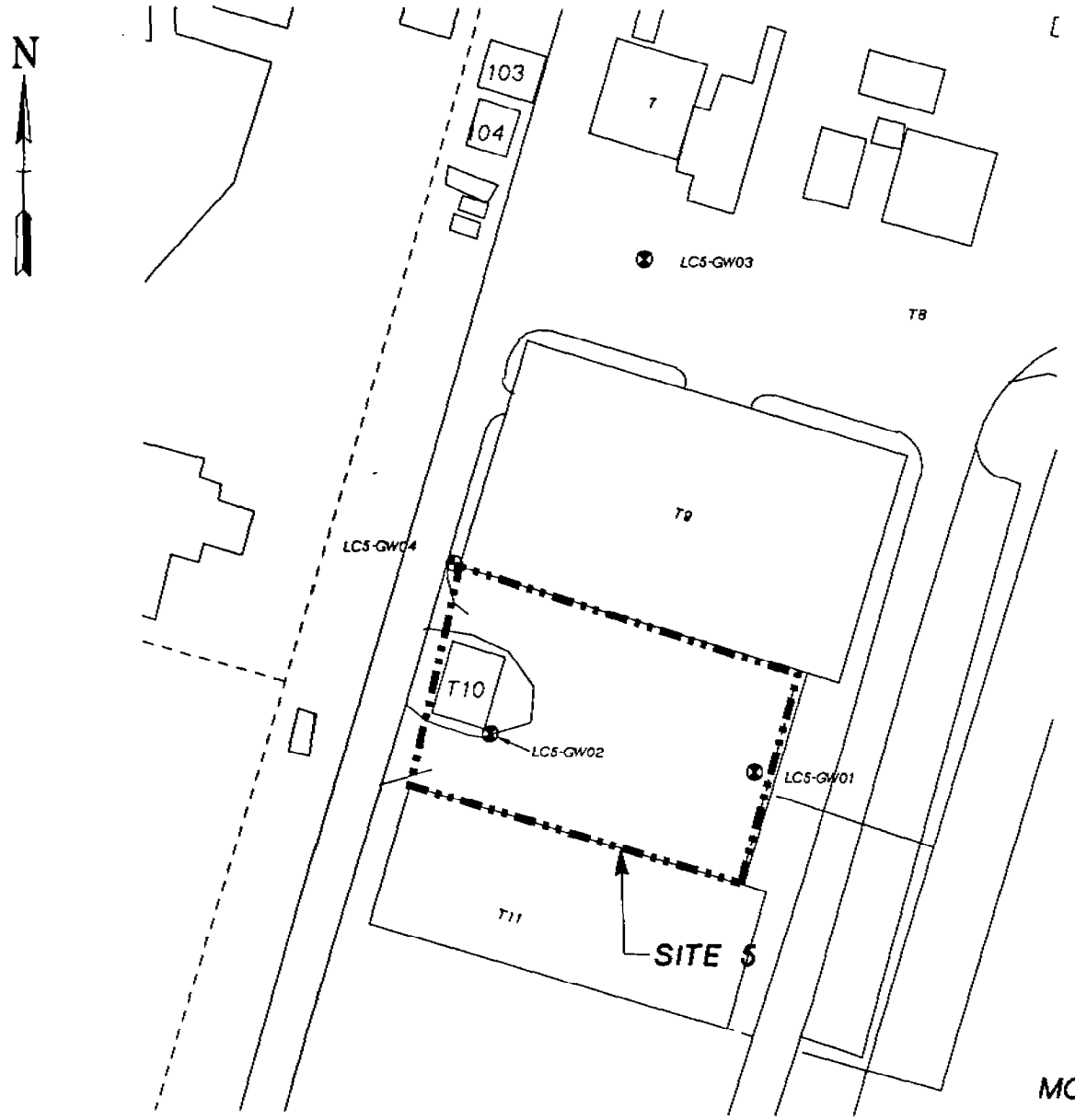
Site 5–Buildings 9-11 Motor Oil Disposal Area

During the period of 1943-1981 an estimated 93,000 gallons of oil and antifreeze were handled at this site. Anectdotal information led to the initial belief that as much as 43,000 gallons of used oil, antifreeze, and solvents may have been disposed of in pits located within Building 11, and that additional volumes of used oil and antifreeze may have been disposed of on the ground between Buildings 9 and 11.

Initial monitoring well installation and soil sampling were conducted at the site in December 1990 by Ebasco as part of a Preliminary Site Inspection (PSI). Four groundwater monitoring wells were installed and sampled, and four soil samples were collected from between Buildings 9 and 11. Soil sample and monitoring well locations are shown in Figure 3-1. The wells were resampled as part of the Site Inspection (SI) conducted by FWES in 1994. Both the PSI and the SI reported elevated levels of 1,1-dichloroethane (1,1-DCA) in one monitoring well, GW-2. The level had increased from 23.2 µg/L in 1991 to 76 µg/L in May 1993. However, 1,1-DCA was not detected in any of the three other wells at the site during either of the sampling events. The absence of 1,1-DCA in surface soils prohibited identification of any contamination source within site boundaries; it was determined that such a source may possibly exist outside the site boundaries. All four monitoring wells contained levels of lead below Virginia State Water Control Board limits.

Soil samples obtained during the PSI indicated low levels of TPH suggesting that the reported dumping of waste oil between Building 9 and 11 was grossly overestimated or overstated. Further soil sampling was not required.

Results of soil and groundwater sampling at Site 5 to date indicate that no risk is posed by contaminants in soil and groundwater. Two rounds of verification groundwater monitoring are proposed to verify the no-risk determination. Sampling results for Site 5 will be assessed and evaluated after the two rounds of sampling and analysis have been completed. The first round of verification sampling was conducted in May 1996 by FWES.



LEGEND

SITE BOUNDARY

LC5-GW02 EXISTING MONITORING WELL (TO BE SAMPLED)

GRAPHIC SCALE

0 75' 150' 225'

1"=75'-0"

BASE MAP PROVIDED BY: FOSTER WHEELER ENVIRONMENTAL SERVICES

FIGURE 3-1
MONITORING WELL LOCATIONS
SITE 5
NAB - LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

CH2M HILL

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Site 9–Driving Range Landfill

Site 9, the Driving Range Landfill, was operational from 1950 through 1956. The six-acre landfill was operated using a trench-and-fill technique, with a trench depth limited to 5 feet by the shallow water table. The types of wastes disposed of in the landfill included municipal wastes, incinerator ash, and potentially hazardous wastes such as pesticides, paints, solvents, inorganics, heavy metals, acids, bases, PCBs, and other unknown materials. The vast majority of the estimated 40,000 cubic yards of waste disposed of in the landfill is presumed to be non-hazardous solid waste. The surface area of the landfill has subsequently been converted to use as a driving range.

Six groundwater monitoring wells were initially installed at the site and sampled between April and May 1986 as part of the RVS. Soil sample and monitoring well locations are shown in Figure 3-2. All of the constituents detected in the groundwater had concentrations which were at or below contract required quantitation limits (CRQLs). Typically, the CRQL is lower than most legally established guidelines, regulations, or requirements.

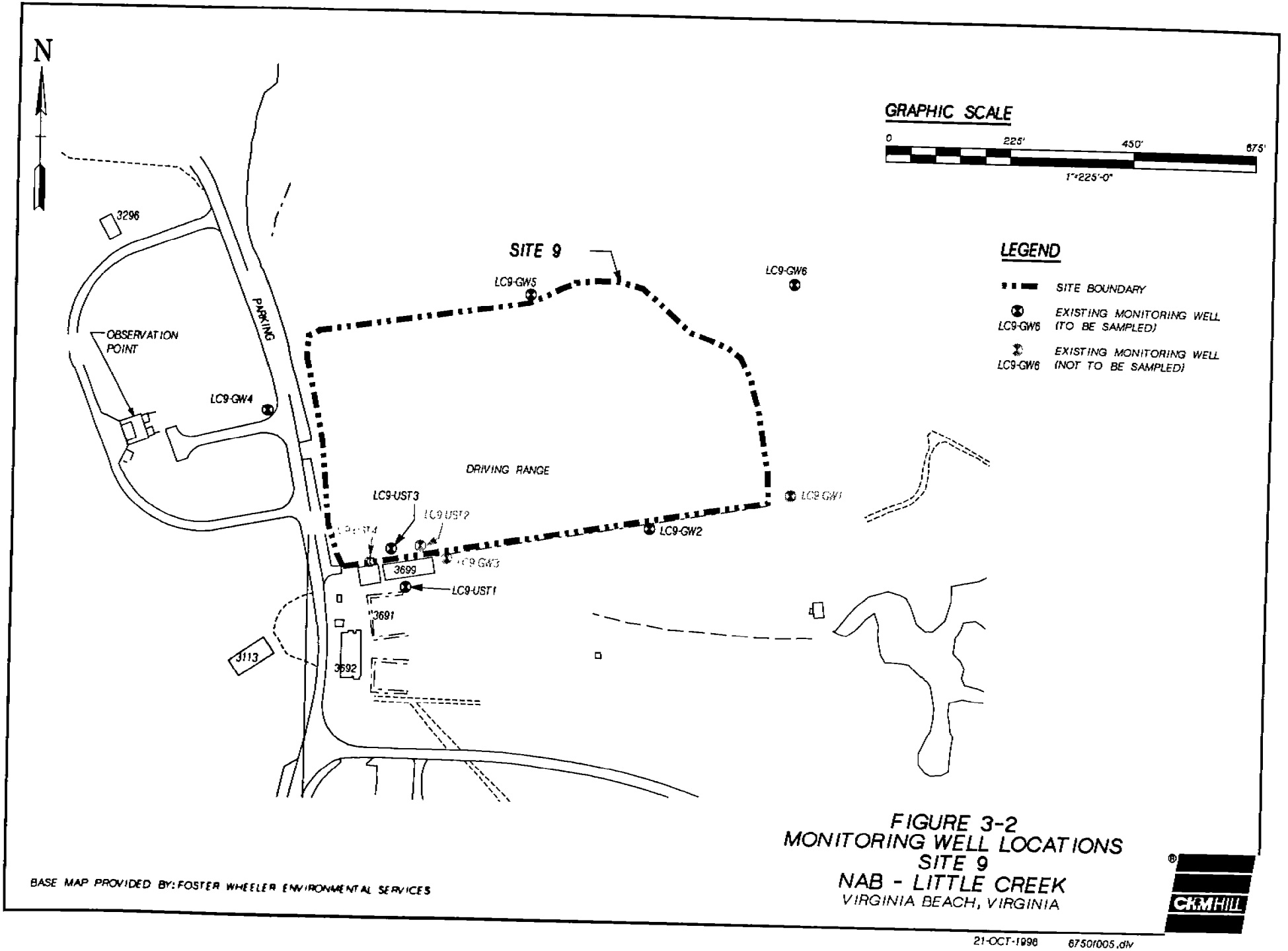
Five of the six monitoring wells were sampled as part of the IRI. Monitoring well LC9-GW3 could not be located for sampling. Four metals, cadmium, copper, manganese, and zinc, were detected at total (unfiltered) concentrations greater than the CRQL. The five wells were resampled in March 1991, and the metal samples were filtered. No TAL metals were detected above the CRQL in the filtered groundwater samples.

Four additional groundwater monitoring wells were installed near the southwest corner of the landfill as part of a UST investigation.

Results of RI/FS sampling and risk assessment indicate that no current risk is posed by contaminants in soil and groundwater. However, a long-term monitoring program is proposed to monitor groundwater quality at the site due to the contents of the landfill and its proximity to the Chesapeake Bay and other surface water bodies. Groundwater monitoring is currently proposed to be conducted semiannually for a period of 5 years (ten rounds of sampling) beginning in 1996. Sampling results will be assessed and the program reevaluated after three years (six rounds) of sampling and analysis have been completed. Based on the 3-year evaluation, sampling may be reduced to an annual frequency, or continued on a semiannual basis for the full 5 years. The first round of monitoring was conducted in May 1996 by FWES.

Site 10–Sewage Treatment Plant Landfill

Site 10, the Sewage Treatment Plant Landfill, was used from 1941 through 1952. The landfill, which consists of several contiguous areas comprising a total of 18 acres, was operated by directly filling in low-lying areas including areas below the water table. The materials disposed of in the landfill are reported to be similar to those at Site 9 with the exception of incinerator ash, because the site incinerator was not installed until after this landfill stopped operation.



BASE MAP PROVIDED BY: FOSTER WHEELER ENVIRONMENTAL SERVICES

FIGURE 3-2
MONITORING WELL LOCATIONS
SITE 9
NAB - LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

CH2M HILL

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Eight groundwater monitoring wells were initially installed and sampled between April and May 1986 as part of the RVS. Soil sample and monitoring well locations are shown in Figure 3-3. Four constituents of concern, one metal, two VOCs; 1,1-dichloroethane (1,1-DCA), and 1,1,1-trichloroethane (1,1,1-TCA) and one pesticide, DDD, were detected above CRQLs in the groundwater samples.

These eight monitoring wells were sampled again during the IRI in December 1990. Elevated levels of inorganics, and one pesticide, Lindane, were detected in the groundwater; no VOCs were detected. Six of the eight monitoring wells were resampled for dissolved inorganics in March 1991. None of the filtered samples contained inorganic concentrations exceeding the CRQLs.

Results of RI/FS sampling and risk assessment indicate that no current risk is posed by contaminants in soil and groundwater. A long-term monitoring program is proposed to continually monitor groundwater quality at the site due to the contents of the landfill and its proximity to the Chesapeake Bay and other surface water bodies. Groundwater monitoring is currently proposed to be conducted semiannually for a period of 5 years (ten rounds of sampling) beginning in 1996. Sampling results will be assessed and the program reevaluated after three years (six rounds) of sampling and analysis have been completed. Based on the 3-year evaluation, sampling may be reduced to an annual frequency, or continued on a semiannual basis for the full 5 years. The first round of monitoring was conducted in May 1996 by FWES.

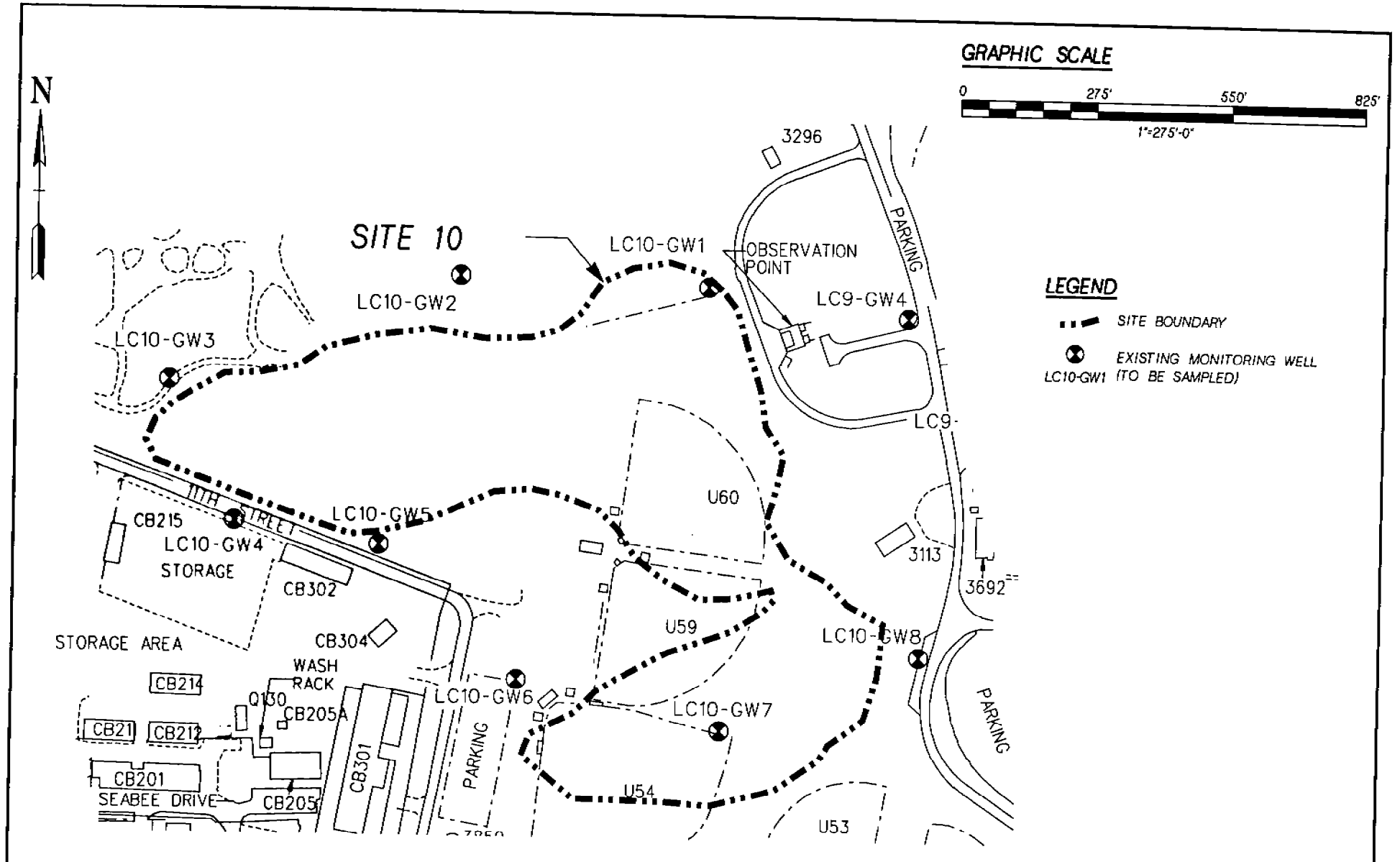
Site 11–School of Music Plating Shop

The School of Music Plating Shop was located in Building 3651. The site included an in-ground concrete tank, used to neutralize plating baths, and its associated piping. The tank is approximately 10 feet east of the southeast corner of Building 3651.

The neutralization tank for the plating shop has a diameter of 5 feet and a depth of 11 feet. Crushed limestone was placed in the tank to neutralize the acidic plating bath wastes. Wastewater entered the tank via an acid-resistant drainpipe that originated in a sink in Building 3651. According to the IRI, neutralized wastewater was discharged from the tank into the storm sewer via an outlet and drain from the northeast side of the tank.

The IAS reported that plating wastes were discharged into the neutralization tank during a 10-year period beginning in 1964. During its period of operation, the plating shop reportedly used silver cyanide, copper cyanide, chromic acid (brite dip), nickel plating baths, and various acids. In addition, lacquer strippers and lacquer were also used. Small quantities of these plating baths, acids, and lacquer strippers were disposed down the sink in the plating shop which drains into the neutralization tank and eventually into the storm sewer system. The IAS reported that approximately 10 gallons of each plating chemical and lacquer stripper were disposed in the shop sinks each year.

Three groundwater monitoring wells were initially installed at the site and sampled as part of the 1986 RVS. Soil sample and monitoring well locations are shown in Figure 3-4. A groundwater sample collected from one of the monitoring wells, LC11-GW1, exhibited levels of VOCs exceeding the CRQLs. During the IRI, the three monitoring wells were resampled. Low concentrations of VOCs and Target Analyte List (TAL) metals were detected in the groundwater samples.



BASE MAP PROVIDED BY:FOSTER WHEELER ENVIRONMENTAL SERVICES

FIGURE 3-3
MONITORING WELL LOCATIONS
SITE 10
NAB - LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

CH2M HILL

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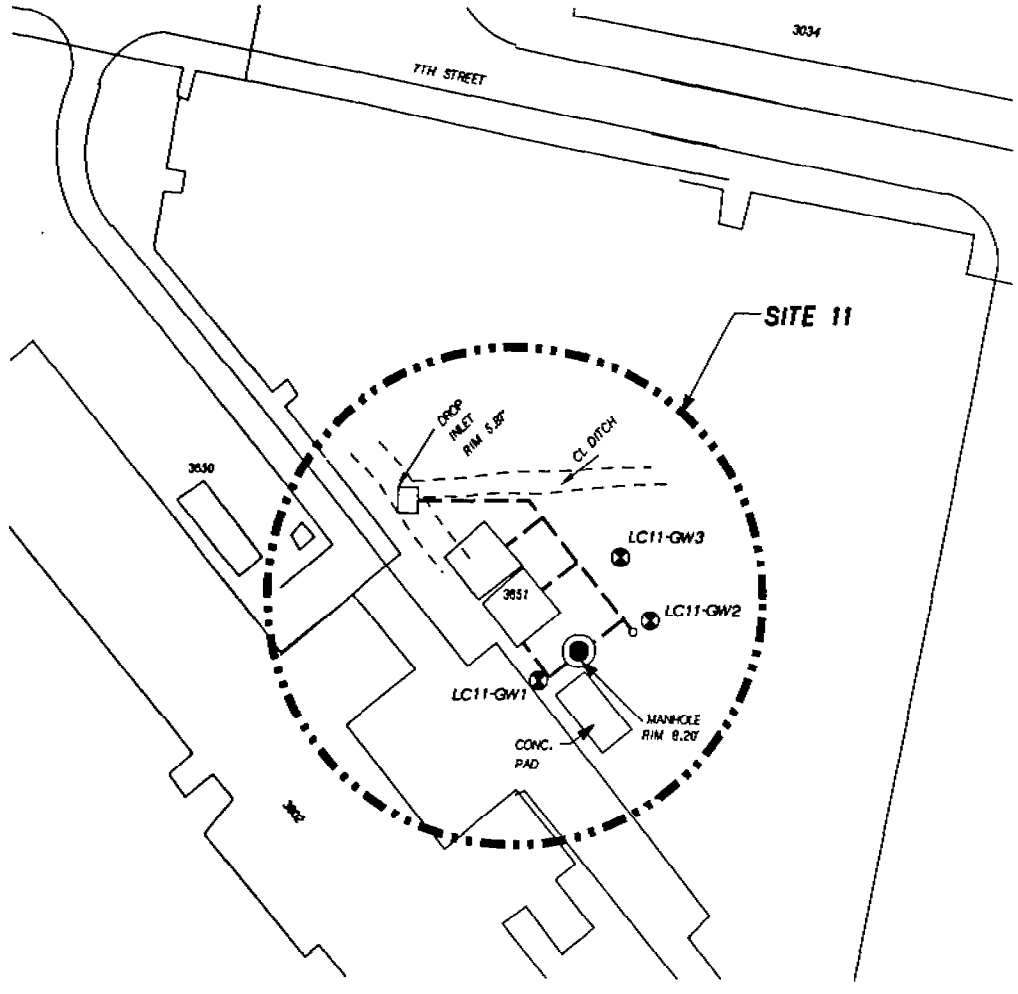
The neutralization tank, piping, and surrounding soil were excavated in 1995. A short-term post-removal groundwater monitoring program is proposed to verify the effectiveness of the source and contaminated soil removal action. Sampling results for Site 11 will be assessed and evaluated after two rounds of sampling and analysis have been completed. The first round of verification sampling was conducted in May 1996 by FWES.



NOTES:

1. MANHOLE PIPING AND SURROUNDING SOIL HAVE BEEN REMOVED, AND THE SITE HAS BEEN RESTORED.

LEGEND

- SITE BOUNDARY
- LC11-GW1 — EXISTING MONITORING WELL (TO BE SAMPLED)
- STORM SEWER LINES

GRAPHIC SCALE

0 75' 150' 225'

1"=75'-0"

FIGURE 3-4
MONITORING WELL LOCATIONS
SITE 11
NAB - LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

BASE MAP PROVIDED BY: FOSTER WHEELER ENVIRONMENTAL SERVICES

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SECTION 4

Technical Approach and Investigation Procedures

This section details the technical approach developed to perform the groundwater monitoring activities at Site 5, Site 9, Site 10, and Site 11. The tasks included in the technical approach are listed below. The remainder of this section contains detailed discussions of each task.

Task 1:	Project Planning
Task 2:	Groundwater Monitoring Program
Task 3:	Sample Analysis and Data Validation
Task 4:	Periodic Reporting

Task 1: Project Planning

This task consists of preparing this work plan, and the sampling and analysis plan (SAP) including the quality assurance project plan (QAPP), the field sampling plan (FSP), the investigation-derived waste management plan (IDWMP), and the health and safety plan (HSP). Meetings and project management activities also are part of this task and are discussed below.

Work Plan

The work plan is the broad plan that scopes out the project and pulls together the SAP and the HASP and provides for the efficient scheduling of resources such as personnel, equipment, and laboratory services. The draft final groundwater monitoring plan prepared by Baker/FWES will be used as guidance for planning the execution of groundwater monitoring activities.

Sampling and Analysis Plan

This SAP consists of a field sampling plan (FSP), a quality assurance project plan (QAPP), a health and safety plan, and an investigation-derived waste management plan (IDWMP). The SAP was developed in compliance with all requirements of the U.S. Navy QA/QC Program Manual. The SAP is attached to this work plan.

The FSP will be referenced during field activities as procedural guidance for all sampling and data collection. The FSP includes the following information:

- Field Operation. The sequence for conducting the field activities. The specific functions of each individual are identified, (e.g., who will take samples, maintain the field log book, monitor the site for air releases, etc.).
- Sampling Objectives and Rationale. The specific objectives of the field sampling are discussed. A brief explanation for selecting each sampling location is also provided.

- Sampling locations and frequency. The general location of each sample is identified. A site map is provided to guide field personnel to the appropriate locations. The type and volume of sample to be collected and the number of samples collected are identified (e.g., duplicates).
- Sample Designations. The FSP discusses the numbering system to be used to identify each sample collected during the field activities. The numbering system will allow for the identification of samples by matrix and location.
- Sampling Equipment and Procedures. The types of equipment to be used during sample collection are identified. The procedures for sample collection are described including equipment decontamination. Much of this is addressed through references to appropriate field SOPs.
- Laboratory Identification. The name, delivery address, and telephone numbers (both office and facsimile) of the laboratory (or laboratories) will be specified, when available.
- Sample Handling and Analysis. The FSP discusses the specific parameters for which each sample is to be analyzed (e.g., organics, metals). The sampling container and preservation technique are identified for each sample matrix and analysis.
- Schedule. Planned times for acquiring field samples and conducting analyses are included.

CH2M HILL has prepared a QAPP that meets requirements specified by the Navy. The QAPP describes the quality assurance and quality control (QA/QC) procedures used for conducting groundwater sampling at Site 5, Site 9, Site 10, and Site 11.

CH2M HILL will not begin field sampling at each site until the Naval Technical Representative (NTR) receives confirmation that the requirements of the laboratory quality assurance plan (LQAP) have been met for that site. The subcontracted analytical laboratory will conform to the Navy's approved LQAP. The LQAP will be submitted as soon as CH2M HILL Basic Ordering Agreements (BOAs) are in place for analytical laboratories.

A site-specific HSP has been prepared and is attached to this work plan. The HSP was produced using information provided in the existing site specific HSP developed by Baker/FWES.

The HSP contains guidance for the health and safety of CH2M HILL employees during all groundwater monitoring fieldwork discussed in this workplan. The HSP includes health and safety assessments for identifying problem areas where exposure to hazardous substances in water and air may occur. The assessments address safe working procedures, restrictions that will apply to the site work, and potential human exposure to hazardous substances and the toxicological effects of the substances.

The HSP will be used by CH2M HILL personnel and subcontractors during fieldwork associated with the project. All groundwater sampling will proceed under Level D personal protection, and will be upgraded to Level C if field conditions warrant. However, upgrade to a higher level of protection will be considered an additional out-of-scope cost and will not be undertaken without prior authorization.

The investigation-derived waste management plan (IDWMP) describes the procedures used for handling and disposing of waste materials generated during the monitoring program. The waste materials will include health and safety disposable items, purge water, and decontamination fluids. The plan also describes the chemical analyses that will be performed to characterize the IDW materials and the potential means of disposal. The potential disposal sites also will be identified.

Meetings

A one-day kickoff/site visit meeting will be held to familiarize Navy and CH2M HILL personnel with one another, to discuss current and future activities planned for the IR Program at NAB Little Creek, and to visit sites currently in the program at NAB Little Creek. The CH2M HILL activity manager and a hydrogeologist will attend the meeting. This meeting will coincide with the kickoff meeting for CTO-25, the remedial design for Site 7.

A one-day Restoration Advisory Board (RAB) meeting planned for Fall of 1996 at NAB Little Creek will require the attendance of the Activity manager and the senior hydrogeologist.

Two one-day meetings at the Virginia Department of Environmental Quality (DEQ) will be required to discuss periodic reporting. These meetings will require the attendance of the Activity manager and the senior hydrogeologist.

CH2M HILL will prepare minutes for the RAB meeting and the two DEQ meetings.

Project Management

The activities involved in project management include daily technical support and guidance, budget and schedule review and tracking, preparation and review of invoices, personnel resources planning and allocation, subcontractor coordination, preparation of monthly progress reports, and communication and coordination of events with LANTDIV and NAB Little Creek. Project Management will occur over the duration of the project which is estimated to be completed in 32 months.

Task 2: Groundwater Monitoring Program

This task includes subcontractor procurement, mobilization and demobilization, and semiannual groundwater sampling.

Subcontractor Procurement

As part of the initial field mobilization for the first sampling activity at Little Creek, CH2M HILL will procure analytical laboratory, data validation, and waste management services. The analytical laboratory will meet Navy Level D quality control.

The firms providing these services shall be procured using the Basic Ordering Agreements (BOAs). In cases where BOAs are not in place for services required under this task order, CH2M HILL will provide subcontractor services in accordance with procedures that will be established by CH2M HILL's contract administrator and LANTDIV's contracting officer.

Mobilization and Demobilization

Mobilization includes the procurement and initial transport of field equipment to the site for each round of groundwater sampling.

Demobilization includes time for IDW sampling and general site restoration before the field equipment and crew leave. Field equipment will be recalibrated and stored after the fieldwork. IDW generated during field activities will be put in 55-gallon drums. Equipment decontamination water and development and purge water also will be put in 55-gallon drums for storage. The 55-gallon drums will be properly labeled and properly stored on the facility at a location designated by LANTDIV and Little Creek before disposal. The disposal method will depend on the results of characterization analysis.

Semiannual Groundwater Monitoring Activities

Groundwater monitoring activities consist of two rounds of groundwater sampling at Site 5 and Site 11, and eight to ten rounds of groundwater sampling at Site 9 and Site 10. All sampling will be done from existing wells; no new wells will be installed. Monitoring activities to be conducted at each site are discussed below.

Groundwater-Sample Numbers and Locations

Site 5–Buildings 9-11 Motor Oil Disposal Area

Verification groundwater monitoring is proposed to verify the no-risk determination for this site. Sampling results for Site 5 will be assessed and the program reevaluated after two rounds of sampling and analysis have been completed. The first round of verification sampling was completed in May 1996 by Baker/FWES.

There are four monitoring wells at the site (LC5-GW1 through LC5-GW4) which are shown in Figure 3-1. The second (final) round of verification sampling will be conducted in the fall/winter 1996 by CH2M HILL. All groundwater samples will be analyzed for Target Compound List (TCL) Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs).

Table 4-1 provides a summary of the total number of samples, total number of QA/QC samples, and applicable laboratory analyses corresponding to the second round of sampling.

Site 9–Driving Range Landfill

Results of RI/FS sampling at this landfill indicate that no risk is posed by contaminants in soil and groundwater. However, a long-term monitoring program is proposed to continually monitor groundwater quality at this site due to the contents of the landfill and its proximity to the Chesapeake Bay and other surface water bodies. Groundwater sampling is currently proposed to be conducted semiannually for a period of 5 years. The sampling program will be evaluated after 3 years (6 rounds) and may, at that time, be scaled back to annual sampling. Therefore, a total of 8 to 10 rounds of groundwater sampling will be conducted at Site 9. The first round of sampling was completed in May 1996 by Baker/FWES.

Reportedly, ten wells have been installed near the site during previous investigations. Six of these monitoring wells are to be sampled as part of the long-term monitoring program.

TABLE 4-1
Summary of Groundwater Samples to be Collected and Submitted for Analysis
Round 2—2nd Half 1996

	Site 5	Site 9	Site 10	Site 11	Total Samples	Field Dup.	Field Blanks	Trip Blanks	Equip. Blanks	MS/ MSDS	Total
TCL VOC	4	6	8	3	21	3	1	3	3	2	33
TCL SVOC	4	-	-	-	4	1	1	-	1	1	8
TAL Metals (dissolved)	-	6	8	3	17	2	1	-	3	1	24
TAL Metals and Cyanide (total)	-	6	8	3	17	2	1	-	3	1	24
Chloride	-	6	8	3	17	2	1	-	3	1	24
Sulfate	-	6	8	3	17	2	1	-	3	1	24
Bicarbonate	-	6	8	3	17	2	1	-	3	1	24

These wells; LC9-GW2, LC9-GW4, LC9-GW5, LC9-GW6, LC9-UST1, and LC9-UST3, are shown in Figure 3-2. The second round of long-term sampling will be conducted in the fall/winter 1996 by CH2M HILL. The third through tenth rounds will be conducted semiannually from 1997 through 2000 at six-month intervals. All groundwater samples will be analyzed for TCL VOCs, total and filtered TAL metals, total cyanide, and anions. The proposed analytical methods for these samples are based on the concentrations of the constituents of concern detected during previous sampling studies.

The wells will be sampled at times of maximum groundwater to surface water discharge. This will be based on information obtained from the tidal survey conducted as part of the 1994 RI/FS. Analysis of these groundwater samples collected at this time may provide data on worst case scenarios, and groundwater quality without potential dilution of contaminant levels by surface water inflow.

Table 4-1 provides a summary of the total number of samples, total number of QA/QC samples, and applicable laboratory analyses corresponding to the second round of sampling. Table 4-2 provides a summary of the total number of samples, total number of QA/QC samples, and applicable laboratory analyses corresponding to the third through tenth rounds of sampling.

Site 10–Sewage Treatment Plant Area Landfill

Results of RI/FS sampling at this landfill site indicate that no current risk is posed by contaminants in soil and groundwater. However, a long-term monitoring program is proposed to continually monitor groundwater quality at this site due to the contents of the landfill and its proximity to the Chesapeake Bay and other surface water bodies. Groundwater sampling is currently proposed to be conducted semiannually for a period of 5 years. The sampling program will be evaluated after 3 years (6 rounds) and may, at that time, be scaled back to annual sampling. Therefore, a total of 8 to 10 rounds of groundwater sampling will be conducted. The first round of sampling was completed in May 1996 by Baker/FWES.

There are eight groundwater monitoring wells at the site (LC10-GW1 through LC10-GW8) which are shown in Figure 3-3. The second round of long-term sampling will be conducted in the fall/winter 1996 by CH2M HILL. The third through tenth rounds will be conducted semiannually from 1997 through 2000 at intervals of six months. All groundwater samples will be analyzed for TCL VOCs, total and filtered TAL metals, total cyanide, and anions. The proposed analytical methods for these samples are based on the concentrations of the constituents of concern detected during previous sampling studies.

The wells will be sampled at times of maximum groundwater to surface water discharge. This will be based on information obtained from the tidal survey conducted as part of the 1994 RI/FS. Analysis of these groundwater samples collected at this time may provide data on worst case scenarios, and groundwater quality without potential dilution of contaminant levels by surface water inflow.

Table 4-1 provides a summary of the total number of samples, total number of QA/QC samples, and applicable laboratory analyses corresponding to the second round of sampling. Table 4-2 provides a summary of the total number of samples, total number of QA/QC samples, and applicable laboratory analyses corresponding to the third through tenth rounds of sampling.

TABLE 4-2
Summary of Groundwater Samples to be Collected and Submitted for Analysis for Each Sampling Round
Rounds 3 through 10—1st Half 1997 through 2nd Half 2000

	Site 9	Site 10	Total Samples	Field Dup.	Field Blanks	Trip Blanks	Equip. Blanks	MS/MSDS	Total
TCL VOC	6	8	14	2	1	2	2	1	22
TAL Metals (dissolved)	6	8	14	2	1	-	2	1	20
TAL Metals and Cyanide (total)	6	8	14	2	1	-	2	1	20
Chloride	6	8	14	2	1	-	2	1	20
Sulfate	6	8	14	2	1	-	2	1	20
Bicarbonate	6	8	14	2	1	-	2	1	20

Site 11–School of Music Plating Shop

A short-term post-removal groundwater monitoring program is proposed to verify the effectiveness of the recently completed source and contaminated soil removal action. Sampling results for Site 11 will be assessed and the program reevaluated after two rounds of sampling and analysis have been completed. The first round of post-removal sampling was completed in May 1996 by Baker/FWES.

There are three monitoring wells at the site (LC11-GW1 through LC11-GW3) which are shown in Figure 3-4. The second (final) round of post-removal sampling will be conducted in the fall/winter 1996 by CH2M HILL. The three existing monitoring wells will be sampled. All groundwater samples will be analyzed for TCL VOCs, total and filtered TAL metals, total cyanide, and anions. The proposed analytical methods for these samples is based on the concentrations of the constituents of concern detected during previous sampling studies.

Table 4-1 provides a summary of the total number of samples, total number of QA/QC samples, and applicable laboratory analyses corresponding to the second round of sampling.

Groundwater-Sampling Techniques

All groundwater samples will be collected from existing wells that have previously been developed and sampled. The assumption is that the wells will not require redevelopment prior to sampling.

Prior to sampling, water level measurements will be collected from each well to be sampled in that round. The wells will not be surveyed. Vertical and horizontal control for each well has already been obtained during well installation.

Before sampling, groundwater will be purged from each well. The volume of groundwater in the monitoring well will be calculated by using values for the depth of the well, the depth to water, and the well diameter. Purging will be performed until a minimum of three well volumes of water have been removed and the temperature, specific conductance, and pH have stabilized within 10 percent for three consecutive readings. Sampling will begin when the parameter measurements have stabilized. Wells that are pumped dry during purging will be allowed to recover before sampling. The IDWMP discusses treatment and disposal of purge water.

Samples will be placed in containers and preserved according to Navy Level D protocol and will be analyzed within the proper holding time. For volatile organic analysis (VOA) the bottles will be filled to minimize aeration of the samples. Sample vials will be filled completely and will be capped to prevent the entrapment of air bubbles in the vial.

All appropriate preservatives will be added to the sample containers by the contracted laboratory before the containers are shipped to the CH2M HILL field team. Low concentration VOA samples will be preserved with hydrochloric acid (HCl), TAL metals samples will be preserved with nitric acid (HNO_3), and cyanide samples will be preserved with sodium hydroxide (NaOH). All samples will be kept cool at 4°C.

The appropriate number of field QA/QC samples, including field blanks, rinsate blanks, and duplicates, will be analyzed in addition to laboratory QA/QC samples, including

matrix spike and matrix spike duplicate samples. Descriptions of monitoring-well sampling techniques are described in more detail in an SOP in Attachment A of the FSP.

Task 3: Sample Analysis and Data Validation

CH2M HILL will be responsible for tracking sample analyses and obtaining results from the laboratory. The analytical data generated during the groundwater monitoring program will be validated by an independent data validation subcontractor according to standard EPA procedures.

Sample Analysis

All analyses of groundwater samples will be conducted at a contracted laboratory that fulfills all requirements of the U.S. Navy's QA/QC Program Manual and EPA's CLP. A signed certificate of analysis will be provided with each laboratory analysis, along with a certificate of compliance certifying that all work was performed in accordance with applicable federal, state, and local regulations. All analyses will be performed following the Navy's guidance for Level D. All validated sample analytical data will be stored in a database.

Field QC Procedures

Quality control duplicate samples and blanks are used to provide a measure of the internal consistency of the samples and to provide an estimate of the components of variance and the bias in the analytical process. Table 10-1 in the QAPP is a summary of the collection frequencies of the field QC samples.

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. Three types of blanks will be generated during sampling activities: trip blanks, field blanks, and equipment blanks.

One trip blank will be included in each cooler containing samples for VOC analysis. Preprepared trip blanks will be obtained from the laboratory, if possible. Otherwise, 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 if contamination occurred during shipment to the field, field storage, or shipment from the field to the analytical laboratory.

One field blank will be collected per matrix, per sampling event, or daily during windy or dusty conditions. The field blanks will indicate if contaminants were introduced during the handling of the sample containers in the field or during sample analysis at the laboratory. The sample container will be filled with ASTM Type II water in the field at the time of sampling. Prepreserved bottles will be obtained from the laboratory, if possible. Otherwise, preservatives will be added in the field. Field blank sample containers will be packed and shipped with the samples.

One equipment blank will be collected and analyzed every day during sampling activities. The equipment blanks will indicate the efficiency of equipment decontamination

procedures. Prepreserved bottles will be obtained from the laboratory, if possible. Otherwise, preservatives will be added in the field. Field blank sample containers will be capped, packed, and shipped with the samples.

Duplicates

Field duplicate samples will be collected at a frequency of 1 per 10 field samples per matrix. The location from which the duplicates are taken will be selected randomly. The duplicate sample will be submitted for analysis as an independent sample. The sample and its duplicate will be numbered nonsequentially.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a frequency of 1 per 20 field samples. Analytical results of these samples indicate the effect the matrix has on extracting the analyte for analysis. Data validators will use these results to evaluate the accuracy of the analytical data.

Data Validation

All groundwater monitoring data will be validated before the project staff performs an interpretation. The data will be validated by an independent subcontractor and will conform to the Navy's guidance for Level D. Data that should be qualified will be flagged with the appropriate symbol. Results for QA/QC samples will be reviewed, and the data will be qualified further, if necessary. Finally, the data set as a whole will be examined for consistency, anomalous results, and reasonableness.

Task 4: Periodic Reporting

This task involves the preparation of periodic letter reports and draft, draft final, and final reports, that document sampling activities and results and conclusions and recommendations for groundwater monitoring.

Periodic Letter Reports

Periodic letter reports will be prepared to document the activities and results of long-term groundwater sampling at Sites 9 and 10 for the second through ninth semi-annual sampling events excluding the 6th event. One letter report will address the semi-annual groundwater monitoring results at both sites. Therefore, a total of seven letter reports will be prepared. Detailed groundwater monitoring reports will be prepared for the 6th and 10th sampling events as documented below.

The letter reports will be submitted after the initiation of each consecutive sampling event and will address groundwater quality with respect to established trigger levels. If established trigger levels have been exceeded, the sampling program will be reevaluated. CH2M HILL assumes that the trigger levels have been determined for these sites and determination of trigger-levels is not included as part of this CTO.

Groundwater Monitoring Reports

A report that documents activities and results of verification groundwater sampling at Site 5 and the post-removal groundwater sampling at Site 11 will be submitted after the second sampling event. One report will address both sites. A report that documents activities and results of long-term groundwater sampling at Sites 9 and 10 will be submitted after the sixth consecutive sampling event. One report will address both sites.

An evaluation of the first round sampling event, completed by Foster Wheeler in May 1996, will be included in the report for Sites 5 and 11 and the report for Sites 9 and 10. CH2M HILL assumes that the trigger levels have been determined for Sites 9 and 10 and determination of trigger-levels is not included as part of this CTO. The reports will contain the following sections:

- Discussion of sampling activities
- Presentation and evaluation of data including contaminant concentration maps
- Discussion of results as compared with action criteria (trigger levels) and previous data
- Conclusions and recommendations for future monitoring and/or actions

A draft 5-year review report that documents activities and results of long-term groundwater sampling at Sites 9 and 10 will be submitted after the tenth consecutive sampling event. One report will address both sites. The reports will contain the following sections:

- Discussion of sampling activities
- Presentation and evaluation of historical data as compared with action criteria (trigger levels)
- Fate and transport of contaminants detected at Sites 9 and 10, including contaminant concentration maps
- An evaluation of risks to potential receptors based upon fate and transport
- Conclusions and recommendations for future monitoring

Each of these reports will be submitted in draft, draft final, and final forms. The daft will be submitted within 72 days of the corresponding sampling round. The Navy will provide comments on the draft reports. Comments will be incorporated into draft final reports. The reports will be submitted to the Navy and regulatory agencies for review and comments. The Navy and regulatory agencies will provide comments on the draft final reports. Comments will be incorporated into final reports. The final reports will then be submitted to the Navy and regulatory agencies. The distribution of project deliverables is tabulated in Table 4-3.

TABLE 4-3
Project Deliverables Distribution

Submittal	LANTDIV	LCRK	VADEQ	EPA
Draft Plans	3	3	2	2
Final Plans	2	2	2	2
Letter Reports (7)	2	2	0	0
Draft Reports (3)	2	2	0	0
Draft Final Reports (3)	2	2	2	2
Final Reports (3)	7	12	2	2

SECTION 5

Staff Organization

This section presents general information on project management and staff organization.

Project Management

Project management will include the overall coordination of all work to be performed at the site. The management structure for CH2M HILL is designed in such a way that there is one central administrative point of contact, the Activity Manager. The Activity Manager will be assisted by a project manager and, if necessary, one or more technical task managers who will manage each technical task as his or her expertise is required.

The Activity Manager will oversee and coordinate each project to maintain the overall project schedule and will coordinate the preparation of the monthly progress report. In addition, the Activity Manager and the technical task managers will conduct periodic internal program review meetings to update all team members on individual task status and upcoming technical needs and to discuss technical issues that might affect the course or the completion of other technical tasks. The Activity Manager also will provide general program support, interact with the Navy and regulatory agencies, and document decisions on technical issues that might affect future work at the base.

The responsibilities of the project manager includes such activities as the preparation and submittal of field logs, daily technical support and oversight, budget and schedule review and tracking, preparation and review of invoices, personnel-resource planning and allocation, and project-specific coordination with LANTDIV, the Activity, and subcontractors.

Project-Specific Organization

Mr. Scott MacEwen will serve as both the Activity Manager and project manager for this CTO and will be the primary point of contact for the project. Mr. MacEwen will be responsible for such activities as review and tracking of budget and schedule, preparation and review of invoices, planning and allocation of personnel resources, and coordination with LANTDIV, the Activity, and subcontractors. The groundwater monitoring tasks will be performed by supporting field personnel. A task manager/field team leader for sampling will be appointed at a later date. In addition, Mr. Doug Dronfield and Dr. Robert Root will perform senior review during the project. The project organizational chart is depicted in Figure 5-1.

Before initiating field activities, CH2M HILL will notify LANTDIV and the Activity about which CH2M HILL personnel will mobilize to the site. CH2M HILL also will notify the Activity personnel to acquire site access. The LANTDIV NTR, Mr. Scott Park, and the NAB Little Creek Program Manager, Ms. Kelly Greaser, will be advised of all site activities and

schedules before site operations begin. Table 5-1 provides names, phone numbers, and addresses for Navy contacts.

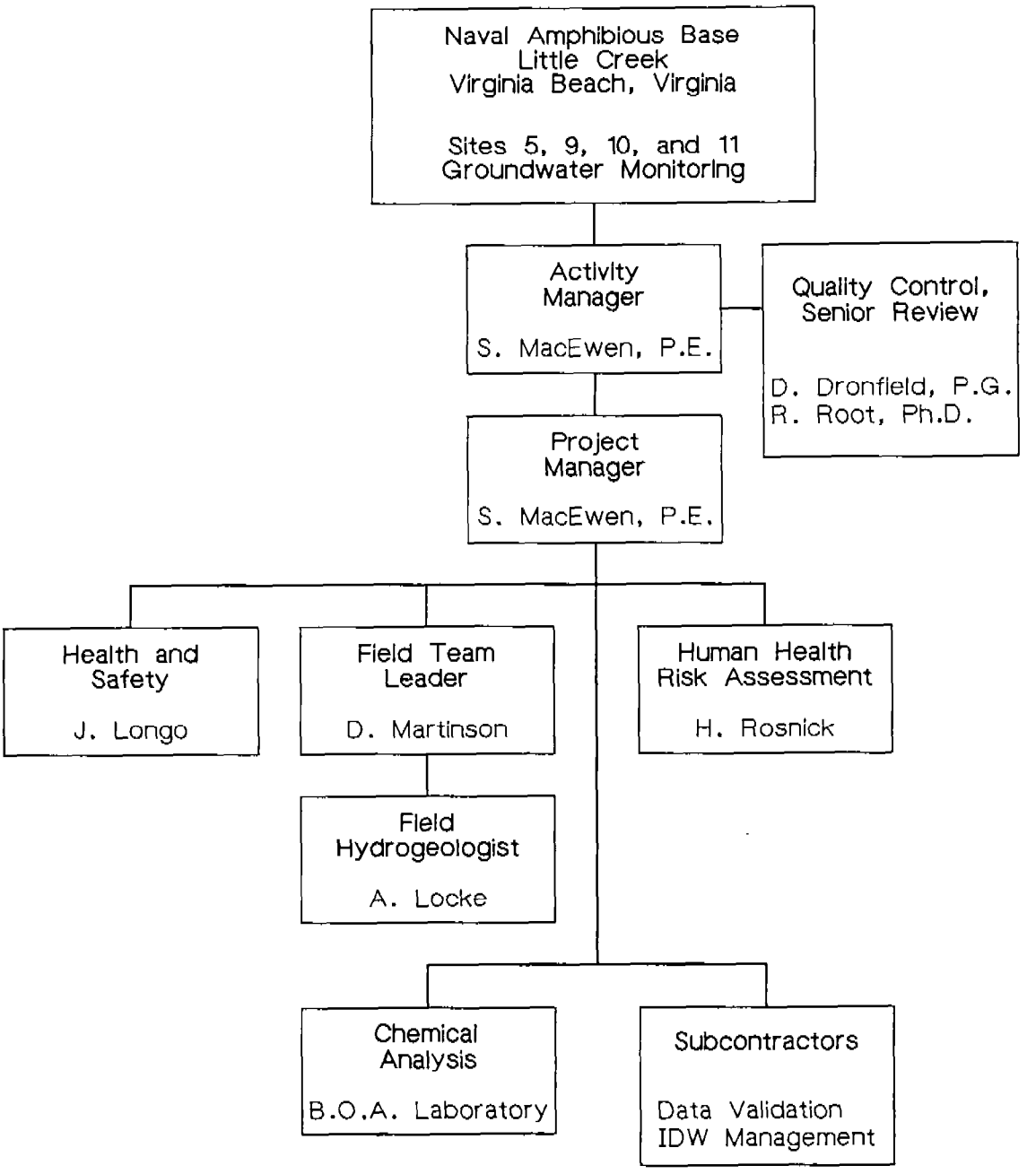

Figure 5-1
PROJECT ORGANIZATION
SITES 5, 9, 10, AND 11
GROUNDWATER MONITORING
NAB Little Creek

CH2M HILL

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Table 5-1
NAB Little Creek Contact List

Contact Person	Responsibility	Department	Phone Number	Fax Number	Mailing Address
Mr. Scott Park	Environmental Engineer and NTR	Installation Restoration Section, LANTDIV Code 18223	757-322-4788	757-322-4805	Code 1822 1510 Gilbert Street Norfolk, VA 23511-2699
Ms. Kelly Greaser	Program Manager, NAB Little Creek	Base Civil Engineering, Environmental N462	757-363-4571	757-464-7060	N462 1450 Gator Blvd. Norfolk, VA 23521-2616

SECTION 6

Contractual Services

This section documents the anticipated subcontract services required for completing tasks documented in this work plan.

The monitoring program will require subcontract services from the following:

- Analytical Laboratory
- Data Validation Contractor
- IDW Disposal Services

SECTION 7

Project Schedule

This section documents the project schedule and the due dates of deliverables.

This project will be performed in accordance with the schedule and milestones presented in Figure 7-1. Table 7-1 shows a breakdown of primary-task deliverables and milestones and their respective due dates for the monitoring program. Government review periods also are tabulated. Periods of review that are longer than scheduled will result in an extended schedule.

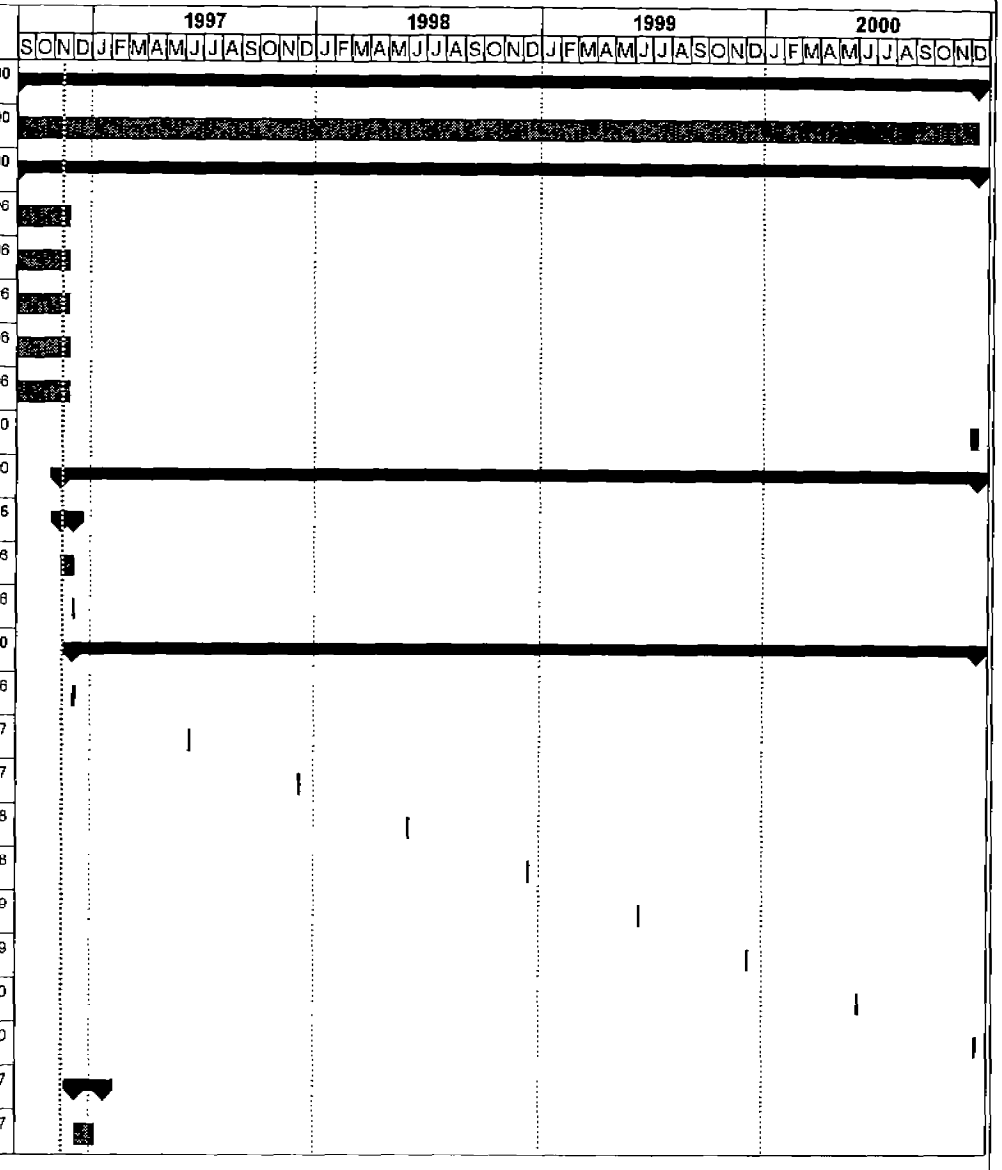
Table 7-1
Proposed Project Milestones
Groundwater Monitoring - Sites 5, 9, 10, and 11
Naval Amphibious Base Little Creek, Virginia Beach, Virginia
Contact Task Order 0024

Key Project Milestones	Cumulative Calendar Days	Interval	Date
CTO Award	0	0	8/19/96
Submit Draft Work plans	30	30	9/19/96
Navy and Regulatory Comments	86	56	11/14/96
Submit Final Work plans (14 days from receipt of comments)	100	14	11/28/96
First Sampling Event (completed)	108	8	12/6/96
Draft Report Sites (5 and 11)	180	72	2/16/97
First Letter Report (Sites 9 and 10)	180	72	2/16/97
Navy Comments (Sites 5 and 11)	193	21	3/8/97
Draft Final Report (Sites 5 and 11)	208	15	3/22/97
Navy and Regulatory Comments (Sites 5 and 11)	248	40	5/1/97
Final Report (Sites 5 and 11)	269	21	5/22/97
Follow-on Sampling Events (6 months after previous event)	280 (1st)	0	May 97
Draft Report (after 6th sampling event begins)	72*	72	
Navy Comments (21 days after submission)	93*	21	
Draft Final Report (15 days after receipt of comments)	108*	15	
Navy and Regulatory Comments (40 days after submission)	148*	40	
Final Report (21 days after receipt of comments)	169*	21	

*after sampling event

Project Schedule
CTO-024 - Groundwater Monitoring @ Sites 5, 9, 10, and 11
Naval Amphibious Base Little Creek

ID	Task Name	DUR	Start	Finish
1	**Task 1 - Project Planning (PP)**	1564d	9/2/96	12/13/00
2	**Subtask 1.1 - Project Management (PP PM)**	1564d	9/2/96	12/13/00
3	**Subtask 1.2 - Project Plan Preparation (PP PP)**	1564d	9/2/96	12/13/00
4	Prepare Draft and Final Work Plans	85d	9/2/96	11/25/96
5	Prepare Draft and Final Sampling and Analysis Plan	85d	9/2/96	11/25/96
6	Prepare Draft and Final Quality Assurance Project Plans	85d	9/2/96	11/25/96
7	Prepare Draft and Final Health and Safety Plans	85d	9/2/96	11/25/96
8	Prepare Draft and Final Investigation Derived Waste Management Plans	85d	9/2/96	11/25/96
9	Attend Meetings (MG)	10d	12/4/00	12/13/00
10	**Task 2 - Groundwater Monitoring Program (FI)**	1492d	11/14/96	12/14/00
11	**Subtask 2.1 - Fieldwork Support (FI FM)**	21d	11/14/96	12/4/96
12	Subcontractor Procurement	20d	11/14/96	12/3/96
13	Mobilization/demobilization (schedule first event only)	2d	12/3/96	12/4/96
14	**Subtask 2.2 - Groundwater Sampling (FI WS)**	1473d	12/3/96	12/14/00
15	Groundwater Sampling at Site 5, 9, 10 & 11 (Round 2)	4d	12/3/96	12/6/96
16	Long term Groundwater Sampling at Site 9 and Site 10 (Round 3)	2d	6/10/97	6/11/97
17	Long term Groundwater Sampling at Site 9 and Site 10 (Round 4)	2d	12/6/97	12/7/97
18	Long term Groundwater Sampling at Site 9 and Site 10 (Round 5)	2d	6/3/98	6/4/98
19	Long term Groundwater Sampling at Site 9 and Site 10 (Round 6)	2d	12/13/98	12/14/98
20	Long term Groundwater Sampling at Site 9 and Site 10 (Round 7)	2d	6/10/99	6/11/99
21	Long term Groundwater Sampling at Site 9 and Site 10 (Round 8)	2d	12/6/99	12/7/99
22	Long term Groundwater Sampling at Site 9 and Site 10 (Round 9)	2d	6/2/00	6/3/00
23	Long term Groundwater Sampling at Site 9 and Site 10 (Round 10)	2d	12/13/00	12/14/00
24	**Task 3 - Sample Analysis and Data Validation (SA)**	46d	12/9/96	1/23/97
25	Subtask 3.1 - Sample Analysis (SA SM) (Schedule Round 2 only)	30d	12/9/96	1/7/97

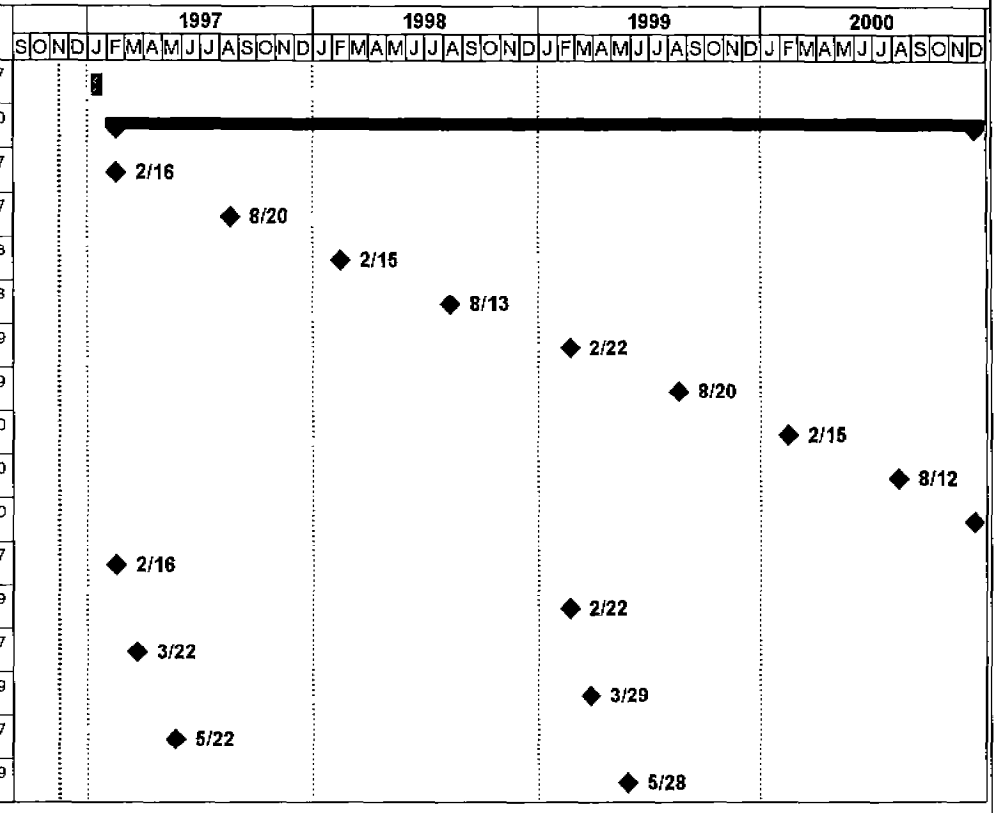


Project:
Date: 11/15/96

Task Milestone Summary

Project Schedule
CTO-024 - Groundwater Monitoring @ Sites 5, 9, 10, and 11
Naval Amphibious Base Little Creek

ID	Task Name	DUR	Start	Finish
26	Subtask 3 2 Data Validation (SA DV) (Schedule Round 2 only)	15d	1/9/97	1/23/97
27	**Task 4 - Periodic Reporting (PR)**	1396d	2/16/97	12/13/00
28	Subtask 4 1 - Submit Periodic Letter Reports for Sites 9 and 10 (PR LR)	0d	2/16/97	2/16/97
29	Subtask 4 1 - Submit Periodic Letter Reports for Sites 9 and 10 (PR LR)	0d	8/20/97	8/20/97
30	Subtask 4 1 - Submit Periodic Letter Reports for Sites 9 and 10 (PR LR)	0d	2/15/98	2/15/98
31	Subtask 4 1 - Submit Periodic Letter Reports for Sites 9 and 10 (PR LR)	0d	8/13/98	8/13/98
32	Subtask 4 1 Submit Periodic Letter Reports for Sites 9 and 10 (PR LR)	0d	2/22/99	2/22/99
33	Subtask 4 1 - Submit Periodic Letter Reports for Sites 9 and 10 (PR LR)	0d	8/20/99	8/20/99
34	Subtask 4 1 - Submit Periodic Letter Reports for Sites 9 and 10 (PR LR)	0d	2/15/00	2/15/00
35	Subtask 4 1 Submit Periodic Letter Reports for Sites 9 and 10 (PR LR)	0d	8/12/00	8/12/00
36	Subtask 4 1 - Submit Periodic Letter Reports for Sites 9 and 10 (PR LR)	0d	12/13/00	12/13/00
37	Subtask 4 2 - Draft Groundwater Monitoring Reports (PR DR) Site 5 & 11	0d	2/16/97	2/16/97
38	Subtask 4 2 - Draft Groundwater Monitoring Reports (PR DR) Sites 9 & 10	0d	2/22/99	2/22/99
39	Subtask 4 3 - Draft Final Groundwater Monitoring Reports (PR DR) Site 5 & 11	0d	3/22/97	3/22/97
40	Subtask 4 3 - Draft Final Groundwater Monitoring Reports (PR DR) Sites 9 & 1(	0d	3/29/99	3/29/99
41	Subtask 4 3 Final Groundwater Monitoring Reports (PR DR) Site 5 & 11	0d	5/22/97	5/22/97
42	Subtask 4 3 Final Groundwater Monitoring Reports (PR DR) Sites 9 & 10	0d	5/28/99	5/28/99



Project
Date: 11/15/96

Task Milestone ◆ Summary

Final

Sampling and Analysis Plan for Groundwater Monitoring at Sites 5, 9, 10, and 11

Naval Amphibious Base Little Creek
Virginia Beach, Virginia

Contract Task Order 024

November 19, 1996

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

Under the

LANTDIV CLEAN II Program
Contract N62470-95-D-6007

Prepared by

CH2M HILL

Herndon, Virginia

Preface

This Sampling and Analysis Plan (SAP) is written for the groundwater monitoring activities for sites 5, 9, 10, and 11 at Naval Amphibious Base Little Creek. Specifically, this SAP focuses on the activities associated with the sampling of groundwater at these four sites. The SAP is comprised of four separate plans.

1. The Quality Assurance Project Plan (QAPP)–The QAPP describes the policy, organization, functional activities, and quality assurance and quality control protocols necessary to achieve Data Quality Objectives (DQOs) as dictated by the intended use of the data.

2. The Field Sampling Plan (FSP)–The FSP provides guidance for all fieldwork by defining in detail the sampling and data-gathering methods to be used during field activities.

3. The Health and Safety Plan (HASP)–The HASP for the field effort describes CH2M HILL's health and safety program for field activities. The HASP identifies potentially hazardous operations and exposures and prescribes appropriate protective measures.

4. The Investigation-Derived Waste Management Plan (IDWMP)–The IDWMP provides guidance and assigns responsibility for the disposal of investigation-derived waste (IDW). The IDWMP describes both well-site disposal and containerization and temporary storage of certain IDW.

Final

Quality Assurance Project Plan for Groundwater Monitoring at Sites 5, 9, 10, and 11

Naval Amphibious Base Little Creek
Virginia Beach, Virginia

Contract Task Order 024

November 19, 1996

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Acronyms and Abbreviations

CLP	Contract Laboratory Program
CofC	Chain-of-Custody
DQOs	Data Quality Objectives
EPA	Environmental Protection Agency
FSP	Field Sampling Plan
HASP	Health and Safety Plan
LANTDIV	U.S. Navy Naval Facilities Engineering Command, Atlantic Division
LQAP	Laboratory Quality Assurance Plan
MS	Matrix Spike
MSD	Matrix Spike Duplicate
µg/l	Micrograms per liter
NFESC	Navy Facilities Engineering Services Command
OLC02	EPA analytical method for Organic Low Concentration Water
OVM	Organic Vapor Monitor
%R	Percent Recovery
PCB	Polychlorinated biphenyl
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RSD	Relative Standard Deviation
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
SOW	Statement of Work
SVOCs	Semivolatile Organic Compounds
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCL	Target Compound List
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds

SECTION 1

Introduction

This plan describes the Quality Assurance and Quality Control (QA/QC) procedures used for conducting groundwater sampling activities at the Sites 5, 9, 10, and 11, at Naval Amphibious Base (NAB) Little Creek, Virginia Beach, Virginia. The Quality Assurance Project Plan (QAPP) focuses on the sampling activities outlined in the Draft Final Groundwater Monitoring Plans (GMP) prepared by Foster Wheeler Environmental Services (FWES), May 9, 1996. All field sampling and laboratory analyses will be conducted in accordance with the *Navy Installation Restoration Laboratory Quality Assurance Guide,* February 1996.

SECTION 2

Project Description

In 1993, FWES performed an RI/FS and SI at NAB Little Creek. Six RI sites and two SI sites were investigated at the facility and evaluated with regard to contamination characteristics, migration pathways, and pollutant receptors. Although none of these sites was found to pose an immediate threat to human health or the environment, four sites were recommended for monitoring of groundwater quality. Three sites were recommended for further investigation, and one site was recommended for a removal action.

The four sites recommended for monitoring of groundwater quality are listed below:

- Site 5 - Buildings 9 - 11 Motor Oil Disposal Area (2 rounds over 1 year to verify no risk)
- Site 9 - Driving Range Landfill (8 to 10 rounds over 5 years)
- Site 10 - Sewage Treatment Plant Landfill (8 to 10 rounds over 5 years)
- Site 11 - School of Music Plating Shop (2 rounds over 1 year to verify no risk)

A brief description of each site and the specific objectives for the groundwater monitoring at each site are provided below.

Site 5–Buildings 9-11 Motor Oil Disposal Area

Background

Site 5 consists of the area between Buildings 9 and 11 and measures approximately 100 feet by 150 feet. A small, concrete-bermed drum storage area, approximately 10 feet by 10 feet and an oil/water separator are located on the northern side of Site 5 along Building 9. Building 11 was removed in 1992, but Building 9 is still in place.

Building 11 was originally built as a cable tank building. From 1969 until 1981, motor oil, solvents, and antifreeze from boat engines maintained in Building 11 were reportedly disposed of in pits in the middle of Building 11. Building 9 was used for motor pool maintenance. Used motor crankcase oil from this maintenance shop was reportedly disposed of in the area between Buildings 9 and 11.

Initial monitoring well installation and soil sampling were conducted at the site in December, 1990. Four groundwater monitoring wells were installed and sampled, and four samples were collected from between Buildings 9 and 11. The Preliminary Site Inspection (PSI) reported elevated levels of 1,1-dichloroethane (1,1-DCA) in one monitoring well. All three monitoring wells contained low levels of lead. Measurable concentrations of total petroleum hydrocarbons (TPH) and lead were detected in some of the soil samples.

Objectives

The objective of the groundwater sampling effort at Site 5 is to sample the four existing monitoring wells (LC5-GW1 through LC5-GW4) semiannually for 1 year beginning in May 1996 (two rounds of sampling) to verify the no-risk determination. The first round of

monitoring was completed in May 1996 and one more round will be done before reevaluating whether continued monitoring is necessary. All of the groundwater samples collected will be analyzed for TCL VOCs and SVOCs.

Site 9–Driving Range Landfill

Background

The Driving Range Landfill is located in the northeast part of the installation and comprises approximately 6 acres. The Driving Range Landfill operated from 1950 to 1956 and was reportedly filled by excavating trenches and backfilling them with waste. Among the wastes reportedly disposed of in the landfill are incinerator ash and non-combustible materials resulting from the incinerator that operated on Hewitt Drive adjacent to the western edge of the landfill. Other landfill contents may include hazardous wastes such as PCBs and potentially large quantities of used motor oil. The majority of the contents of the landfill is believed to be municipal solid waste.

Objectives

Ten wells were installed near the site during previous investigations. The long-term monitoring program calls for six of these monitoring wells, LC9-GW2, LC9-GW4, LC9-GW5, LC9-GW6, LC9-UST1, and LC9-UST3 to be sampled semiannually for 5 years beginning in May 1996 (ten rounds of sampling). After 3 years, the frequency may be reduced to annual sampling if results warrant. The first round of sampling has already been conducted. The wells will be sampled at times of maximum groundwater to surface water discharge as determined by the tidal survey conducted as part of the 1993 RI/FS. Collecting samples at this time will provide data for the worst case scenario when groundwater quality is unaffected by dilution of contaminants from surface water inflow. The samples will be tested for TCL VOCs , total and dissolved TAL metals, total cyanide, and anions.

Site 10–Sewage Treatment Plant Landfill

Background

The Sewage Treatment Plant Landfill is located in the northeast part of the NAB Little Creek installation and comprises approximately 18 acres. The landfill began operating in 1941 and accepted predominantly solid wastes until 1952. Disposal of sewage sludge from the onsite sewage treatment plant continued until 1968, when the plant was shut down. Wastes reported to have been disposed in the landfill include demolition debris and household and industrial wastes, some of which may have contained hazardous constituents.

Objectives

There are eight groundwater monitoring wells at the site (LC10-GW1 through LC10-GW8). The long-term monitoring program calls for these wells to be sampled semiannually for a period of 5 years beginning in May 1996 (ten rounds of sampling). After the first 3 years,

the frequency may be reduced to annual sampling if results warrant. The first round of sampling has already been completed. The wells will be sampled at times of maximum groundwater to surface water discharge as determined by the tidal survey conducted as part of the 1993 RI/FS. Sampling at this time is intended to represent the worst case scenario when groundwater quality is unaffected by potential dilution of contaminant levels by surface water inflow. All samples will be analyzed for TCL VOCs, total and dissolved TAL metals, total cyanide, and anions.

Site 11–School of Music Plating Shop

Background

The School of Music Plating Shop was located in Building 3651, in the eastern part of the base. The sites consists of an in-ground concrete tank and associated piping, used to neutralize plating baths. Neutralized wastewater was reportedly discharged from the tank into the storm sewer via an outlet on the northeast side of the tank. Small quantities of silver cyanide, copper cyanide, chromic acid, nickel plating baths, various acids, lacquer strippers, and lacquer were disposed in the shop sinks and eventually into the storm sewer during the period of operation of the plating shop (1964-1974).

Three groundwater monitoring wells were initially installed at the site and sampled. A groundwater sample collected from one of the monitoring wells, LC11-GW1, exhibited levels of VOCs exceeding the CRQLs. During the IRI the three monitoring wells were resampled and low concentrations of VOCs and TAL metals were detected.

Objectives

A short-term post-removal groundwater monitoring program is planned to verify the effectiveness of a recently completed source and contaminated soil removal action. To establish the present quality of groundwater at the site, the three existing groundwater wells (LC11-GW1 through LC11-GW3) will be sampled semiannually for a period of 1 year beginning in May 1996 (two rounds of sampling). The first round of sampling has already been conducted. Samples will be analyzed for TCL VOCs, total and dissolved TAL metals, and anions.

SECTION 3

Project Organization

Mr. Scott MacEwen will serve as the activity manager and the primary contact at CH2M HILL. Mr. MacEwen will assume primary responsibility for ensuring that the work is performed in a manner that is acceptable to LANTDIV and will be responsible for such activities as budget and schedule review and tracking, preparation and review of invoices, personnel resources planning and allocation, and coordination with LANTDIV, the Naval Base, and subcontractors. Mr. Doug Dronfield and Mr. Robert Root will provide senior review. Figure 3-1 represents a chart view of the project organization.

The groundwater sampling will be performed by CH2M HILL supporting field personnel. CH2M HILL will notify LANTDIV and NAB Little Creek which CH2M HILL personnel will mobilize to the site prior to initiating field activities. A field task manager will be assigned to lead all field activities. This person will be responsible for assuring that the SAP is being followed, maintaining the field log book, monitoring the site for all releases, and other activities. The field staff will be responsible for collecting the samples, supervising subcontractors, completing sample paperwork, and shipping samples.

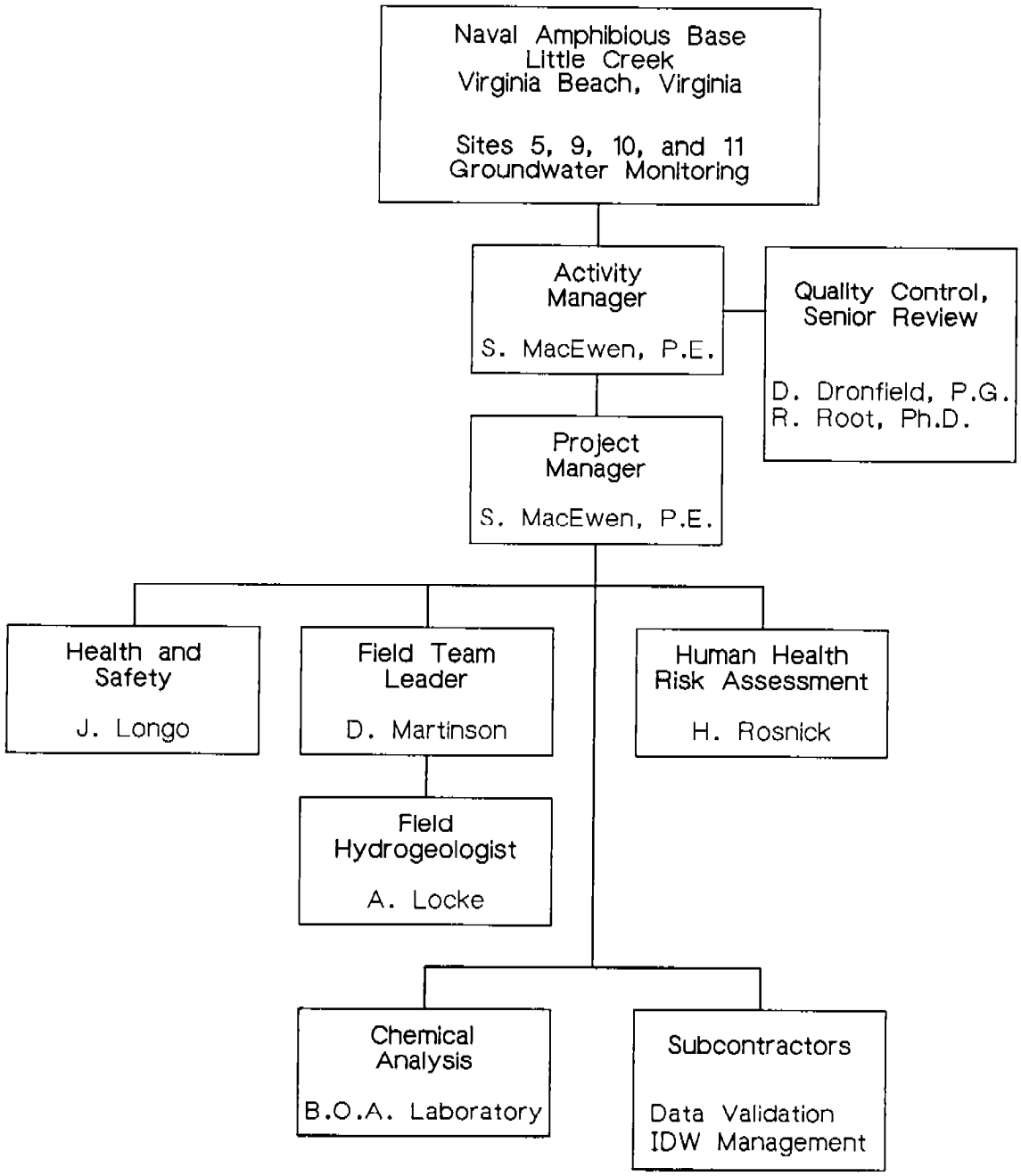

Figure 3-1
PROJECT ORGANIZATION
SITES 5, 9, 10, AND 11
GROUNDWATER MONITORING
NAB Little Creek

CH2M HILL

15-NOV-1996 6750f001.dlv

SECTION 4

Quality Assurance Objectives

Data Quality Objectives (DQOs) will be established for this sample collection effort as specified in the *Data Quality Objectives for Remedial Response Activities,* March 1987. DQOs are the quantitative and qualitative descriptions of the quality of data required to support an environmental decision or action. DQOs serve as target values for data quality, they are not necessarily criteria for acceptance or rejection of data. DQOs for a site vary according to the end use of the data. Everyone from the data gatherer to the analytical laboratory is involved in the DQO development process from the beginning.

The fundamental mechanisms that will be employed to achieve quality goals are:

- 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
- Correction of errors through a corrective action program.

The four documents in the SAP (QAPP, FSP, HASP, and IDWMP) contain the plans and procedures for safe, competent sampling and for effective management of the data. The laboratory providing analytical data for this sampling effort will develop its own Laboratory Quality Assurance Plan (LQAP). The SAP and the LQAP must address the elements of the Navy QA Program.

Audits in the field and in the laboratories will determine how the QA/QC procedures are being implemented. Any discrepancies will be addressed through the corrective action programs described in the SAP and LQAP.

The detection limits achieved by the EPA's TCL organics and TAL inorganics analyses for soil are adequate to meet the DQOs for this project. Navy D Level data validation for this project will ensure that the data obtained with the EPA protocols will be acceptable.

DQOs are measured by the degree of precision, accuracy, representativeness, completeness, and comparability of the data that is required for the project. The project precision and accuracy objectives for laboratory analysis are included in Table 4-1. The quality objectives for field parameters are included in Appendix A of the FSP (i.e., Standard Operating Procedures for pH, conductivity, OVM).

TABLE 4-1
Precision and Accuracy Objectives

Parameter	Precision (Relative Percent Difference)	Accuracy (% Spike Recovery)	Intended Data Use
Groundwater and Surface Water			
TCL Volatiles	< ±20	80-120	Determine extent of contamination Risk assessment
TCL Semivolatiles	< ±20	80-120	Determine extent of contamination Risk assessment
TAL Metals and Cyanide	< ±20	80-120	Determine extent of contamination Risk assessment

Accuracy and Precision

Accuracy is a measure of the agreement between an experimental result and the true value of the parameter. Analytical accuracy can be determined using known reference materials or matrix spikes. 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 (%R) determined by the following equation:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where: SSR = spiked sample result
SR = sample result (native)
SA = spike added

Precision is the measure of the agreement or repeatability of a set of duplicate results obtained from repeat determinations made under the same conditions. The precision of a duplicate determination can be expressed as the relative percent difference (RPD) which is determined by the following equation:

$$RPD = \frac{[X1 - X2]}{X1 + X2} \times 200$$

where: X1 = first duplicate value
X2 = second duplicate value

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

Accuracy and precision will be monitored by using field duplicate, matrix spike, and matrix spike duplicate samples. These data alone cannot be used to evaluate accuracy and precision of individual samples but will be used to assess the long-term accuracy and precision of the analytical method.

Completeness

Completeness is defined as the percentage of analytical measurements made that are judged to be valid, with validity being defined by the DQOs. Percent completeness is calculated as the number of valid analyses divided by the total number of analyses performed multiplied by 100. The completeness goal for the project is 85 percent.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent parameter variations at a sampling point. Representativeness is a measure of how closely the measured results reflect the actual distribution and concentration of certain chemical compounds in the medium sampled. The FSP describes the procedures to be used to collect samples. This process will generate samples that are as representative as possible. Documentation of laboratory and field procedures, as described in the FSP, will be used to establish that protocols have been followed and that sample identification and integrity have been maintained.

Comparability

Comparability is the term that describes the confidence with which one data set can be compared to another. Comparability refers to such issues as using standard field and analytical techniques, following the same QA/QC procedures, and reporting data in the same units. This criterion becomes important if more than one field team is collecting samples or more than one laboratory is analyzing the samples. Consistency in sampling and laboratory procedures will be maintained throughout the project. (See the FSP for a discussion of sampling procedures.) In addition, accepted methodologies will be used for sample analysis, and these methods will not be changed during the project.

SECTION 5

Sample Collection Procedures

A detailed description of sampling procedures is provided in the attached FSP and Appendix A of the FSP. Procedures are included that describe, at a minimum:

- Sample plan design considerations
- Sample packing, handling, and shipment (including time considerations)
- Special conditions for sample container preparation and time requirements (tabulated)
- Preparation and use of trip blanks and field blanks
- Documentation of sampling activities

SECTION 6

Sample Custody

Essential to any sampling and analytical program is maintaining the integrity of the sample from collection to data reporting. This requires tracking the possession and handling of samples from the time of collection, through analysis, to final disposal. This documentation is referred to as chain-of-custody (CofC). Figure 6-1 shows an example of a CofC form. The essential components of this CofC are described in the FSP and summarized below.

Field Custody

The sample coordinator is responsible for the care and custody of samples until they are shipped or otherwise delivered to the laboratory custodian.

Transfer of Custody

The CofC form must be completed before samples are shipped. The persons involved in relinquishing and receiving the samples will sign, date, and note the time of sample receipt on the CofC form. The first such transfer may occur between the field sampler and the sample carrier. Another transfer may occur between the sample carrier and the laboratory sample custodian. Each sample shipment will be accompanied by a CofC record that identifies the contents of the shipment.

Laboratory Custody

Laboratory custody procedures are detailed in each laboratory's Quality Assurance Plan (LQAP). The laboratory custodian will verify that the custody seals on the sample shipment or the containers are intact and that the information on the CofC matches the actual contents. The laboratory custodian will also note any anomalies, such as broken bottles, elevated temperatures, and missing labels. The project-specific procedures for sample custody are described fully in the FSP.

Sample Disposal

Unless otherwise instructed, the analytical laboratory will dispose of unused sample portions, according to Resource Conservation and Recovery Act (RCRA) regulations and the LQAP, after the analyses have been completed and any outstanding issues between the contractor and the laboratory have been resolved.

FIGURE 6-1 EXAMPLE OF A CHAIN OF CUSTODY

CH2M HILL
QUALITY ANALYTICAL LABORATORIES

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CH2M HILL Project #

Purchase Order #

Project Name

Company Name/CH2M HILL Office

Project Manager & Phone #
Mr. [ ]
Ms [ ]
Dr. [ ]

Report Copy to:

Requested Completion Date:

Sampling Requirements: SDWA [ ] NPDES [ ] RCRA [ ] OTHER ____

Sample Disposal: Dispose [ ] Return [ ]

Sampling Date	Sampling Time	Type COMP	Type GRAB	Matrix WATER	Matrix SOIL	CLIENT SAMPLE ID (9 CHARACTERS)	# OF CONTAINERS	LAB TEST CODES	ANALYSES REQUESTED

SHADED AREA – FOR LAB USE ONLY

Lab 1 #	Lab 2 #
Quote #	Kit Request #
Project #	
No. of Samples	Page ___ of ___
COC Rev / Login	LIMS Ver / Ack Gen
REMARKS	LAB 1 ID / LAB 2 ID

Sampled By & Title (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name)	Date/Time	Shipped Via: UPS BUS Fed-Ex Hand Other ____	Shipping #
Work Authorized By (Please sign and print name)	Remarks		

HAZWRAP/NESSA: Y N

QC Level: 1 2 3 Other: ____

COC Rec	ICE
Ana Req	TEMP
Cust Seal	Ph

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: ORIGINAL - LAB, Yellow - LAB, Pink - Client

REV 11/92 FORM 340

SECTION 7

Equipment Calibration

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

Field Equipment Calibration

The field equipment to be used during this investigation that will require calibration includes:

- pH Meter
- Conductivity Meter
- OVM
- Explosimeter

The pH meter, conductivity meter, OVM, and explosimeter will be calibrated before and during each day's use according to procedures and schedules outlined in the Health and Safety Plan (HASP) and in the FSP. The standards which will be used to calibrate these instruments are shown in Table 7-1. Standards will be purchased as necessary from appropriate vendors.

If an individual suspects an equipment malfunction, the device shall be removed from service and tagged so that it is not inadvertently used, and the equipment manager notified so that a substitute piece of equipment can be used. Backup equipment will be available in by overnight delivery in the event of a malfunction.

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

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

Laboratory Equipment Calibration

The laboratory itself is responsible for equipment and instrument calibration and maintenance. Manufacturer's guidance shall be followed for general upkeep. Laboratory calibration procedures are outlined in the LQAP.

TABLE 7-1
Calibration Standards

Instrument	Calibration Standard	Span	Reading	Method
OVM	100 ppm isobutylene	RF = 0.55	100 ppm	1.5 l/m reg:T-tubing
pH Meter	pH 4 and 7 Buffers	N/A	N/A	N/A
Conductivity Meter	EC 225 and 1,000 µs/cm	N/A	N/A	N/A
Explosimeter	50% LEL Pentane	N/A	0.0% LEL, 21% Oxygen	N/A

SECTION 8

Analytical Procedures

All laboratory analyses will be performed by an approved laboratory meeting U.S. Navy Level D quality control. The laboratories will be procured using CH2M HILL's Basic Ordering Agreements (BOAs). Laboratory procedures to be used for the project are listed in Table 8-1.

TABLE 8-1
Analytical Procedures

Analysis	Methodology
TCL Volatiles and Semivolatiles	U.S. EPA CLP Statement of Work for Organic Analysis (8/91 or latest version)
TAL Metals and Cyanide	U.S. EPA CLP Statement of Work for Inorganic Analysis (8/90 or latest version)
Anions	
Chloride	EPA 325.3
Sulfate	EPA 375.4
Bicarbonate	EPA 403/406c

SECTION 9

Data Reduction, Validation, and Record Keeping

Data reduction and reporting are steps in the overall management and use of both field and laboratory data, and data validation is a step in the overall management and use of laboratory data. Figure 9-1 shows the flow of information and sample tracking forms.

Data Reduction

Data reduction, validation, and reporting will ensure that all documents for the investigations can be accounted for when they are completed. Accountable documents include items such as logbooks, field data records, correspondence, CofC records, analytical reports, data packages, and reports.

Definition

Analytical data collected will be computerized. Electronic data will be requested for all TCL and TAL analyses from the laboratory in a format agreed upon by the data manager. Other types of analytical data will be entered and then verified by spot-checking procedures. The sample manager will handle data entries that are unverified.

Background Data

Background data produced for internal records and not reported as part of the analytical data include the following: laboratory worksheets, laboratory notebooks, sample tracking system forms, maintenance records, calibration records, and associated quality control. These sources will be available for inspection and to determine the validity of data.

Data Validation

Validation of analytical data will be contracted by CH2M HILL in accordance with Navy Level D QA/QC requirements. The project, its objectives, and the intended use of the data will be discussed with the data validation personnel.

Data Records

The following describes procedures for maintaining the project's records:

- The task manager shall determine the records to be generated before the start of work. These records will be listed in the site-specific FSP.

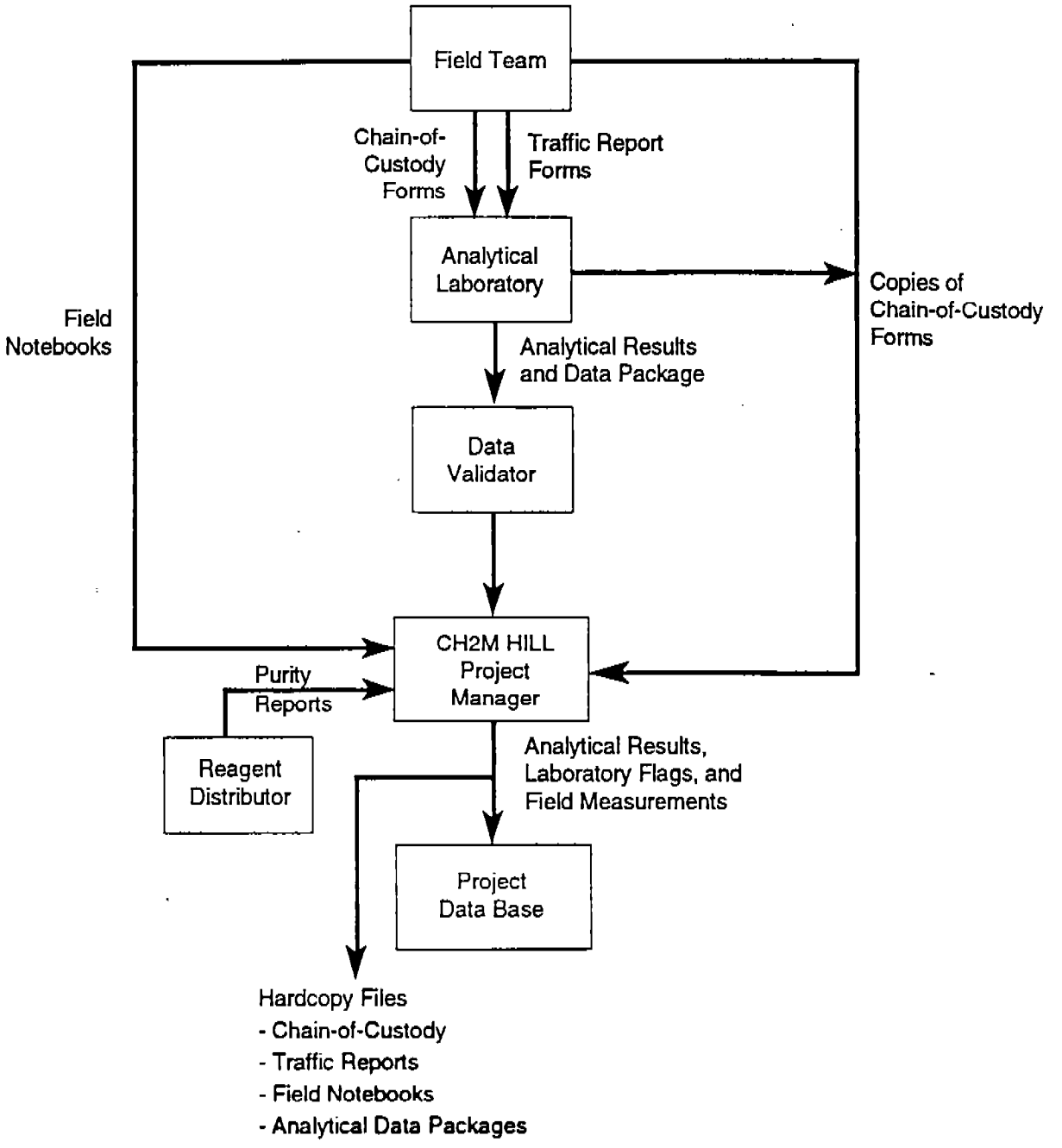

Figure 9-1
FLOW OF FORMS AND SAMPLE AND ANALYSIS INFORMATION

- Records of field activities that support the integrity of samples shall be entered on bound and numbered pages. Such records shall be dated and signed or otherwise authenticated on the day of entry.
- Records retained on file shall be indexed. The indexing system shall include the location of records within the indexing system. (The indexing system shall be in alphabetical, chronological or numerical order, or as otherwise indicated in written procedures.)
- There shall be sufficient information in records to permit identification between the record and the item(s) or activity to which it applies. Identification of records will be by means that permit traceability.
- The records storage system shall provide for accurate retrieval of records without undue delay.

SECTION 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. 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 to estimate any variance or bias in the analytical process. The field and laboratory QA/QC sampling procedures are described below.

Field Sampling Quality Control Procedures

Quality control duplicate samples and blanks are used to provide a measure of the internal consistency of the samples and an estimate of variance and bias. Table 10-1 shows the number of each type of field QC sample that should be collected for the number of investigative samples collected. Tables 10-2 and 10-3 summarize groundwater samples that will be collected and submitted to the laboratory for Round 2 and Rounds 3 through 10, respectively. The table shows the collection frequencies of the field QC samples.

TABLE 10-1
QC Sample Collection Frequencies

Type of QC Sample	Frequency Collected
Field Duplicate	One per 10 samples per matrix per event
Trip Blank	One per cooler containing samples for volatile organic compound analysis
Field Blank	One per sampling event (if very windy or dusty, collect one per day)
Equipment Blank	One every day
Matrix Spike/Matrix Spike Duplicate	One for each group of up to 20 samples sent to a single laboratory.

One duplicate sample will be obtained for every 10 field samples collected. The sampling station from which the duplicate is taken will be randomly selected for each event. Each duplicate sample will be split evenly into two sample containers and submitted for analysis as two independent samples.

Matrix spike/matrix spike duplicates (MS/MSD) will be collected at the rate of one for every 20 field samples collected. MS/MSD samples give an indication of laboratory analysis accuracy and precision within the sample matrix.

TABLE 10-2
Summary of Groundwater Samples to be Collected and Submitted for Analysis
Round 2—2nd Half 1996

	Site 5	Site 9	Site 10	Site 11	Total Samples	Field Dup.	Field Blanks	Trip Blanks	Equip. Blanks	MS/ MSDS	Total
TCL VOC	4	6	8	3	21	3	1	3	3	2	33
TCL SVOC	4	-	-	-	4	1	1	-	1	1	8
TAL Metals (dissolved)	-	6	8	3	17	2	1	-	3	1	24
TAL Metals and Cyanide (total)	-	6	8	3	17	2	1	-	3	1	24
Chloride	-	6	8	3	17	2	1	-	3	1	24
Sulfate	-	6	8	3	17	2	1	-	3	1	24
Bicarbonate	-	6	8	3	17	2	1	-	3	1	24

TABLE 10-3
Summary of Groundwater Samples to be Collected and Submitted for Analysis for Each Round of Sampling
Rounds 3 through 10—1st Half 1997 through 2nd Half 2000

	Site 9	Site 10	Total Samples	Field Dup.	Field Blanks	Trip Blanks	Equip. Blanks	MS/MSDS	Total
TCL VOC	6	8	14	2	1	2	2	1	22
TAL Metals (dissolved)	6	8	14	2	1	-	2	1	20
TAL Metals and Cyanide (total)	6	8	14	2	1	-	2	1	20
Chloride	6	8	14	2	1	-	2	1	20
Sulfate	6	8	14	2	1	-	2	1	20
Bicarbonate	6	8	14	2	1	-	2	1	20

Blanks provide a measure of cross-contamination sources, decontamination efficiency, and other potential errors that can be introduced from sources other than the sample. Three types of blanks can be generated during sampling activities: trip blanks, field blanks, and equipment rinsate blanks.

One trip blank will be included in each cooler used for the daily shipment of volatile organic compound (VOC) samples. If more than one cooler is being sent on a given day, all of the VOC samples should be placed in one cooler, if possible, to minimize the number of trip blanks needed. The trip blanks will be prepared before each sampling event, shipped or transported to the field with the sampling bottles, and returned unopened for analysis. Trip blanks will indicate if there is any contamination during shipment to the field, from storage in the field, or from shipment from the field to the analytical laboratory.

One equipment blank per sample media will be obtained for every day of sampling. Equipment blanks will give an indication of the efficiency of decontamination procedures.

One field blank will be collected for each sampling event. Field blanks are used to determine the chemical quality of water used for such procedures as decontamination and blank collection.

Laboratory Analytical Quality Control Procedures

The analytical laboratory will use the quality control elements including matrix spikes, matrix spike duplicates, and laboratory blanks as specified in the *Navy Installation Restoration Laboratory Quality Assurance Guide, Interim Guidance Document*, February, 1996. Field quality control procedures are provided in Appendix A of the FSP.

Matrix Spike/Matrix Spike Duplicate

Matrix spike/matrix spike duplicates will be 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 triple volume of one sample to provide the laboratory with enough material to analyze the sample, the spiked sample, and the spiked sample duplicate.

SECTION 11

Performance and Systems Audits

Both field and laboratory audits will be conducted.

Laboratory Performance and Systems Audits

The analytical laboratories will conduct internal quality control checks as indicated in each laboratory's LQAP. The laboratories are subject to external audits by the Navy and CH2M HILL.

Field Team Performance and Systems Audits

A performance audit will be conducted on an as-needed basis by the project manager during the sampling activities to verify that proper sampling and documentation procedures presented in the QAPP and the FSP are followed and that subsequent sample data are valid. The audit will focus on the details of the QA program. The audit checklist serves as the guide for performing audits for field procedures and is shown in Figure 11-1. The audit will evaluate the following:

- Project responsibilities
- Sample collection and preservation procedures
- Equipment decontamination procedures
- Field equipment calibration procedures
- Sample custody procedures
- Document control
- Sample identification system
- QC corrective action procedures

An audit report summarizing any results and corrections will be prepared and filed in the project files. Significant variances from established procedures will be reported to the project manager.

Figure 11-1
FIELD PERFORMANCE AUDIT CHECKLIST

Project Responsibilities

Project No.: _____ Date: _____

Project Location: _____ Signature: _____

Team Members: _____

Yes __ No __ 1) Was a SAP Prepared?
Comments _____

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

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

Sample Collection

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

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

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

Figure 11-1
FIELD PERFORMANCE AUDIT CHECKLIST
(Continued)

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

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

Yes __ No __ 6) Are quality assurance checks performed as specified in the FSP?
Comments _____

Yes __ No __ 7) Are photographs taken and documented as specified in the FSP?
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 _____

Figure 11-1
FIELD PERFORMANCE AUDIT CHECKLIST
(Continued)

Yes __ No __ 4) Are the samples identified with sample tags?
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 _____

SECTION 12

Preventive Maintenance

Routine maintenance procedures and schedules for sampling equipment are described in the manufacturer's instruction manuals. All records of inspection and maintenance will be dated and documented in the field notebook.

Maintenance procedures and schedules for all field and laboratory analytical instruments will follow the recommendations of the equipment manufacturers. Routine laboratory equipment maintenance will be performed by laboratory personnel as needed or as indicated in the LQAP. All records of inspection and maintenance will be dated and documented in laboratory record books.

Critical spare parts for the pH meter, OVM, conductivity meter, and explosimeter include batteries, electrodes, and membranes. They will be included in the sampling kits to minimize downtime. In addition, back-up meters will be available, if needed. Spare parts will be purchased from accepted vendors.

SECTION 13

Data Assessment Procedures

The precision and accuracy of data will be routinely assessed to ensure that they meet the requirements of the DQOs.

All data will be validated by a subcontractor before interpretation by CH2M HILL. The validation will be performed according to *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*, February 1994, and the *USEPA Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses*, January 1993.

Data validation will be performed by an independent contractor, as it would not be appropriate for CH2M HILL to validate data collected by CH2M HILL staff. Data that should be qualified will be flagged with the appropriate symbol. Results for field and equipment blanks will be reviewed, and the data will be qualified further, if necessary. Finally, the data set as a whole will be examined for consistency, anomalous results, and reasonableness.

SECTION 14

Corrective Actions

The project manager is responsible for initiating corrective actions. Corrective action steps will include problem identification, investigation responsibility assignment, action to eliminate the problem, increased monitoring of the effectiveness of the corrective action, and verification that the problem has been eliminated.

Examples of corrective actions include, but are not limited to, correcting CofC forms, analysis reruns (if holding time criteria permit), recalibration with fresh standards, replacement of sources of blank contamination, examination of calculation procedures, additional training in sample preparation and analysis, reassignment of analytical responsibilities using a different batch of containers, or recommending an audit of laboratory procedures. Additional approaches may include:

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

SECTION 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 any problems. The report will be an assessment of the measured QA parameters (for example, precision and accuracy), results of performance audits, any reported non-conformance, and any significant QA problems and the recommended solutions. Any change in the QAPP will be summarized in a report or letter and sent to LANTDIV and distributed to the CH2M HILL project team.

Final

Field Sampling Plan for Groundwater Monitoring at Sites 5, 9, 10, and 11

Naval Amphibious Base Little Creek
Virginia Beach, Virginia

Contract Task Order 024

November 19, 1996

Prepared for

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Naval Facilities Engineering Command

Under the

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Prepared by

CH2M HILL

Herndon, Virginia

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SECTION 1

Sampling Program

This Field Sampling Plan (FSP) documents procedures and practices to be followed during groundwater monitoring of Sites 5, 9, 10, and 11 at Naval Amphibious Base Little Creek, Virginia Beach, Virginia. The four sites are:

- Site 5 - Buildings 9-11 Motor Oil Disposal Area
- Site 9 - Driving Range Landfill
- Site 10 - Sewage Treatment Plant Landfill
- Site 11 - School of Music Plating Shop

The locations of Sites 5, 9, 10, and 11 are depicted on Figure 1-1. The following sections document the sampling program. All sample analyses will be performed in accordance with standard EPA methods and procedures by a contracted laboratory that fulfills all requirements of the U.S. Navy's QA/QC Program Manual and EPA's Contract Laboratory Program. A signed certificate of analysis will be provided with each laboratory analysis, along with a certificate of compliance certifying that all work was performed in accordance with the applicable federal, state, and local regulations. All analyses will be performed following the Navy's guidance for Level D. Table 1-1 lists the analytical parameters included on EPA's Target Compound List (TCL) and Target Analyte List (TAL).

Groundwater monitoring activities consist of eight to ten rounds of groundwater sampling at Sites 9 and 10 and two rounds of sampling at Sites 5 and 11 conducted on a semiannual basis beginning in the spring of 1996. All sampling will be done from existing wells; no new wells will be installed. The scope of each round is discussed below.

Groundwater Monitoring Rounds 1 and 2

The first two rounds of monitoring will address all four sites. The first round (Round 1) was already completed by Foster Wheeler Environmental Services (FWES) in May 1996. Results of this round are provided in Appendix C. Round 2 will be conducted by CH2M HILL in December 1996. Table 1-2 lists the specific samples to be collected in Round 2 and the analyses to be performed on each sample. The specific activities to be performed at each site are discussed below.

Site 5 - Buildings 9 - 11 Motor Oil Disposal Area

Groundwater samples will be collected from the four existing monitoring wells (LC-GW1 through LC-GW5) at Site 5 using a Grundfos® Redi-Flo2 sampling pump. Figure 1-2 illustrates the monitoring well locations. All of the groundwater samples collected will be analyzed for TCL VOCs and SVOCs. These wells will be sampled in rounds 1 and 2 only. Analytical results from rounds 1 and 2 will be evaluated to determine whether additional sampling rounds are necessary.

Site 9 - Driving Range Landfill

Six monitoring wells, LC9-GW2, LC9-GW4, LC9-GW5, LC9-GW6, LC9-UST1, and LC9-UST3, will be sampled using a Grundfos ® Redi-Flo2 pump. Figure 1-3 illustrates the monitoring well locations. The wells will be sampled at times of maximum groundwater to surface water discharge as determined by the tidal survey conducted as part of the 1993 RI/FS. The samples will be tested for TCL VOCs , total and dissolved TAL metals, total cyanide, and anions. Site 9 wells will be sampled for a 5-year period (see "Groundwater Monitoring Rounds 3 Through 10" below).

Site 10 - Sewage Treatment Plant Landfill

Eight monitoring wells, LC1-GW1 through LC10-GW8, will be sampled using a Grundfos® Redi-Flo2 pump. Figure 1-4 illustrates the monitoring well locations. The wells will be sampled at times of maximum groundwater to surface water discharge as determined by the tidal survey conducted as part of the 1993 RI/FS. All samples will be analyzed for TCL VOCs, total and dissolved TAL metals, total cyanide, and anions. Site 10 wells will be sampled for a 5-year period (see "Groundwater Monitoring Rounds 3 Through 10" below).

Site 11 - School of Music Plating Shop

Three wells at Site 11, LC11-GW1 through LC11-GW3, will be sampled using a Grundfos® Redi-Flo2 pump. Figure 1-5 illustrates the monitoring well locations. Samples will be analyzed for TCL VOCs, total and dissolved TAL metals, and anions. These wells will be sampled in rounds 1 and 2 only to evaluate the quality of the groundwater after the recent source removal action. Analytical results from rounds 1 and 2 will be evaluated to determine whether additional sampling rounds are necessary.

Groundwater Monitoring Rounds 3 Through 10

Rounds 3 through 10 will address only Sites 9 and 10. Round 3 will be conducted by CH2M HILL in the spring of 1997 and the subsequent rounds will be performed at six-month intervals thereafter. Table 1-3 lists the specific samples to be collected in Rounds 3 through 10 and the analyses to be performed on each sample. A report will be prepared after 3 years (the sixth round of monitoring) to review results to date and to recommend if sampling during the fourth and fifth years should be done on an annual (2 additional rounds) or semiannual (4 additional rounds) basis.

WDCR1044/011.DOC

TABLE 1-1
Analytical Parameters

Volatile Organic Compounds on Target Compound List (TCL)		
Acetone	Chloromethane	4-Methyl-2-Pentanone
Benzene	Dibromochloromethane	Methylene Chloride
Bromoform	1,1-Dichloroethane	Styrene
Bromodichloromethane	1,2-Dichloroethane	1,1,2,2-Tetrachloroethane
Bromomethane	1,1-Dichloroethene	Tetrachloroethene
2-Butanone	1,2-Dichloroethene (total)1,2-	Toluene
Carbon Disulfide	Dichloropropane	1,1,1-Trichloroethane
Carbon Tetrachloride	cis-1,3-Dichloropropene	1,1,2-Trichloroethane
Chlorobenzene	trans-1,3 Dichloropropene	Trichloroethene
Chloroethane	Ethylbenzene	Vinyl Chloride
Chloroform	2-Hexanone	Xylenes (total)
Semivolatile Organic Compounds on Target Compound List (TCL)		
1,2-Dichlorobenzene	4-Chloro-3-methylphenol	4-Bromophenyl-phenylether
1,3-Dichlorobenzene	2-Methylnaphthalene	Hexachlorobenzene
1,4-Dichlorobenzene	Hexachlorocyclopentadiene	Pentachlorophenol
Phenol	2,4,6-Trichlorophenol	Phenanthrene
bis-(2-Chloroethyl)ether	2,4,5-Trichlorophenol	Anthracene
2-Chlorophenol	2-Chloronaphthalene	Di-n-butylphthalate
2-Methylphenol	2-Nitroaniline	Carbazole
2,2'-oxybis(1-Chloropropane)	Dimethylphthalate	Fluoranthene
4-Methylphenol	Acenaphthylene	Pyrene
N-Nitroso-di-n-propylamine	2,6-Dinitrotoluene	Butylbenzylphthalate
Hexachloroethane	3-Nitroaniline	3,3'-Dichlorobenzidine
Nitrobenzene	Acenaphthene 2,4-Dinitrophenol	Benzo(a)anthracene
Isophorone	4-Nitrophenol	Chrysene
2-Nitrophenol	Dibenzofuran	bis-(2-Ethylhexyl)phthalate
2,4-Dimethylphenol	2,4-Dinitrotoluene	Di-n-octylphthalate
bis-(2-Chloroethoxy)methane	Diethylphthalate	Benzo(b)fluoranthene
2,4-Dichlorophenol	4-Chlorophenyl-phenylether	Benzo(k)fluoranthene
1,2,4-Trichlorobenzene	Fluorene	Benzo(a)pyrene
Naphthalene	4-Nitroaniline	Indeno(1,2,3-cd)pyrene
4-Chloroaniline	4,6-Dinitro-2-methylphenol	Dibenz(a,h)anthracene
Hexachlorobutadiene	N-Nitrosodiphenylamine	Benzo(g,h,i)perylene
Inorganics on Target Analyte List (TAL)		
Aluminum	Cobalt	Nickel
Antimony	Copper	Potassium
Arsenic	Cyanide	Selenium
Barium	Iron	Silver
Beryllium	Lead	Sodium
Cadmium	Magnesium	Thallium
Calcium	Manganese	Vanadium
Chromium	Mercury	Zinc

TABLE 1-2
Groundwater Samples to be Collected and Analyzed - Round 2

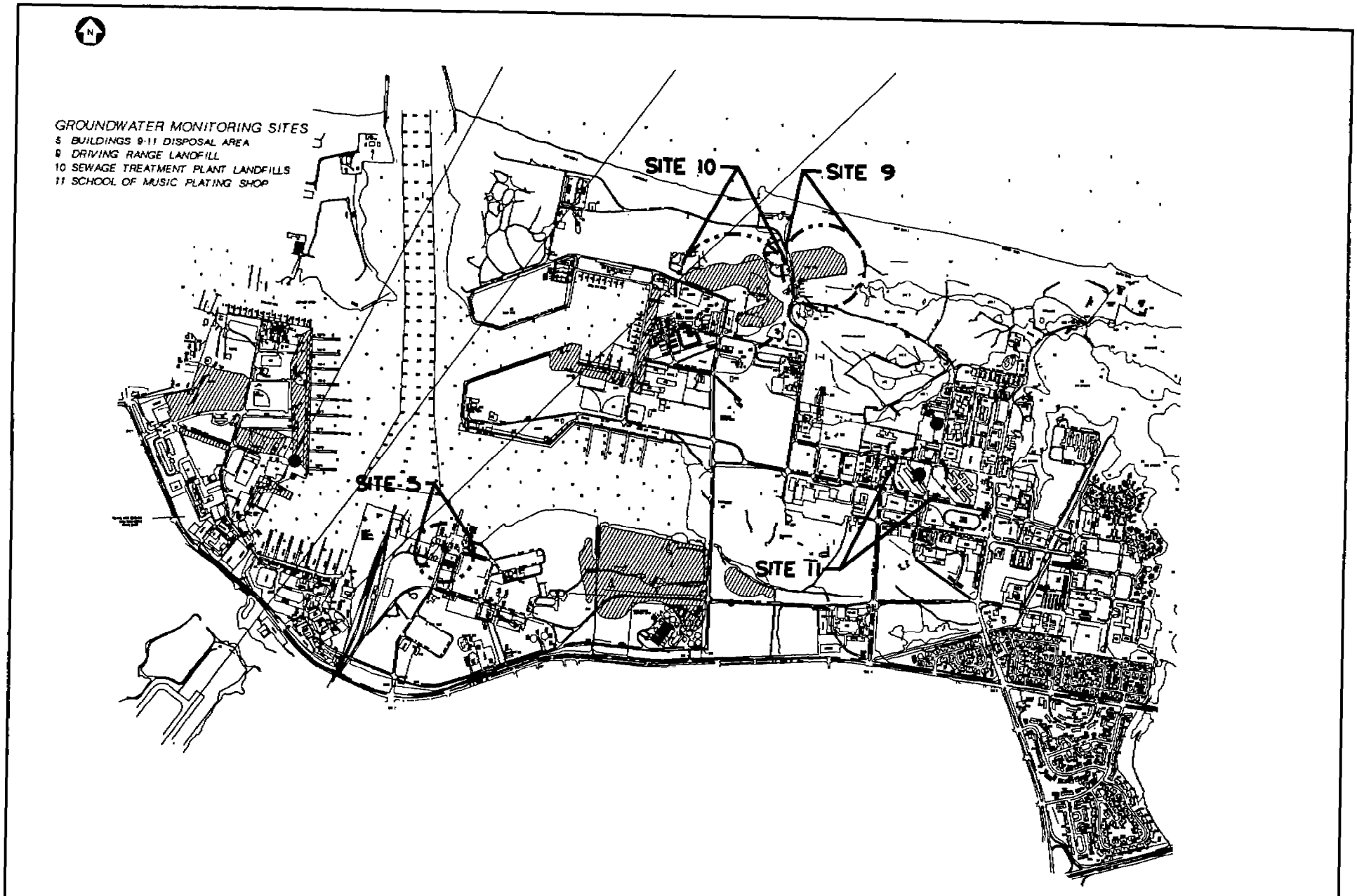
Site	Monitoring Well	Sample Number	TCL VOC	TCL SVOC	TAL Metals/CN (total)	TAL Metals (dissolved)	Anions*
Site 5	LC5-GW01	LC05-GW0001	X	X			
Site 5	LC5-GW02	LC05-GW0002	X	X			
Site 5	LC5-GW03	LC05-GW0003	X	X			
Site 5	LC5-GW04	LC05-GW0004	X	X			
Site 5	Duplicate	LC05-GW0099	X	X			
Site 9	LC9-GW2	LC09-GW0002	X		X	X	X
Site 9	LC9-GW4	LC09-GW0004	X		X	X	X
Site 9	LC9-GW5	LC09-GW0005	X		X	X	X
Site 9	LC9-GW6	LC09-GW0006	X		X	X	X
Site 9	LC9-UST1	LC09-GWUST1	X		X	X	X
Site 9	LC9-UST3	LC09-GWUST3	X		X	X	X
Site 9	Duplicate	LC09-GW0099	X		X	X	X
Site 10	LC10-GW1	LC10-GW0001	X		X	X	X
Site 10	LC10-GW2	LC10-GW0002	X		X	X	X
Site 10	LC10-GW3	LC10-GW0003	X		X	X	X
Site 10	LC10-GW4	LC10-GW0004	X		X	X	X
Site 10	LC10-GW5	LC10-GW0005	X		X	X	X
Site 10	LC10-GW6	LC10-GW0006	X		X	X	X
Site 10	LC10-GW7	LC10-GW0007	X		X	X	X
Site 10	LC10-GW8	LC10-GW0008	X		X	X	X
Site 10	Duplicate	LC10-GW0099	X		X	X	X
Site 11	LC11-GW01	LC11-GW0001	X		X	X	X
Site 11	LC11-GW02	LC11-GW0002	X		X	X	X
Site 11	LC11-GW03	LC11-GW0003	X		X	X	X
QA/QC	Trip Blank	TB-MO-DY-YR	X				
QA/QC	Trip Blank	TB-MO-DY-YR	X				
QA/QC	Trip Blank	TB-MO-DY-YR	X				
QA/QC	Field Blank	FB-MO-DY-YR	X	X	X	X	X
QA/QC	Equip. Blank	EB-MO-DY-YR	X	X	X	X	X
QA/QC	Equip. Blank	EB-MO-DY-YR	X		X	X	X
QA/QC	Equip. Blank	EB-MO-DY-YR	X		X	X	X

*Anions consist of chloride, sulfate, and bicarbonate.

TABLE 1-3
Groundwater Samples to be Collected and Analyzed - Rounds 3 Through 10

Site	Monitoring Well	Sample Number	TCL VOC	TAL Metals/CN (total)	TAL Metals (dissolved)	Anions*
Site 9	LC9-GW2	LC09-GW0002	X	X	X	X
Site 9	LC9-GW4	LC09-GW0004	X	X	X	X
Site 9	LC9-GW5	LC09-GW0005	X	X	X	X
Site 9	LC9-GW6	LC09-GW0006	X	X	X	X
Site 9	LC9-UST1	LC09-GWUST1	X	X	X	X
Site 9	LC9-UST3	LC09-GWUST3	X	X	X	X
Site 9	Duplicate	LC09-GW0099	X	X	X	X
Site 10	LC10-GW1	LC10-GW0001	X	X	X	X
Site 10	LC10-GW2	LC10-GW0002	X	X	X	X
Site 10	LC10-GW3	LC10-GW0003	X	X	X	X
Site 10	LC10-GW4	LC10-GW0004	X	X	X	X
Site 10	LC10-GW5	LC10-GW0005	X	X	X	X
Site 10	LC10-GW6	LC10-GW0006	X	X	X	X
Site 10	LC10-GW7	LC10-GW0007	X	X	X	X
Site 10	LC10-GW8	LC10-GW0008	X	X	X	X
Site 10	Duplicate	LC10-GW0099	X	X	X	X
QA/QC	Trip Blank	TB-MO-DY-YR	X			
QA/QC	Trip Blank	TB-MO-DY-YR	X			
QA/QC	Field Blank	FB-MO-DY-YR	X	X	X	X
QA/QC	Equip. Blank	EB-MO-DY-YR	X	X	X	X
QA/QC	Equip. Blank	EB-MO-DY-YR	X	X	X	X

*Anions consist of chloride, sulfate, and bicarbonate.

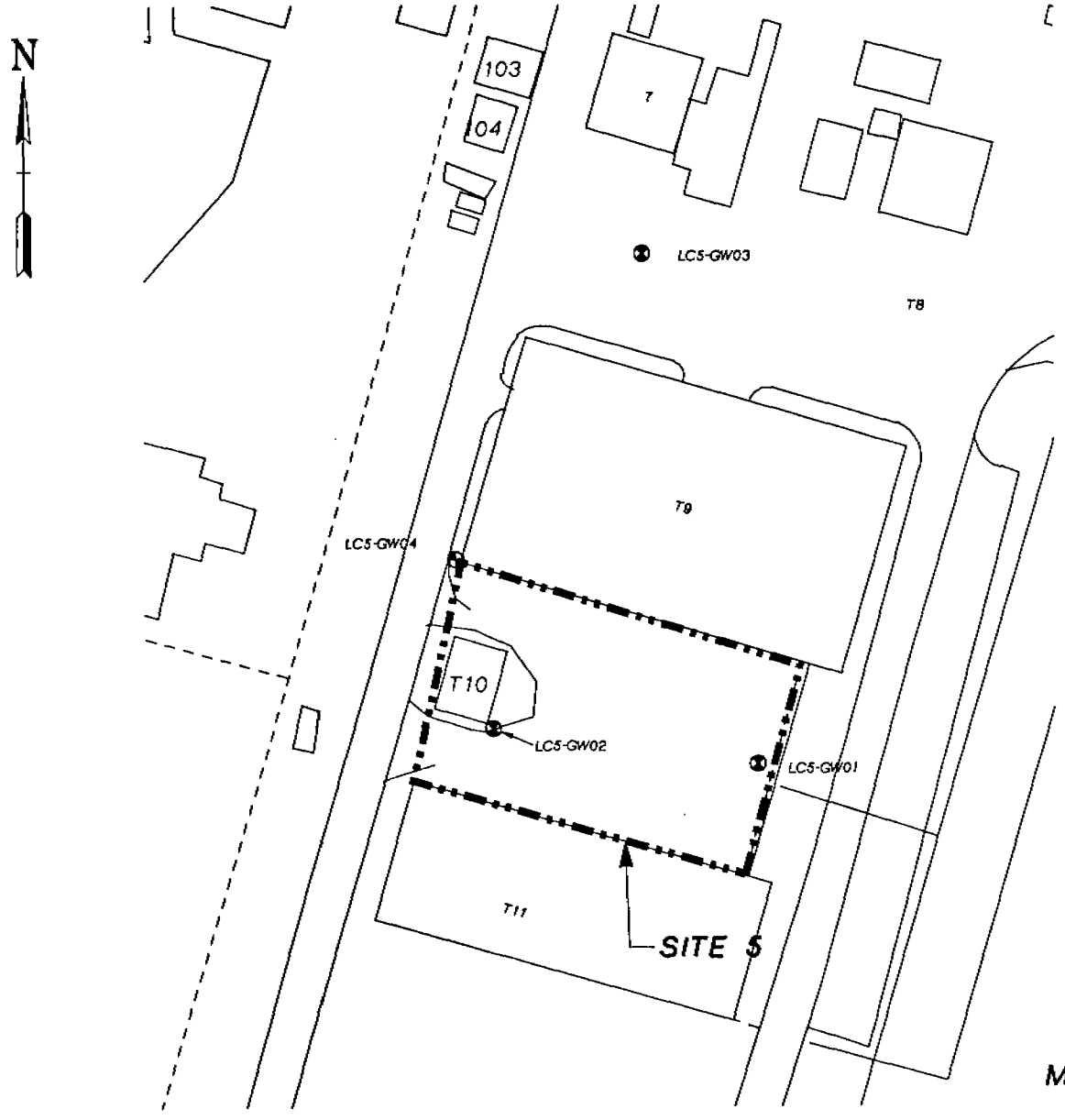


SOURCE: BASE MAP PROVIDED BY LANTDIV

FIGURE 1-1
BASE LOCATION MAP WITH SITE LOCATIONS
NAB - LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

CH2M HILL

21-OCT-1996 6750f008.div



LEGEND

SITE BOUNDARY

LC5-GW02 EXISTING MONITORING WELL (TO BE SAMPLED)

GRAPHIC SCALE

0 75' 150' 225'

1"=75'-0"

FIGURE 1-2
MONITORING WELL LOCATIONS
SITE 5
NAB - LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

BASE MAP PROVIDED BY: FOSTER WHEELER ENVIRONMENTAL SERVICES

CH2M HILL

21-OCT-1996 6750f009.div

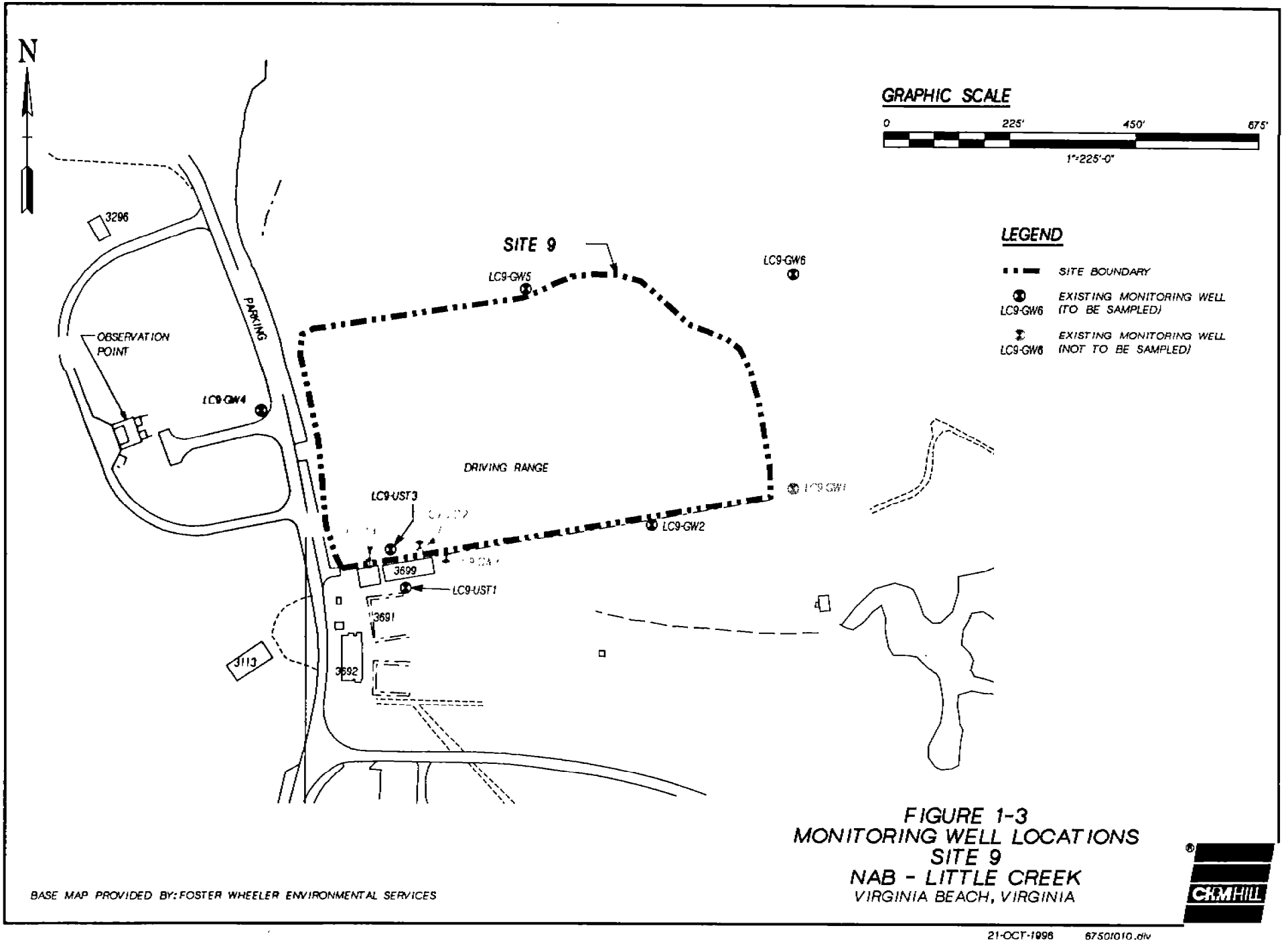
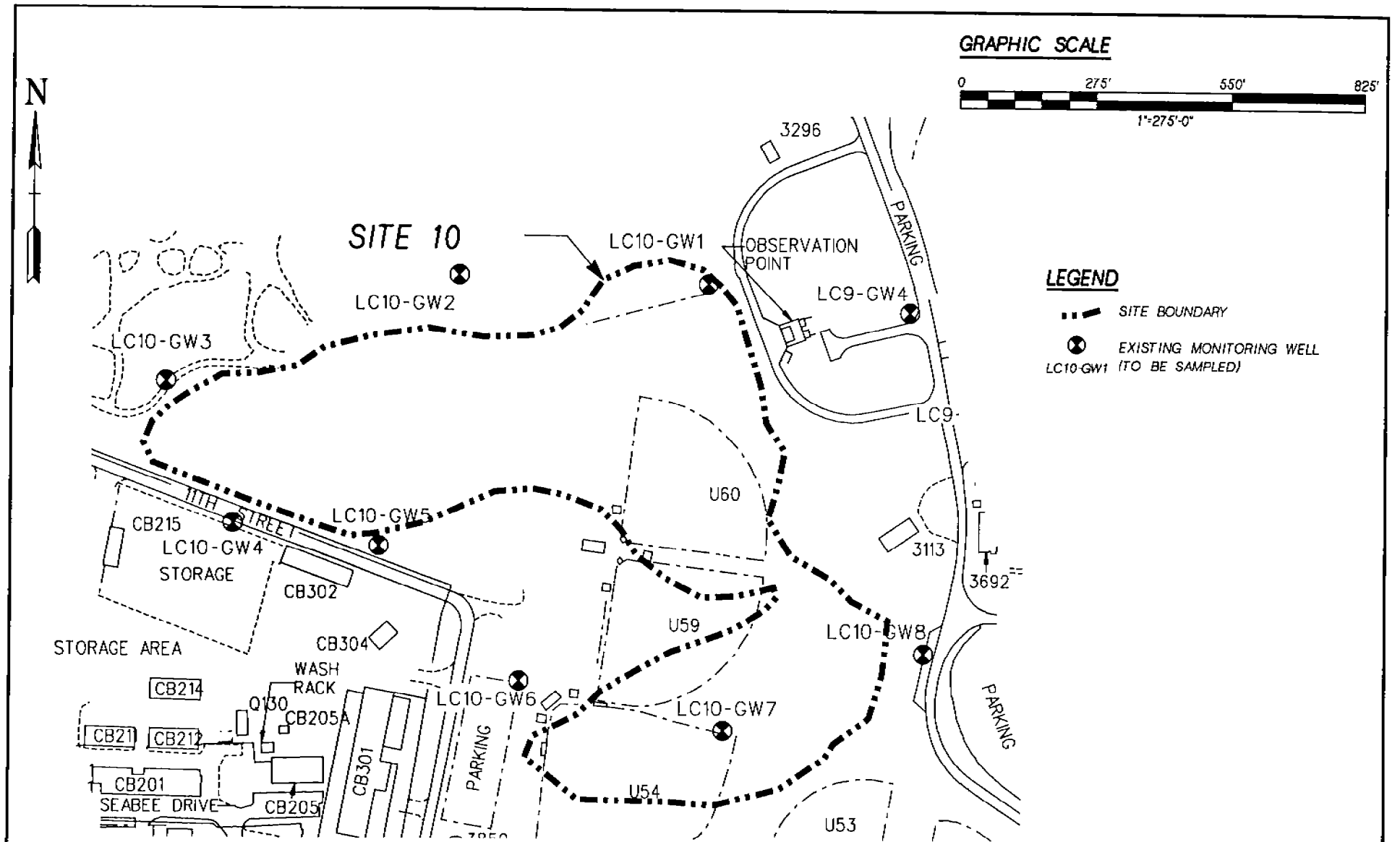


FIGURE 1-3
MONITORING WELL LOCATIONS
SITE 9
NAB - LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

21-OCT-1996 67501010.div

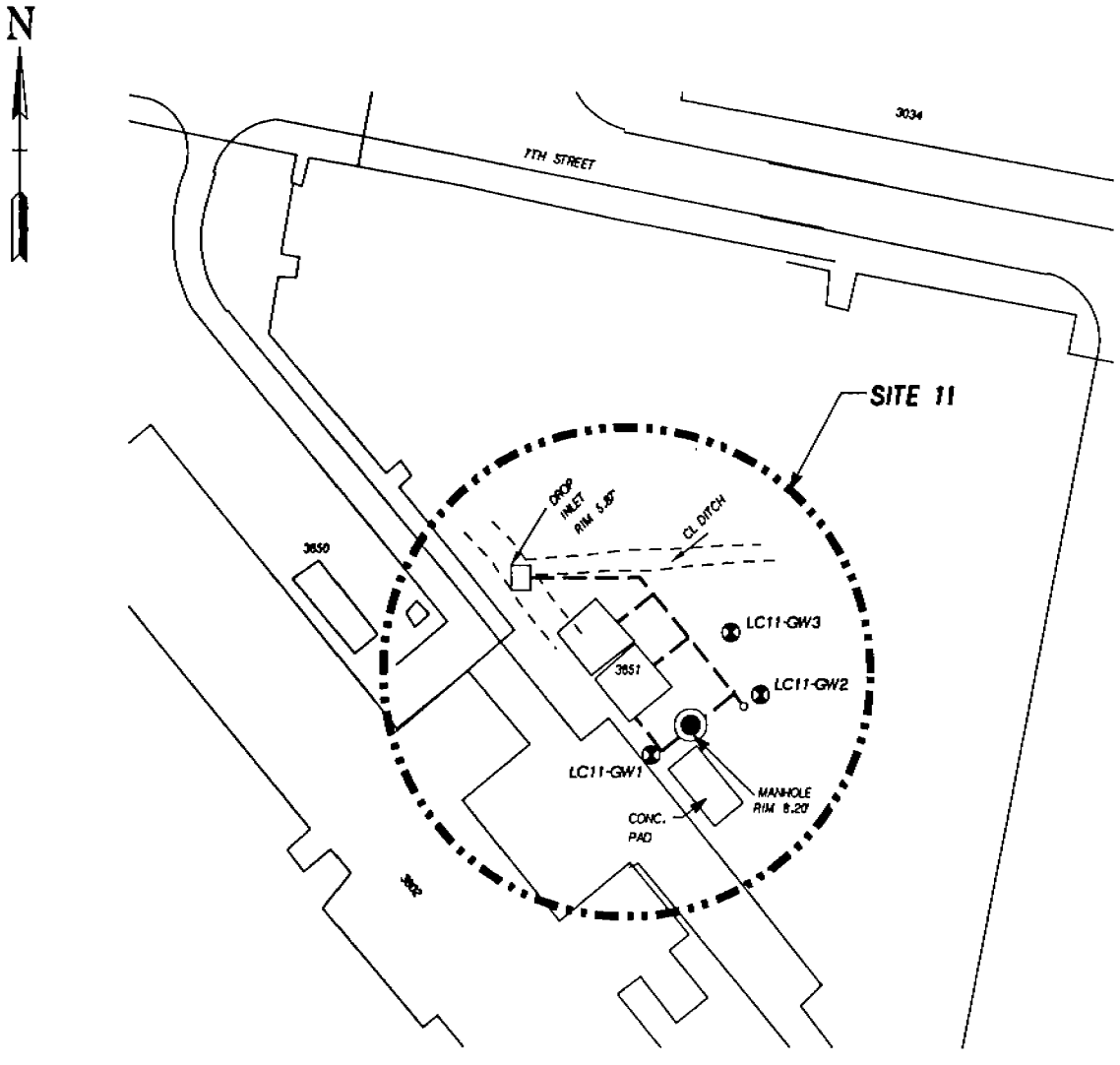


BASE MAP PROVIDED BY:FOSTER WHEELER ENVIRONMENTAL SERVICES

FIGURE 1-4
MONITORING WELL LOCATIONS
SITE 10
NAB - LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

CH2M HILL

21-OCT-1996 6750f011.div



NOTES:

1. MANHOLE PIPING AND SURROUNDING SOIL HAVE BEEN REMOVED, AND THE SITE HAS BEEN RESTORED.

LEGEND

- SITE BOUNDARY
- LC11-GW1 — EXISTING MONITORING WELL (TO BE SAMPLED)
- STORM SEWER LINES

GRAPHIC SCALE

0 75' 150' 225'

1"=75'-0"

BASE MAP PROVIDED BY: FOSTER WHEELER ENVIRONMENTAL SERVICES

FIGURE 1-5
MONITORING WELL LOCATIONS
SITE 11
NAB - LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

CH2M HILL

21-OCT-1998 6750f012.dlv

SECTION 2

Sampling Operations

All aspects of the sampling operations will conform to U.S. Navy specifications and guidelines. This includes the frequency of collecting and providing QC samples: duplicates; trip, field, and equipment blanks; and matrix spike and matrix spike duplicates.

Groundwater samples will be collected from the existing monitoring wells at each site using a Grundfos ® Redi-Flo2 sampling pump. A brief explanation of the groundwater sampling techniques to be employed during the groundwater monitoring effort are provided below. Detailed descriptions of monitoring well sampling techniques are included in the standard operating procedures (SOPs) in Appendix A.

Monitoring Well Sampling

All groundwater samples will be collected from existing wells that have previously been developed and sampled. The assumption is that the wells will not require redevelopment prior to sampling.

Prior to sampling, water level and well depth measurements will be collected from each well to be sampled in that round. The wells will not be surveyed. Vertical and horizontal control for each well has already been obtained during well installation. This information is provided in Appendix B.

Also prior to sampling, dissolved oxygen (DO) measurements will be collected from 2 or 3 depths within each well. DO measurements will be repeated after purging each well.

Before sampling, groundwater will be purged from each well. The volume of groundwater in the monitoring well will be calculated by using values for the depth of the well, the depth to water, and the well diameter. Purging will be performed until a minimum of three well volumes of water have been removed and the temperature, specific conductance, and pH have stabilized within 10 percent for three consecutive readings. Sampling will begin when the parameter measurements have stabilized. Wells that are pumped dry during purging will be allowed to recover before sampling. The IDWMP discusses treatment and disposal of purge water.

The stabilized field parameter readings (temperature, specific conductance, and pH) will be recorded for each well.

Samples will be placed in containers and preserved according to Navy Level D protocol and will be analyzed within the proper holding time. For volatile organic analysis (VOA) the bottles will be filled to minimize aeration of the samples. Sample vials will be filled completely and will be capped to prevent the entrapment of air bubbles in the vial.

Bottle caps will be removed carefully from the laboratory cleaned sample bottle. The cap will not be laid down nor the inside touched. At no time should the inside of the bottle come into contact with anything other than the sample.

All appropriate preservatives will be added to the sample containers by the contracted laboratory before the containers are shipped to the CH2M HILL field team. VOC samples will be preserved with hydrochloric acid (HCl), TAL metals samples will be preserved with nitric acid (HNO_3), and cyanide samples will be preserved with sodium hydroxide (NaOH). All samples will be kept cool at 4°C. Table 2-1 presents the required containers, preservatives, and holding times for groundwater samples.

The appropriate number of field QA/QC samples, including field blanks, rinsate blanks, and duplicates, will be analyzed in addition to laboratory QA/QC samples, including matrix spike and matrix spike duplicate samples. Table 2-2 and Table 2-3 present summaries, by site, of the number of groundwater samples and QC samples to be submitted for analyses for Round 2 and Rounds 3 through 10 respectively.

Equipment Decontamination

All non-dedicated sampling equipment will be decontaminated prior to the beginning of sampling activities and after each use. Specific field decontamination procedures are presented in the SOPs in Appendix A.

Field Quality Control Procedures

Quality control duplicate samples and blanks are used to provide a measure of the internal consistency of the samples and to provide an estimate of the components of variance and the bias in the analytical process.

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. Three types of blanks will be generated during sampling activities: trip blanks, field blanks, and equipment blanks.

One trip blank will be included for each cooler containing samples for VOC analysis. The trip blanks will be prepared prior to 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 if any contamination occurred during shipment to the field, field storage, or during shipment from the field to the analytical laboratory.

One field blank will be collected each sampling event. The field blanks will indicate if any contaminants were introduced during the handling of the sample containers in the field or during sample analysis at the laboratory. The sample container will be filled with ASTM Type II water in the field at the time of sampling. The blanks will be capped, packed, and shipped with the samples.

One equipment blank will be collected and analyzed every day during sampling activities. The equipment blanks will indicate the efficiency of equipment decontamination procedures.

Duplicates

Field duplicate samples will be collected at a frequency of 1 per 10 field samples per matrix. The location from which the duplicates are taken will be randomly selected. The duplicate sample will be submitted for analysis as two independent samples. These samples will be numbered non-sequentially.

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a frequency of one per 20 field samples. Analytical results of these samples indicate the impact the matrix (water or soil) has on extracting the analyte for analysis. Data validators will use these results to evaluate the accuracy of the analytical data.

WDCR1044/011.DOC

TABLE 2-1
Required Containers, Preservatives, and Holding Times for Water Samples

Analysis	Sample Container	Preservative	Holding Time	Volume of Sample Collected
TCL Volatiles	Three 40-ml glass vial w/teflon lined cap	HCl to pH <2; Cool to 4°C	14 days	Fill completely; no air bubbles
TCL Semivolatiles	Two 1-liter amber bottle w/teflon lined cap	Cool to 4°C	7 days to extraction, 40 days to analysis	Fill to shoulder
TAL Metals	1-liter polyethylene bottle for each analysis	HNO_3 to pH <2; Cool to 4°C	6 months	Fill to shoulder
TAL Cyanide	1-liter bottle	NaOH to pH > 12, Cool to 4°C	14 days	Fill to shoulder
Anions	Three 250-ml plastic or glass bottles	Cool to 4°C	24 hours	Fill to shoulder

WDCR1044/012.DOC

TABLE 2-2
Summary of Groundwater and QC Samples for Offsite Analysis
Round 2—2nd Half 1996

	Site 5	Site 9	Site 10	Site 11	Total Samples	Field Dup.	Field Blanks	Trip Blanks	Equip. Blanks	MS/ MSDS	Total
TCL VOC	4	6	8	3	21	3	1	3	3	2	33
TCL SVOC	4	-	-	-	4	1	1	-	1	1	8
TAL Metals (dissolved)	-	6	8	3	17	2	1	-	3	1	24
TAL Metals and Cyanide (total)	-	6	8	3	17	2	1	-	3	1	24
Chloride	-	6	8	3	17	2	1	-	3	1	24
Sulfate	-	6	8	3	17	2	1	-	3	1	24
Bicarbonate	-	6	8	3	17	2	1	-	3	1	24

TABLE 2-3
Summary of Groundwater and QC Samples for Offsite Analysis for Each Sampling Round
Rounds 3 through 10—1st Half 1997 through 2nd Half 2000

	Site 9	Site 10	Total Samples	Field Dup.	Field Blanks	Trip Blanks	Equip. Blanks	MS/MSDS	Total
TCL VOC	6	8	14	2	1	2	2	1	22
TAL Metals (dissolved)	6	8	14	2	1	-	2	1	20
TAL Metals and Cyanide (total)	6	8	14	2	1	-	2	1	20
Chloride	6	8	14	2	1	-	2	1	20
Sulfate	6	8	14	2	1	-	2	1	20
Bicarbonate	6	8	14	2	1	-	2	1	20

SECTION 3

Documentation

Sample Designation

Each sample will be designated by an alphanumeric code that will identify the NAB Little Creek, site number, and matrix sampled and contain a sequential sample number. Site-specific procedures are elaborated below.

The NAB Little Creek code will be LC. Sample types will be identified by a two-letter code and each sample number will be identified with alpha-numeric characters.

The following is a general guide for sample identification:

First Segment of Sample Designation		Second Segment of Sample Designation	
NAB Little Creek Base Code	Site Number	Sample Type	Sample Number
AA	AA	AA	AAAA

Symbol Definition:

A = Alpha-numeric

Base Code

LC = NAB Little Creek

Site Number:

05 = Site 5 - Buildings 9-11 Motor Oil Disposal Area
09 = Site 9 - Driving Range Landfill
10 = Site 10 - Sewage Treatment Plant Landfill
11 = Site 11 - School of Music Plating Shop

Sample Type:

GW = Monitoring Well Groundwater Sample

Sample Number:

AAAA = Unique identifier

Sample Shipping Procedures

Strict adherence to both personnel and equipment decontamination procedures will help ensure the safety of onsite workers as well as the acquisition of quality data.

All field sampling activities will be documented through the use of field logs and chain-of-custody procedures. Sample containers will be clean, first-quality containers provided by the contracted laboratory. A complete listing of the types of bottles and preservatives to be

used is given in Table 2-1 in Section 2 of this FSP. An identification label will be attached to each sample container indicating the sample number, station number, analysis to be performed, preservative used, date and time of sample collection, and the name of the responsible sampling team member.

After collection, samples will be packed in coolers with vermiculite (and ice) for shipment to the contracted laboratory via an overnight courier. Chain-of-custody forms will be taped to the inside of the lid of each cooler. Chain-of-custody forms contain general information about the location of the activity and the members of the sampling team, as well as specific information about the type of sample, sample location, number of sample containers from each station, and analyses to be performed. Each time the sample is relinquished or received, the party involved signs the form and indicates the time and date.

The coolers used to deliver the samples will be sealed with strapping tape. Evidence tape will be placed across the front and back of each lid to control tampering. The samples will be shipped to the laboratory at the end of each day of sampling to ensure that holding times are not exceeded.

Trip blanks (TB), field blanks (FB), and equipment blanks (EB) will be labelled using their alphabetic identifier followed by the sample date. For example TB062096 is a trip blank collected on 6/20/96.

WDCR1044/011.DOC

Field Sampling Plan

Appendix A

List of Standard Operating Procedures for Sampling

Volatiles Monitoring with an OVM

Explosimeter Operations

Water Level Measurements

Field Measurement of Dissolved Oxygen

Groundwater Sampling from Monitoring Wells

Field Measurement of pH

Field Measurement of Specific Conductance and Temperature

VOC Sampling - Water

Field Filtering

Field Rinse Blank Preparation

Decontamination of Personnel and Equipment

STANDARD OPERATING PROCEDURE

Volatiles Monitoring by OVM

I. Purpose and Scope

The purpose of this procedure is to provide guidelines for the calibration and use of an OVM Organic Vapor Monitor.

II. Equipment and Materials

- Operations manual
- An OVM hand readout unit and side pack assembly
- 100 ppm isobutylene as calibration gas
- T-type feeder tube with 1.5 liter/min. regulator

III. Procedures and Guidelines

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

OVM, Organic Vapor Monitor

1. Introduction

   The OVM Organic Vapor Monitor is designed to detect organic vapors in air. It uses a photo-ionization detector (PID) as its detection principle. This detector allows the monitor to respond to a wide variety of organic compounds.

2. Operational Checks

   - See basic operating instructions in operations manual.

3. Calibration

   - See basic operating instructions in operations manual.

IV. Attachments

- None.

V. Key Checks and Preventative Maintenance

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

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

- A complete spare instrument should be available whenever field operations require volatiles monitoring.
- Spare parts should be on hand so minor repairs may be made in the field.
- Batteries should be charged daily.
- Occasionally allow the batteries to totally discharge before recharging to prevent battery memory from occurring.

STANDARD OPERATING PROCEDURE

Explosimeter Operations

I. Purpose and Scope

This SOP provides a guideline for field measurements of the levels of combustible gas and oxygen in air.

II. Equipment and Materials

- Industrial Scientific (MX251) Combustible Gas and Oxygen Indicator, or equivalent meter, which can be field calibrated
- Flow-control regulator and hose
- Calibration gas (50 percent LEL pentane—0.75 percent pentane and 15 percent oxygen in nitrogen)
- Equipment calibration data sheet

III. Procedures and Guidelines

A. **Calibration:** The explosimeter must be calibrated before initial daily use. Record calibration information on equipment calibration data sheet. Calibration will be performed according to the following procedure:

1. Turn instrument on
   - Unscrew knurled nut on bottom
   - Rotate metal cover 180°
   - Tighten knurled nut
2. Check battery
   - Check for no "LoBatt" display—do not use if LoBatt displayed
3. Calibrate instrument
   - Observe that instrument reads 0 percent LEL and 21 percent Oxygen (OX) (record readings)
   - Connect sampling pump onto top of instrument
   - Connect .75 percent Pentane/15 percent oxygen gas (with 1.5 LPM Regulator and direct tubing)
   - Turn pump ON

- Turn gas ON
- Record LEL and O_2 after stabilized; LEL must read 50 percent +/-5 percent; O_2 must read 15 percent +/- 5 percent
- Disconnect sample pump and return to charger

B. **Sample Measurement:** The instrument is then ready for air sampling. Note and record the readings for percent LEL and percent O_2

IV. Attachments

- Equipment calibration data sheet

V. Key Checks and Preventative Maintenance

Check that the batteries be adequately charged. Certain materials such as silicone, silicates, and organic lead compounds tend to poison the catalyst in the instrument, thereby giving erroneously low readings; calibration checks should be made frequently if such materials are suspected to be present.

If the CGI does not cal-check within ±5 percent of 50 percent LEL, an internal calibration must be performed, or the instrument replaced.

EXPLOSIMETER CALIBRATION SHEET

Date	Time	Analyst Initials	Instrument Readings: Uncalibrated @LEL=0% O_2=21%	Instrument Readings: Calibrated @LEL=50%±5 O_2=15%±5	Comments

STANDARD OPERATING PROCEDURE

Water-Level Measurements

I. Purpose and Scope

The purpose of this procedure is to provide a guideline for the measurement of the depth to groundwater in monitoring wells, where a second phase of floating liquid (e.g., gasoline) is not encountered. This SOP includes guidelines for discrete measurements of static water levels.

II. Equipment and Materials

A. Discrete Measurements of Static Water Level

- Electronic water level meter, Solinst or equivalent, with a minimum 100-foot tape; cable should have graduations in increments of 0.1 feet or less
- Engineering rule graduated in 0.01-foot increments

III. Procedures and Guidelines

A. Measurement Of Static Water Level

Verify that the unit is turned on and functioning properly. Slowly lower the probe on its cable into the well until the probe just contacts the water surface; the unit will respond with a tone or light signal. Sight across the top of the locking well casing adjacent to the measuring point, recording the position of the cable when the probe is at the water surface. The measuring point will be a standardized surveyed location on the top of each well casing, adjacent to the lock hasp, indicated by a notch, paint mark, or similar method. Measure the distance from this point to the next lower interval marker on the cable, and record the water level reading in the log book.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

A. Discrete Measurements of Static Water Level

Prior to each use, verify that the battery is charged by pressing the test button on the water-level meter. Verify that the unit is operating correctly by testing the probe in distilled or deionized water. Leave the unit turned off when not in use.

STANDARD OPERATING PROCEDURE

Field Measurement of Dissolved Oxygen

I. Purpose

To provide general guidelines for the calibration and use of the Dissolved Oxygen (DO) meter.

II. Scope

This is a general guideline for the field use of a DO meter. For specific instructions, refer to the operations manual.

III. Equipment and Materials

- Operations manual
- A DO probe and readout/control unit with batteries
- Electrolyte solution (KCl dissolved in deionized water) and probe membrane

IV. Procedures and Guidelines

A. Calibration

Calibrate prior to initial daily use before any readings are taken. Clean probe according to manufacturer's recommendations.

1. Prepare DO probe according to manufacturer's recommended procedures using electrolyte solution.
2. In the off position, set the pointer to zero using the screw in the center of the meter panel.
3. Turn function switch to red line and adjust using red line knob until the meter needle aligns with red mark at the 31 degrees C position.
4. Turn function switch to zero and adjust to zero using the zero control knob.
5. Attach prepared probe and adjust retaining ring finger tight.
6. Allow 15 minutes for optimum probe stabilization (when meter is off or during disconnection of the probe).
7. Place probe in hollow stopper that is supplied for use with the YSI Calibration Chamber.

8. Place approximately 1/2 inch of deionized water into a 4-ounce, wide mouth screw cap bottle. Keep this bottle capped and with the DO meter.

9. Just before use, shake the bottle to saturate the water with air.

10. Remove cap, place probe in bottle keeping an air-tight seal around the rubber stopper. Swirl water around in the bottle while waiting for conditions to reach equilibrium.

11. Shield chamber from sun and wind to avoid temperature fluctuations during calibration.

12. Turn function switch to temperature and record temperature reading. Determine calibration factor for that temperature and altitude correction factor from tables supplied by manufacturer.

13. Multiply the calibration factor by the correction factor to get a corrected calibration value.

14. Turn function switch to appropriate ppm range and adjust the calibrate knob until the meter reads the corrected calibration value. Wait two minutes to verify calibration value. Re-adjust as necessary.

B. Procedure

Before going out into the field:

a) Check batteries
b) Obtain fresh electrolyte solution
c) Prepare DO probe

1. Calibrate meter using calibration procedure.

2. Place probe in water to be measured. The probe should be moved through the water at 1 ft/sec or use a probe with a built-in stirrer.

3. Allow sufficient time for probe to stabilize to water temperature and DO. Record DO meter reading.

V. Attachments

DO Meter Calibration Sheet.

VI. Key Checks and Items

- Battery check
- Calibration

VII. Preventive Maintenance

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

DO METER
CALIBRATION SHEET

Date	Time	Analyst's Signature	Temp (C)	Alt. (ft)	Predict (ppm O_2)	Actual (ppm O_2)	Comment

STANDARD OPERATING PROCEDURE

Groundwater Sampling from Monitoring Wells

I. Purpose and Scope

This procedure presents guidelines for the collection of groundwater samples from monitoring wells.

II. Equipment and Materials

- Probe box; box with inlet/outlet ports for purged groundwater and watertight ports for each probe
- pH meter; Orion Model SA250 or equivalent
- Temperature/conductivity meter; YSI Model 33 or equivalent
- In-line disposable 0.45μ filters; QED FF8100 or equivalent
- Grundfos® Redi-Flo2 Pump
- Peristaltic Pump with Tubing (capable of yielding 2 gpm)
- Submersible Pump

III. Procedures and Guidelines

A. Setup and Purging

1. For the well to be sampled, information is obtained on well location, diameter(s), depth, and screened interval(s), and the method for disposal of purged water.
2. A pump will be used for well purging. The expected mechanism is a submersible pump with dedicated purge pipe for each well.
3. Instruments are calibrated according to manufacturer's instructions.
4. The well number, site, date, and condition are recorded in the field logbook.
5. Plastic sheeting is placed on the ground, and the well is unlocked and opened.
6. Water level measurements are collected in accordance with SOP Water Level Measurements, and the total depth of the well is measured.

7. The volume in gallons of water in the well casing or sections of telescoping well casing is calculated as follows:

   $0.052\ (\pi r^2 h) = 0.163\ (r^2 h) = \text{gallons}$

   where: $\pi = 3.14$

   r = Radius of the well pipe in inches
   h = height of water in well in feet

   The volume of water in typical well casings may be calculated as follows:

   2-inch diameter well:
   0.163 gal/ft x ___ (linear feet of water) = gallons

   4-inch diameter well:
   0.653 gal/ft x ___ (linear feet of water) = gallons

   6-inch diameter well:
   1.469 gal/ft x ___ (linear feet of water) = gallons

   The initial field parameters of pH, specific conductance, and temperature of water are measured and recorded in the field logbook. The measurement probes are inserted into the probe box. The purged groundwater is directed throughout the box, allowing measurements to be collected before the water contacts the atmosphere.

8. Sampling equipment is cleaned and decontaminated prior to sampling in accordance with SOP Decontamination of Personnel and Equipment.

9. If a bailer is being used, it is removed from either its protective covering or the well casing and attached to a cord compatible with constituents and long enough to reach the bottom of the well. If a bladder pump is being used, air, sample, and lifting lines are attached to the pump. The lifting lines should bear the weight of the pump; the air and sample lines are attached to the lifting lines at 10-foot intervals. If the well is purged using dedicated tubing, it is lowered into the well to the top of the screened zone.

10. The sampling device is lowered to the well interval from which the sample is to be collected. If a bailer is being used, it is allowed to fill with a minimum of surface disturbance to prevent sample water aeration. When the bailer is raised, the bailer cord must not touch the ground.

11. During purging, the field parameters are measured at least once during each well volume.

In productive wells, the well purging end point is determined using the field measurements. In nonproductive wells, the well is

repeatedly bailed dry to obtain a minimum of three well volumes, and allowed to recover before sampling.

12. Three to five well volumes are purged (more may be purged if parameters do not stabilize). Purging is stopped when field parameters have stabilized over two consecutive well volumes. Field parameters are considered stabilized when pH measurements agree within 0.5 units, temperature measurements agree within 1°C, and specific conductance measurements agree within 10 percent (e.g., 100 units for readings of 1,000 µmhos/cm).

B. Sample Collection

Once purging has been completed, the well is ready to be sampled. The elapsed time between completion of purging and collection of the groundwater sample from the well should be minimized. Typically, the sample is collected immediately after the well has been purged, but this is also dependent on well recovery.

Samples will be placed in bottles that are appropriate to the respective analysis and that have been cleaned to laboratory standards. Each bottle typically will have been previously prepared with the appropriate preservative, if any.

The following information, at a minimum, will be recorded in the log book:

1. Sample identification (site name, location, and project number; sample name/number and location; sample type and matrix; time and date; sampler's identity)
2. Sample source and source description
3. Field observations and measurements (appearance, volatile screening, field chemistry, sampling method), volume of water purged prior to sampling, number of well volumes purged, and field parameter measurements
4. Sample disposition (preservatives added; laboratory sent to, date and time sent; laboratory sample number, chain-of-custody number, sample bottle lot number)
5. Additional remarks

The steps to be followed for sample collection are as follows:

1. The cap is removed from the sample bottle, and the bottle is tilted slightly.
2. The sample is slowly discharged from the pump so that it runs down the inside of the sample bottle with a minimum of splashing. Samples may be field filtered before transfer to the sample bottle. Filtration must occur in the field immediately upon collection. Inorganics, including metals, are to be collected and preserved in the filtered form as well as the unfiltered form. The recommended

method is through the use of a disposable in-line filtration module (0.45 micron filter) using the pressure provided by the pumping device for its operation. When a bailer is used, filtration may be driven by a peristaltic pump.

3. Adequate space is left in the bottle to allow for expansion, except for VOC vials, which are filled to overflowing and capped.

4. The bottle is capped, then labeled clearly and carefully.

5. Samples are placed in appropriate containers and, if necessary, packed with ice in coolers as soon as practical.

6. If the sampler is dedicated, it is returned to the well and the well is capped and locked. Nondedicated samplers are cleaned and decontaminated in accordance with SOP Decontamination of Personnel and Equipment.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

Maintain field equipment in accordance with the manufacturer's recommendations; this will include, but is not limited to:

- Inspect sampling pump regularly and replace as warranted
- Inspect tubing regularly and replace as warranted
- Inspect air/sample line quick-connects regularly and replace as warranted
- Verify battery charge, calibration, and proper working order of field measurement equipment prior to initial mobilization and daily during field efforts

STANDARD OPERATING PROCEDURE

Field Measurement of pH

I. Purpose

To provide a general guideline for field measurement of pH.

II. Scope

Standard field pH determination techniques for use on groundwater samples.

III. Equipment and Materials

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

IV. Procedures and Guidelines

A. Calibration

Calibrate unit prior to initial daily use and at least once every 4 hours or every five samples, whichever is less. Calibrate with at least two solutions. Clean probe according to manufacturer's recommendations. Duplicate samples should be run once every 10 samples or every 4 hours.

1. Place electrode in pH 7 buffer solution.
2. Allow meter to stabilize and then turn calibration dial until a reading of 7.0 is obtained.
3. Rinse electrode with deionized water and place it in a pH 4 or pH 10 buffer solution.
4. Allow meter to stabilize again and then turn slope adjustment dial until a reading of 4.0 is obtained for the pH 4 buffer solution or 10.0 for the pH 10 buffer solution.

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

B. Procedure

1. Before going out into the field:

   a) Check batteries.
   b) Do a quick calibration at pH 7 and 4 to check electrode.
   c) Obtain fresh solutions.

2. Calibrate meter using calibration procedure.

3. Pour the sample into a clean beaker.

4. Rinse electrode with deionized water between samples.

5. Immerse electrode in solution. Make sure the white KCl junction on the side of the electrode is in the solution. The level of electrode solution should be one inch above sample to be measured.

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

C. General

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

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

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

4. Following field measurements:

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

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

V. Key Checks and Items

- Check batteries
- Calibrate

VI. Preventive Maintenance

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

STANDARD OPERATING PROCEDURE

Field Measurement of Specific Conductance and Temperature

I. Purpose and Scope

The purpose of this procedure is to provide a general guideline for field measurement of specific conductivity and temperature of groundwater samples.

II. Equipment and Materials

- Conductivity meter and electrode
- Distilled water in squirt bottle
- Standard potassium chloride (KCl) solution (0.01 N)

III. Procedures and Guidelines

A. **Technical:** Detection limit = 1 umho/cm @ 25°C; range = 0.1 to 100,000 umho/cm

B. **Calibration:** Calibrate prior to initial daily use with standard solution. The standards should have different orders of conductance. Clean probe according to manufacturer's recommendations. Duplicates should be run once every 10 samples. Calibration procedure:

1. With mode switch in OFF position, check meter zero. If not zeroed, set with zero adjust.
2. Plug probe into jack on side of meter.
3. Turn mode switch to red line and turn red line knob until needle aligns with red line on dial. If they cannot be aligned, change the batteries.
4. Immerse probe in 0.01 N standard KCl solution. Do not allow the probe to touch the sample container.
5. Set the mode control to TEMPERATURE. Record the temperature on the bottom scale of the meter in degrees C.
6. Turn the mode switch to appropriate conductivity scale (i.e., x100, x10, or x1). Use a scale that will give a midrange output on the meter.
7. Wait for the needle to stabilize. Multiply reading by scale setting and record the conductivity.

8. If the conductivity meter does not perform an automatic temperature adjustment, the conductivity may be adjusted to 25°C using the formula:

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

Where:

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

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

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

9. Rinse the probe with deionized water.

C. **Sample Measurement:** Pour the sample into a small beaker and place the probe in the sample. Note and record the reading. Rinse the probe with deionized water when done.

IV. Attachments

- Conductivity meter calibration sheet

V. Key Checks and Preventative Maintenance

- Check battery.
- Calibrate meter.
- Clean probe with deionized water when done.
- When reading results, note sensitivity settings.
- Refer to operations manual for recommended maintenance.
- Check batteries, and have a replacement set on hand.

CONDUCTIVITY METER CALIBRATION SHEET

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

STANDARD OPERATING PROCEDURE

VOC Sampling—Water

I. Purpose and Scope

To provide general guidelines for sampling aqueous volatile organic compounds.

II. Scope

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

III. Equipment and Materials

- Sample vials, clean latex or surgical gloves, pH meter
- Hydrochloric acid (HCl) for preservation
- pH meter or pH indicating paper
- Surgical or latex gloves

IV. Procedures and Guidelines

1. Sample VOCs before sampling other analyte groups.
2. When sampling for VOCs, especially residential wells, evaluate the area around the sampling point for possible sources of air contamination by VOCs. Products that may give off VOCs and possibly contaminate a sample include perfumes and cosmetics, skin applied pharmaceuticals, automotive products (gasoline, starting fluid, windshield deicers, carburetor cleaners, etc.) and household paint products (paint strippers, thinners, turpentine, etc.).
3. VOC sample vials will be pre-preserved with 0.5 ml HCl. To confirm that sufficient HCl has been added, the pH of a test sample will be checked. Sample pH must be less than 2. A small quantity of HCl will be available on site for the case where additional acid is required to preserve the sample.
4. Keep the caps off the sample vials for as short a time as possible.
5. Wear clean latex or surgical gloves.
6. Fill the sample vial immediately, allowing the water stream to strike the inner wall of the vial to minimize formation of air bubbles. DO NOT RINSE THE SAMPLE VIALS BEFORE FILLING.

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

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

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

V. Attachments

None.

VI. Key Checks and Items

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

STANDARD OPERATING PROCEDURE

Field Filtering

I. Purpose

To provide a general guideline for the field filtering of water samples for dissolved metals analysis.

II. Scope

Standard method of field filtering techniques.

III. Equipment and Materials

- One unpreserved sample transfer bottle plus one preserved sample shipment bottle for each sample
- Geotech filtering apparatus
- Pump
- Nitric acid (HNO_3) solution - high grade - reagent grade not acceptable
- Glass fiber prefilters
- Vacuum source
- 45 µ cellulose acetate filters
- Online filters

IV. Procedures and Guidelines

A. Reagent Preparation

1. 10% HNO3 solution: Add about 900 ml of DI water to a 1 liter Erlenmeyer flask. Using a graduated cylinder, add 100 ml concentrated HNO3 to the DI water while stirring.

B. Procedure

1. Attach a vacuum source (pump, syringe, etc.) or a Q.E.D. online filter to the receiver assembly.
2. Flush the entire filter system with 10% HNO3 solution. Open assembly, discard rinsate, and reassemble unit.

3. Flush the entire filter system with DI water. Open assembly, discard rinsate and reassemble unit (not required when using Q.E.D. online filter).
4. Filter sample and transfer to polyethylene bottle (with preservative) for shipment.
5. Discard filter assembly and prefilter.

V. Attachments

None.

VI. Key Checks and Items

- 10% HNO3 solution for cleaning
- All water must be deionized
- Prefilter with glass fiber filters if sample is turbid
- Record lot number of nitric acid and deionized water
- Wear gloves
- Note monitoring wells with high concentrations of suspended solids in field notebooks
- There is a separate equipment blank for dissolved metals called a filtration blank. Collect using the same procedure as SOP Field Rinse Blank Preparation except collect through the same type filter as that used for dissolved metals.

STANDARD OPERATING PROCEDURE

Field Rinse Blank Preparation

I. Purpose

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

II. Scope

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

III. Equipment and Materials

- Blank liquid (use ASTM Type II grade water)
- Sample bottles as appropriate
- Gloves
- Preservatives as appropriate

IV. Procedures and Guidelines

A. Decontaminate all sampling equipment that has come in contact with sample according to SOP Decontamination of Personnel and Equipment.

B. To collect the sample for volatiles analysis, pour blank water over one piece of equipment and into two 40-ml vials until there is a positive meniscus and seal vials. Note the sample number and associated piece of equipment in the field notebook.

For non-volatiles, one aliquot is to be used for equipment. For example, if a pan and trowel are used, place trowel in pan and pour blank fluid in pan such that pan and trowel surfaces which contacted the sample are contacted by the blank fluid. Pour blank fluid from pan into appropriate sample bottles.

Do not let the blank fluid come in contact with any equipment that has not been decontaminated.

C. Document and ship samples in accordance with the procedures for other samples.

D. Collect next field sample.

V. Attachments

None.

VI. Key Checks and Items

- Wear gloves.
- Do not use any non-decontaminated equipment to prepare blank.
- Use ASTM-Type II grade water.

STANDARD OPERATING PROCEDURE

Decontamination of Personnel and Equipment

I. Purpose

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

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

- Deionized ("DI") water or distilled water
- Potable water (must be from a municipal water supplier, otherwise a priority pollutant +40 analysis must be run)
- 2.5% (W/W) trisodium phosphate ("TSP") and water solution
- Concentrated (V/V) pesticide grade methanol or hexane (DO NOT USE ACETONE)
- 10% (V/V) nitric acid (HNO3) and water solution (only ultrapure grade HNO3 is to be used)
- Large plastic pails or tubs for TSP and water, scrub brushes, squirt bottles for TSP, methanol and water, plastic bags and sheets
- DOT approved 55-gallon drum for disposal of waste
- Phthalate-free gloves
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

IV. Procedures and Guidelines

A. Personnel Decontamination

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

1. Wash boots in TSP solution, then rinse with water. If disposable latex booties are worn over boots in the work area, rinse with TSP solution, remove, and discard into DOT approved 55-gallon drum. If booties are ripped, decontaminate work boots with TSP solution and water.
2. Wash outer gloves in TSP solution, rinse, remove, and discard into DOT approved 55-gallon drum.
3. Remove disposable coveralls ("Tyveks") and discard into approved 55-gallon drum. If Tyvek is ripped, inspect clothing under Tyvek for contamination. Remove contaminated clothing and wash at the end of the day.
4. Remove respirator (if worn).
5. Remove inner gloves and discard.
6. At the end of the work day, shower entire body, including hair, either at the work site or at home.
7. Sanitize respirator if worn.

B. Sampling Equipment Decontamination

Reusable non-dedicated sampling equipment is decontaminated after each use as follows.

1. Don phthalate-free gloves.
2. Rinse and scrub contaminated equipment with potable water.
3. Wash all equipment surfaces that contacted the potentially contaminated soil/water with TSP solution. Wash inside and outside of bailers.
4. Rinse with potable water.
5. Rinse with 10% HNO3 solution when sampling for inorganics (carbon split spoons will be rinsed with a 1% solution).
6. Rinse with distilled or potable water and methanol or hexane solution (DO NOT USE ACETONE).
7. Rinse with deionized water.
8. Completely air dry and wrap exposed areas with aluminum foil (shiny side out) for transport and handling if equipment will not be used immediately.
9. Collect all rinsate and dispose of in a DOT approved 55-gallon drum.

C. Health and Safety Monitoring Equipment Decontamination

Note that disposable sampling equipment such as in-line filters or tubing do not need to be decontaminated. Also, equipment dedicated to a single sampling location does not require decontamination.

1. Before use, wrap soil contact points in plastic to reduce need for subsequent cleaning.

2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with TSP solution, then a towel wet with methanol solution, and finally three times with a towel wet with distilled water. Dispose of all used paper towels in a DOT approved 55-gallon drum.

D. Sample Container Decontamination

The outsides of sample bottles or containers filled in the field must be decontaminated before being packed for shipment or handled by personnel without hand protection.

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

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

E. Heavy Equipment And Tools

Heavy equipment such as drilling rigs, drilling rods/tools, and the backhoe will be decontaminated upon arrival at the site and between locations as follows:

1. Set up a decontamination pad in area designated by the Navy

2. Steam clean heavy equipment until no visible signs of dirt are observed. This may require wire or stiff brushes to dislodge dirt from some areas.

V. Attachments

None.

VI. Key Checks and Items

- Clean with solutions of TSP, methanol (or isopropanol) and distilled water.
- Do not use acetone for decontamination.
- Drum all contaminated rinsate and materials.
- Decontaminate filled sample bottles before relinquishing them to anyone.

WDCR1044/011.DOC

Final

Health and Safety Plan for Groundwater Monitoring at Sites 5, 9, 10, and 11

Naval Amphibious Base Little Creek
Virginia Beach, Virginia

Contract Task Order 024

November 19, 1996

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

Under the

LANTDIV CLEAN II Program
Contract N62470-95-D-6007

Prepared by

CH2M HILL

Herndon, Virginia

WDCR1043/018.DOC/7

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Attachment 1 Employee Signoff
Attachment 2 Material Safety Data Sheets

CH2M HILL 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, Program and Training Manual*, and CH2M HILL's *Site safety Notebook* as appropriate. The site safety coordinator (SSC) 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 **PROJECT NO:** 136750.PP.PP

CH2M HILL PROJECT MANAGER: Scott MacEwen, P.E. **OFFICE:** WDC

SITE NAME: Naval Amphibious Base Little Creek

SITE ADDRESS: Virginia Beach, Virginia

DATE HEALTH AND SAFETY PLAN PREPARED: September 19, 1996

DATE(S) OF INITIAL VISIT: October, 1996

DATE(S) OF SITE WORK: October, 1996 - October, 2000

SITE ACCESS: All sites are accessed through Gate 5.

SITE DESCRIPTION AND HISTORY:

Figure 1-1 is a site map.

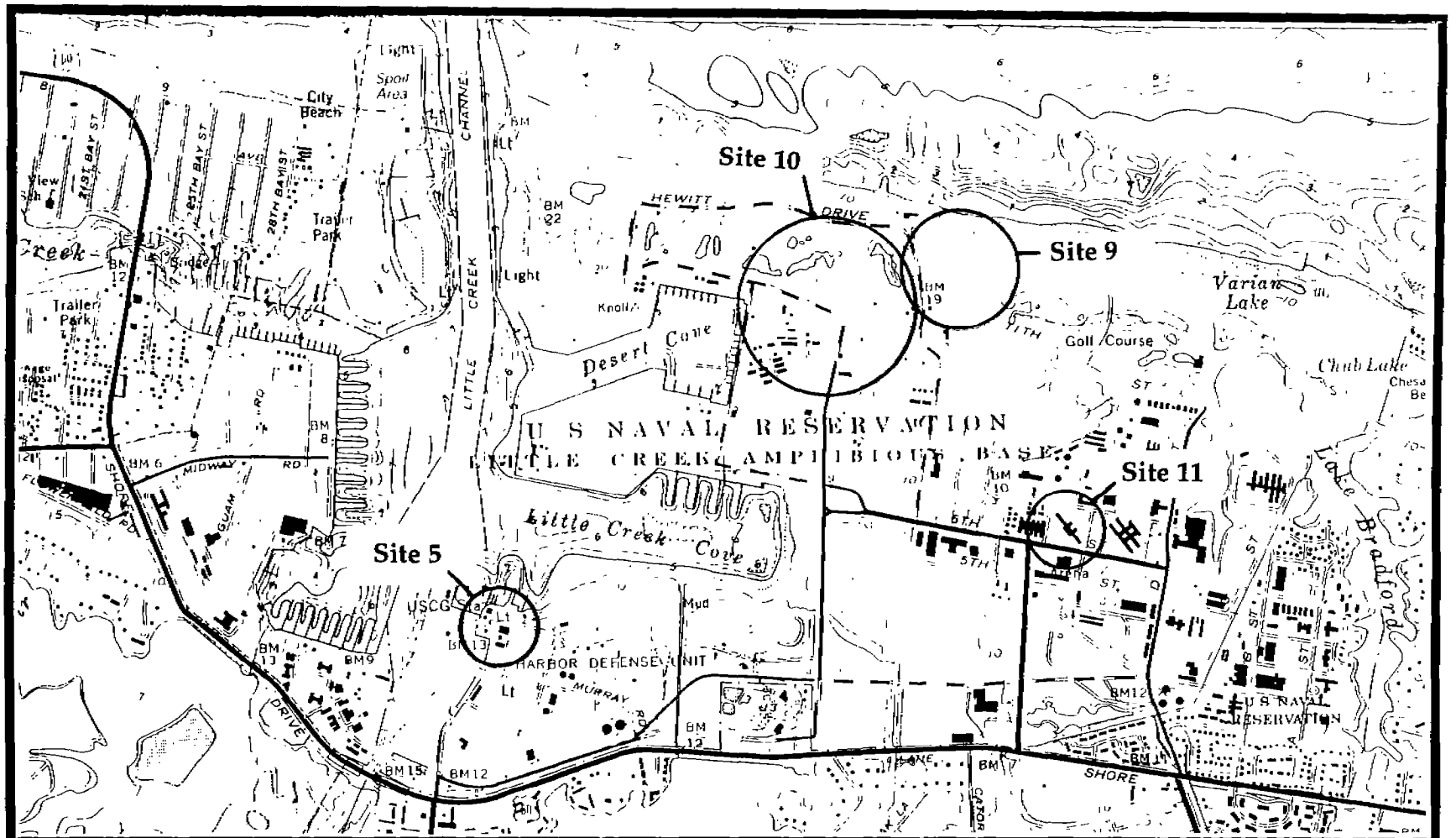
NAB Little Creek, located in Virginia Beach, Virginia, provides logistic facilities and support services for local commands, organizations, homeported ships, etc., to meet the amphibious warfare training requirements for the Armed Forces of the United States. In 1993 an RI/FS and SI were performed at NAB Little Creek. Six RI sites and two SI sites were investigated at the facility and evaluated with regard to contamination characteristics, migration pathways, and pollutant receptors. Although none of these sites were found to pose an immediate threat to human health or the environment, four sites were recommended for monitoring of groundwater quality. Three sites were recommended for further investigation, and one site was recommended for a removal action.

The four sites recommended for monitoring of groundwater quality are listed below. The monitoring activities at these four sites is addressed by this HSP.

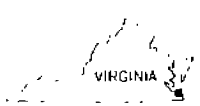
- Site 5 - Buildings 9 - 11 Motor Oil Disposal Area - motor oil, antifreeze, and various solvents reportedly spilled in this area.
- Site 9 - Driving Range Landfill - reportedly used for disposal of incinerator ash and municipal and industrial wastes, possibly containing pesticides, paints, solvents, inorganic, heavy metals, acids, bases, PCBs, and other unknown materials
- Site 10 - Sewage Treatment Plant Landfill - reportedly used for disposal of sewage sludge and household and industrial wastes, possibly containing hazardous constituents
- Site 11 - School of Music Plating Shop - small quantities of silver cyanide, copper cyanide, chromic acid, nickel plating baths, various acids, lacquer strippers, and lacquer were reportedly disposed in the shop sinks and eventually into the storm sewer during the period of operation of the plating shop (1964-1974).

NAB Little Creek is on more than 2,100 acres of land in the northwest corner of Virginia Beach, Virginia. The facility is bounded on the north by the Chesapeake Bay, on the south and east by the City of Virginia Beach, and on the west by the city of Norfolk. The topography of NAB Little Creek is nearly level. Surface elevations at the site range from sea level to 15 feet.

The Virginia Beach/Norfolk region has a maritime climate that is characterized by long, temperate summers and mild winters. The average annual temperature is 60.7° Fahrenheit (F). July is the warmest month, temperatures averaging 78.7°F; January is the coolest month, temperatures averaging 43.1°F. Freezing temperatures are infrequent in the region. Precipitation averages 43 inches annually and is distributed evenly over the year. Precipitation increases slightly from June to August because of the prevalence of convective thunderstorms. The average annual snowfall is 8.8 inches. Winds are generally in easterly and moderate, ranging from 6 to 11 knots.

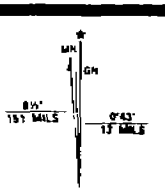


LITTLE CREEK AMPHIBIOUS BASE
VIRGINIA BEACH, VIRGINIA
SITE LOCATION MAP



QUADRANGLE LOCATION

Little Creek, VA Quadrangle
7.5 Minute Series (Topographic)



UTM GRID AND 1986 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Prepared by:
Foster Wheeler Environmental Services

Figure 1-1
Scale: 1" = 2000'

2 PROJECT ORGANIZATION AND TASKS TO BE PERFORMED UNDER THIS PLAN

2.1 PROJECT ORGANIZATION

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

CH2M HILL:
Project Manager: Scott MacEwen, P.E.
Field Team Leader: Don Martinson
Refer to Section 4 for field staff.

CONTRACTORS and SUBCONTRACTORS: IDW Subcontractor TBD.

2.2 DESCRIPTION OF TASKS (Reference Section 1, "Field Activity Start-up Form," of *Site Safety Notebook*

Refer to project documents (i.e., work plan) for detailed task information. A health and safety risk analysis has been performed for each task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection. Tasks in addition to those listed below require an approved amendment to this plan 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).

2.2.1 HAZWOPER-REGULATED TASKS

- Groundwater sampling
- Investigation-derived waste (drum) sampling and disposal
- Observation of loading of material for offsite disposal

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.**

TASK	RESTRICTIVE CONDITIONS
• Electrical installation	
• Iron work (installing rebar)	
• Masonry work	
• General heavy equipment work (excavation, grading, etc.)	
• Mechanical installations (equipment, pumps, etc.)	
• Engineering testing/evaluation	
• Building construction	

3 HAZARD EVALUATION AND CONTROL

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, 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 *Corporate Health and Safety Program, Program and Training Manual,* 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

No utility location is required for this groundwater monitoring effort because only existing monitoring wells will be sampled.

3.3 GENERAL PHYSICAL (SAFETY) HAZARDS AND CONTROLS

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**	**Groundwater Monitoring of Wells**	**IDW Drum Sampling and Disposal[a]**	**Observation of Loading of Material for Offsite Disposal**
Flying debris/objects (HS-07)	Provide shielding and PPE; maintain distance.		X	X
Noise > 85 dBA	Noise protection and monitoring required.			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		
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		
Suspended loads	Work not permitted under suspended loads.			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
Back injury (HS-29)	Use proper lifting techniques, or provide mechanical lifting aids.	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		
Protruding objects	Flag visible objects.	X	X	X
Visible lightning	Stop work.	X	X	X
Vehicle traffic (HS-24)	Provide temporary traffic controls, including trained flaggers and lookouts. Implement traffic control program when required.			X

3.3 GENERAL PHYSICAL (SAFETY) HAZARDS AND CONTROLS

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**	**Groundwater Monitoring of Wells**	**IDW Drum Sampling and Disposal[a]**	**Observation of Loading of Material for Offsite Disposal**
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	
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
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

3.3 GENERAL PHYSICAL (SAFETY) HAZARDS AND CONTROLS

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**	**Groundwater Monitoring of Wells**	**IDW Drum Sampling and Disposal[a]**	**Observation of Loading of Material for Offsite Disposal**
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. • 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.		X	

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 SSC 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.

Other Potential Biological Hazards:

None known

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 *Corporate Health and Safety Program, Program and Training Manual,* and *Corporate Health and Safety Program, Radiation Protection Program Manual,* for standards of practice for operating in contaminated areas.

Hazards	Controls
None Known	None Required

3.7 HAZARDS POSED BY CHEMICALS BROUGHT ON THE SITE

3.7.1 HAZARD COMMUNICATION

(Reference CH2M HILL *Hazard Communication Manual* and Section 5 of the *Site Safety Notebook*)

CH2M HILL's *Hazard Communication Program Manual,* which is available from area or regional offices and from the Corporate Human Resources Department in Denver. 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 SSC 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 Attachment 2 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
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 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.

3.8 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)
Acenaphthalene	Site 9 - 1.3 ppb	NL	NL	Skin and mucous membrane irritation	UK
Cadmium	Site 9 - UK	0.2 mg/m3	50 mg/m3	Inh: Pulm edema, dysp; Ing: cough, chest tight, subs pain, head, chills, musc aches, nau, vomit, diarr, anos, emphy, prot, mild anemia, [carc]	N/A
Chloroform	Site 11 - 3.2 ppb	2 ppm	1,000 ppm	Inh: Dizz, mental dullness, nau, disorientation,; Ing: head, ftg, anes, hepatomegaly; Con: irrit eyes, skin, (carc)	11.42
Chromium	Site 10 - 10 ug/l Site 11 - UK	0.5 mg/m3	N/F	Ing: lungs Inh: histologic fibrosis of lungs	N/A
Copper	Site 9 - <30 ug/l	1 mg/m3	N/A	Inh: irrit nasal, musc memb; Ing: pharynx, nasal perforation; Con: eye irrit, metallic taste, derm, in animals: lung, liver, kidney damage, anemia	N/A
Cyanide	Site 11 - <5 ug/l	5 mg/m3	50 mg/m3	Inh: asphy and death can occur; Abs: weak, head, conf; nau, vomit; Ing: incr rat resp; slow gasping resp; Con: irrit eyes, skin	N/A
1,1-Dichloroethane	Site 5 - 76 ug/l Site 10 - 16 ug/l Site 11 - 17 ug/l	100 ppm	4,000 ppm	Inh: CNS depres, skin irrit; Ing: liver, kidney damage	11.06
1,2-Dichloroethane (Ethylene dichloride)	Site 11 - 37 ug/l	1 ppm	1,000 ppm (Ca)	Inh: CNS depress; Ing: nau, vomit; Abs: derm; Con: irrit eyes, corneal opacity; (carc)	11.05
1,1-Dichlorethylene	Site 11 - 34 ug/l	4 mg/m3			
trans-1,2-Dichlorethylene	Site 11 - 1.9 ug/l	200 ppm	4,000 ppm	Inh, Ing, Con: Irrit eyes, resp sys.; CNS depres	9.65
1,2-Dichloropropane (Propylene Dichloride)	Site 11 - 6.5 ug/l	75 ppm	2,000 ppm (Ca)	Inh: Eye irrit; drow, li-head; Con: irrit skin; (carc)	10.87
Lead	Site 5 - UK	0.100 mg/m3	700 mg/m3	Ing: pallor, pal eye, anor, Inh: weak, lass, insom, facial Con: low-wght, malnut, constip, abdom pain, colic anemia; gingival lead line; tremor; para wrist, ankles, encephalopathy, nephropathy; irrit eyes, hypotension	N/A
Manganese	Site 9 - UK	1 mg/m3	N.E.	Inh: Parkinson's, asthenia, Ing: insom, flume, fever, dry throat, cough, tight chest, dysp, rales, flu-like fever, low-back pain, vomit; mal; ftg	N/A
Silver	Site 9 - 9 ppb Site 10 - 3 ppb	0.01 mg/m3	N.E.	Inh: blue-gray eyes, nasal septum, throat, skin,; Ing: GI dist; Con: irrit skin, ulceration	N/A
1,1,1-Trichloroethane (Methyl chloroform)	Site 10 - 13 ug/l Site 11 - 340 ug/l	350 ppm	1000 ppm (Ca)	Inh: head, lass, CHS depress, poor equi; Con: irrit eyes, derm; Ing: card arrhy	11.00
Trichloroethylene	Site 11 - 490 ug/l	50 ppm	1,000 ppm (Ca)	Inh: head, verti; Con: vis dist, tremors, som, nau, vomit; Con: irrit eyes, derm, card arrhy, pares, (carc)	9.45

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)
TPH/Oil and Grease	Site 5 - UK Site 9 - 10,000 ug/l Site 10 - 9,000 ug/l	5 mg/m^3	2,500 mg/m^3	Irritation of the eyes, skin, and respiratory system	UK
Zinc (Zinc oxide dust)	Site 9 - 720 ppb Site 10 - 2,800 ppb	5 mg/m3	500 mg/m^3	Metallic taste; headache; blurred vision; low back pain; vomiting; fatigue; decreased pulmonary function	NA

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

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 SOP 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 "SSC" have received 8 hours of supervisor and instrument training and can serve as site safety coordinator (SSC) for the level of protection indicated. An SSC with a level designation (D, C, B) equal to or greater than the level of protection being used 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. 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	SSC/FA-CPR
Don Martinson	Reston, VA	Field Team Leader	FA-CPR, Level B SSC
Charissa Rigano	Reston, VA	Field Team Member	FA-CPR, Level D SSC
Brooke Bennett	Reston, VA	Field Team Member	FA-CPR, Level D SSC
Adam Locke	Reston, VA	Field Team Member	FA-CPR

4.2 FIELD TEAM CHAIN OF COMMAND AND COMMUNICATION PROCEDURES

4.2.1 CLIENT

Contact Name: Scott Park, NTR/LANTDIV
Phone: (757) 322-4788

Activity Representative: Kelly Greaser
Phone: (757)363-4571

4.2.2 CH2M HILL

Program manager:	Brint Bixler (703) 471-1441
Project Manager:	Scott MacEwen (703) 471-1441
Health and Safety Manager:	John Longo (201) 316-9300
Field Team Leader:	Don Martinson (703) 471-1441
Site Safety Coordinator:	Don Martinson (703) 471-1441

The SSC 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 SSC 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 Section 3, *Corporate Health and Safety Program Manual*)

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).

IDW Disposal Subcontractor: TBD

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 Section 3, *Corporate Health and Safety Program Manual*)

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: NA
Contact Name: NA
Telephone: NA

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 SSC 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 SOP HS-07, *Personal Protective Equipment*, HS-08, *Respiratory Protection*, Section 2 of the *Site Safety Notebook*)

5.1 PPE SPECIFICATIONS[a]

Task	Level	Body	Head	Respirator[b]
General work uniform when no chemical exposure is anticipated	D	Work clothes; steel-toe, steel-shank leather work boots; work gloves	Hardhat[c] Safety glasses Ear protection[d]	None required
Groundwater sampling. IDW Drum Sampling	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
None anticipated	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 GME-H[e] cartridges or equivalent
None anticipated	B	**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	Positive-pressure demand self-contained breathing apparatus (SCBA): MSA Ultralite, 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 SSC.
[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 GME-H cartridge is the new standard-issue cartridge. Available stock of the previously standard GMC-H cartridges may be used for tasks covered by 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 SSC who meets the requirements specified in subsection 4.1 is present.

6 AIR MONITORING SPECIFICATIONS (Reference CH2M HILL SOP HS-06, *Air Monitoring*, and Section 2 of the *Site Safety Notebook*)

Instrument	Tasks	Action Levels[a]		Frequency[b]	Calibration
FID: OVA model 128 or equivalent	None anticipated	ppm ppm ppm	Level D Level C Level B	Initially and periodically during task	Daily
PID: OVM with 11.7 eV lamp or equivalent	Groundwater sampling activities. IDW drum sampling	Bkmd -1 ppm 1- 5 ppm > 5 ppm	Level D Level C Level B	Initially and periodically during task	Daily
CGI: MSA model 260 or 261 or equivalent	Groundwater sampling activities. IDW drum sampling.	0-10%[c] LEL: 10-25%[c] LEL: >25%[c] LEL:	No explosion hazard Potential explosion hazard Explosion hazard; evacuate or vent	Continuous during advancement of boring or trench	Daily
O_2 Meter: MSA model 260 or 261 or equivalent	None anticipated	>25.0%[c] O_2: 20.9%[c] O_2: <19.5%[c] O_2:	Explosion hazard; evacuate or vent Normal O_2 O_2 deficient; vent or use SCBA	Continuous during advancement of boring or trench	Daily
Dust Monitor: Miniram model PDM-3 or equivalent	None anticipated	mg/m^3 mg/m^3	Level D Level C	Initially and periodically during task	Zero Daily
Detector Tube: Drager benzene specific 0.5/c (0.5 to 10 ppm range) with pretube, or equivalent	None anticipated	<0.5 ppm 0.5-1 ppm >1 ppm	Level D Level C Level B	Initially and periodically when PID/FID >1 ppm	Not Applicable
Colorimetric Tube: Drager vinyl chloride specific (0.5 to 30 ppm range) with pretube, or equivalent	None anticipated	<0.5 ppm 0.5 ppm	Level D Level B	Initially and periodically when PID/FID >1 ppm	Not Applicable
Radiation Meter[d]: Ludlum Model 3 with GM probe model 44-9, or equivalent	None anticipated	Background: >3x Background: >2 mR/Hr:	Continue work Consult RHM Establish REZ	Initially, periodically, and at end of task	Daily
Noise-Level Monitor[e]:	None anticipated	< 85 dB(A) 85 - 120 dB(A) 120 dB(A)	No action required Hearing protection required[e] Stop; re-evaluate	Initially and periodically during task	Daily

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 SSC; 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.

Note d: Refer to SOP HS-10 for instructions and documentation on radiation monitoring and screening.

Note e: Contact HSM. Noise monitoring, training, and audiometric testing also are required.

6.1 CALIBRATION SPECIFICATIONS

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

Instrument	Gas	Span	Reading	Method
PID: HNU, 10.2 eV probe	100 ppm isobutylene	9.8 ± 2.0	55 ppm	1.5 lpm reg T-tubing OR 0.25 lpm reg direct tubing
HNU, 11.7 eV probe		5.0 ± 2.0	68 ppm	
PID: OVM, 10.0 or 10.6 eV bulb	100 ppm isobutylene	RF = 0.55	55 ppm	1.5 lpm reg T-tubing
OVM, 11.8 eV bulb		RF = 0.68	68 ppm	
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: OVA-128	100 ppm methane	3.0 ± 1.5	100 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	Not applicable	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: Not applicable

Personnel and Areas

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

HSM: John Longo/NJO
Other:

7 DECONTAMINATION (REFERENCE CH2M HILL SOP HS-13. *DECONTAMINATION*)

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

7.1 DECONTAMINATION SPECIFICATIONS

Personnel

- 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:**

Dispose of PPE in accordance with IDWMP.

- **Water-disposal method:**

Dispose of decon water with purge water in accordance with IDWMP.

Sample Equipment

- Wash/rinse equipment
- Solvent-rinse equipment
- **Solvent-disposal method:**

Dispose of decontamination solvents with decon water and purge water in accordance with the IDWMP.

Heavy Equipment

- Power wash
- Steam clean
- **Water-disposal method:**

N/A

7.2 DIAGRAM OF PERSONNEL-DECONTAMINATION LINE

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SSC 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 SSC 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.

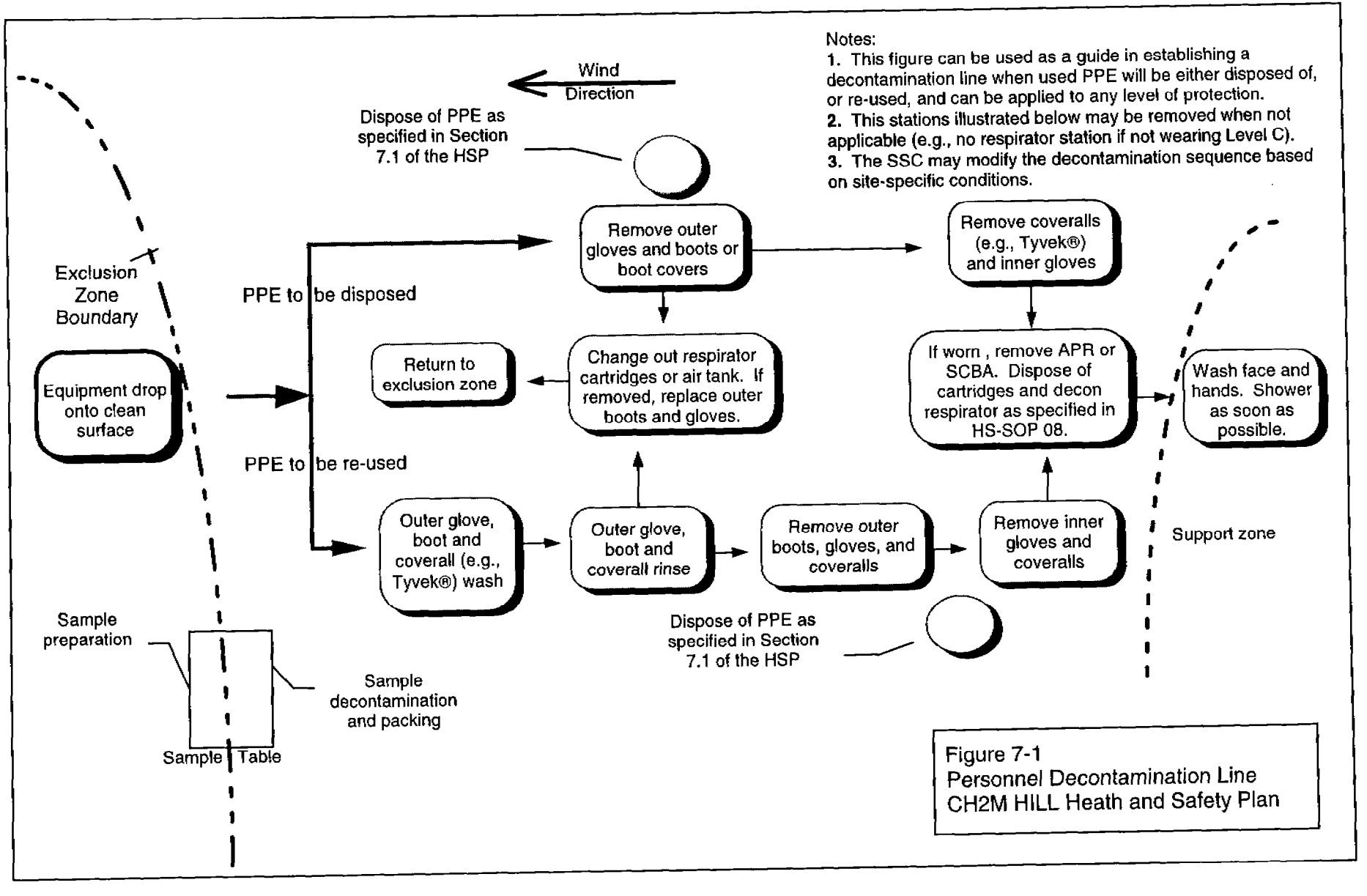


Figure 7-1
Personnel Decontamination Line
CH2M HILL Heath and Safety Plan

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 SSC 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

- The site safety coordinator (SSC) 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. Refer to Section 8 of *Site Safety Notebook*.
- The SSC 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 SSC in appropriate level of protection.
- The SSC is to conduct periodic inspections of work practices to determine the effectiveness of this plan -- refer to CH2M HILL SOP 18, *Health and Safety* Checklist, or Section 4 of *Site Safety Notebook*. Deficiencies are to be noted, reported to the HSM, and corrected.

10.2 HAZWOPER COMPLIANCE PLAN (Reference CH2M HILL SOP HS-17, *Health and Safety 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 2.2.1.
- 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 RESPONSE PLAN (REFERENCE CH2M HILL SOP HS-12, *EMERGENCY RESPONSE*)

11.1 PRE-EMERGENCY PLANNING

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

- Review 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 SSC will evaluate emergency response actions and initiate appropriate follow-up actions.

11.2 EMERGENCY EQUIPMENT AND SUPPLIES

The SSC should mark the locations of emergency equipment on the site map and 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
Eye wash	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 sections 12 and 13 (e.g., 911).
- During a time of no emergency, contact CH2M HILL's medical consultant for advice and guidance on medical treatment.
- The SSC 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 12, *Emergency Response and First Aid*, and Section 6 of *Site Safety Notebook*. 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 SSC 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 SSC 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 SSC accounts for all personnel in the onsite assembly zone.
- A person designated by the SSC before work begins will account for personnel at the offsite assembly area.
- The SSC 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 site map in Section 1. Evacuation routes and assembly areas (and alternative routes and assembly areas) are specified 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: No site-specific signals applicable

12 EMERGENCY RESPONSE

12.1 EMERGENCY RESPONSE TELEPHONE NUMBERS

SITE ADDRESS: NAB Little Creek Virginia Beach, Virginia	**Phone:** 757-363-4571 (Ms. Kelly Greaser) **Cellular Phone:**
Security: NAB Little Creek Response Operator	**Phone:** x4444 (on base); 757-363-4444 (off base)
Fire: NAB Little Creek Response Operator	**Phone:** x4444 (on base); 757-363-4444 (off base)
Ambulance: NAB Little Creek Response Operator	**Phone:** x4444 (on base); 757-363-4444(off base)
Public Works Department (Utility Clearances): N/A	**Phone:** N/A
Emergency: NAB Little Creek Response Operator	**Phone:** x4444 (on base); 757-363-4444(off base)

*When using a cellular phone outside the telephone's normal calling area, exercise caution in relying on the cellular phone to activate 911. When the caller is outside the normal calling area, the cellular service carrier should connect the caller with emergency services in the area where the call originated, but this may not occur. Telephone numbers of backup emergency services should be provided if a cellular phone is relied on to activate 911.

Hospital: Sentara Bayside Hospital **Address:** 800 Independence Avenue Virginia Beach, Virginia 23455	**Phone:** 757-363-6244 (Emergency) 757-363-6100 (Information) Note: To reach the hospital from base phones, dial "9" first.

Route to Hospital:

From Site 5:

1. Leave site, turn left. Proceed southeast on Murray Rd.
2. Turn left (east) onto Amphibious Drive.
3. Turn right (south) onto D street and proceed through Gate 5 to exit Base.
4. Continue through Gate 5 and head straight (south) on Independence Blvd.
5. Hospital is on the left side, approximately 5 miles south on Independence Blvd.

From Site 9:

1. Leave site, turn left. Proceed south on Hewitt Drive.
2. Turn left (east) onto Gator Blvd.
3. Turn right (south) onto D street and proceed through Gate 5 to exit Base.
4. Continue through Gate 5 and head straight (south) on Independence Blvd.
5. Hospital is on the left side, approximately 5 miles south on Independence Blvd.

From Site 10:

From west side of site

1. Leave site, turn left. Proceed south on Helicopter Rd.
2. Turn left (east) onto Amphibious Drive.
3. Turn right (south) onto D street and proceed through Gate 5 to exit Base.
4. Continue through Gate 5 and head straight (south) on Independence Blvd.
5. Hospital is on the left side, approximately 5 miles south on Independence Blvd.

From east side of site

1. Leave site, turn right. Proceed south on Hewitt Drive.
2. Turn left (east) onto Gator Blvd.
3. Turn right (south) onto D street and proceed through Gate 5 to exit Base.
4. Continue through Gate 5 and head straight (south) on Independence Blvd.
5. Hospital is on the left side, approximately 5 miles south on Independence Blvd.

From Site 11:

1. Leave site, turn right. Proceed south on E Street.
2. Turn left (east) onto Gator Blvd.
3. Turn right (south) onto D street and proceed through Gate 5 to exit Base.
4. Continue through Gate 5 and head straight (south) on Independence Blvd.
5. Hospital is on the left side, approximately 5 miles south on Independence Blvd.

(Refer to Figures 12-1 through 12-4)

12.2 GOVERNMENT AGENCIES INVOLVED IN PROJECT

Federal Agency and Contact Name: Department of the Navy, Atlantic Division
Phone: 757-322-4788 Mr. Scott Park, NTR

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

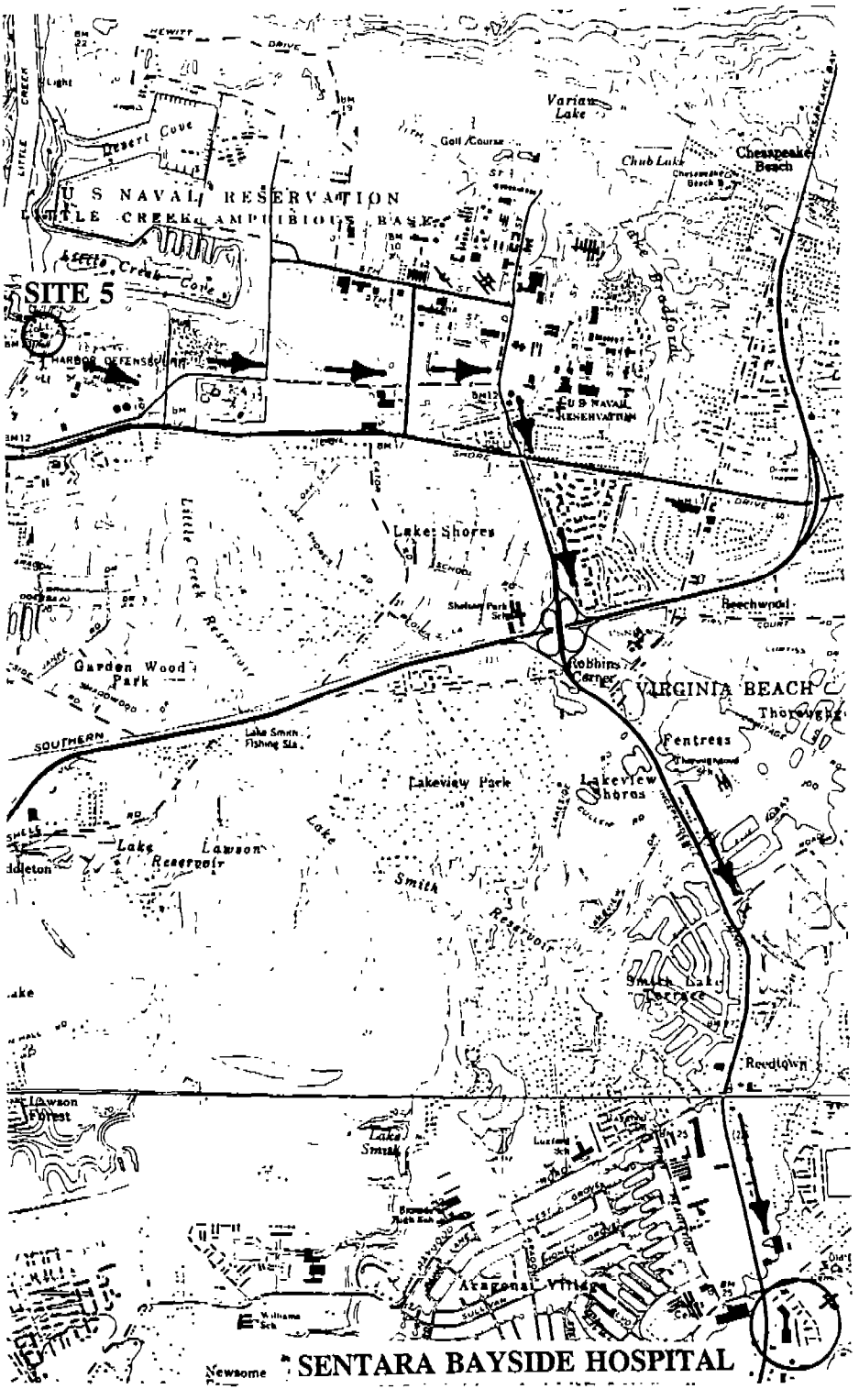


Figure 12-1

DIRECTIONS TO SENTARA BAYSIDE HOSPITAL FROM SITE 5
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

Little Creek, VA Quadrangle
7.5 Minute Series (Topographic)

Prepared by:
EWES

Date: May 1996

Scale: 1" = 2000'

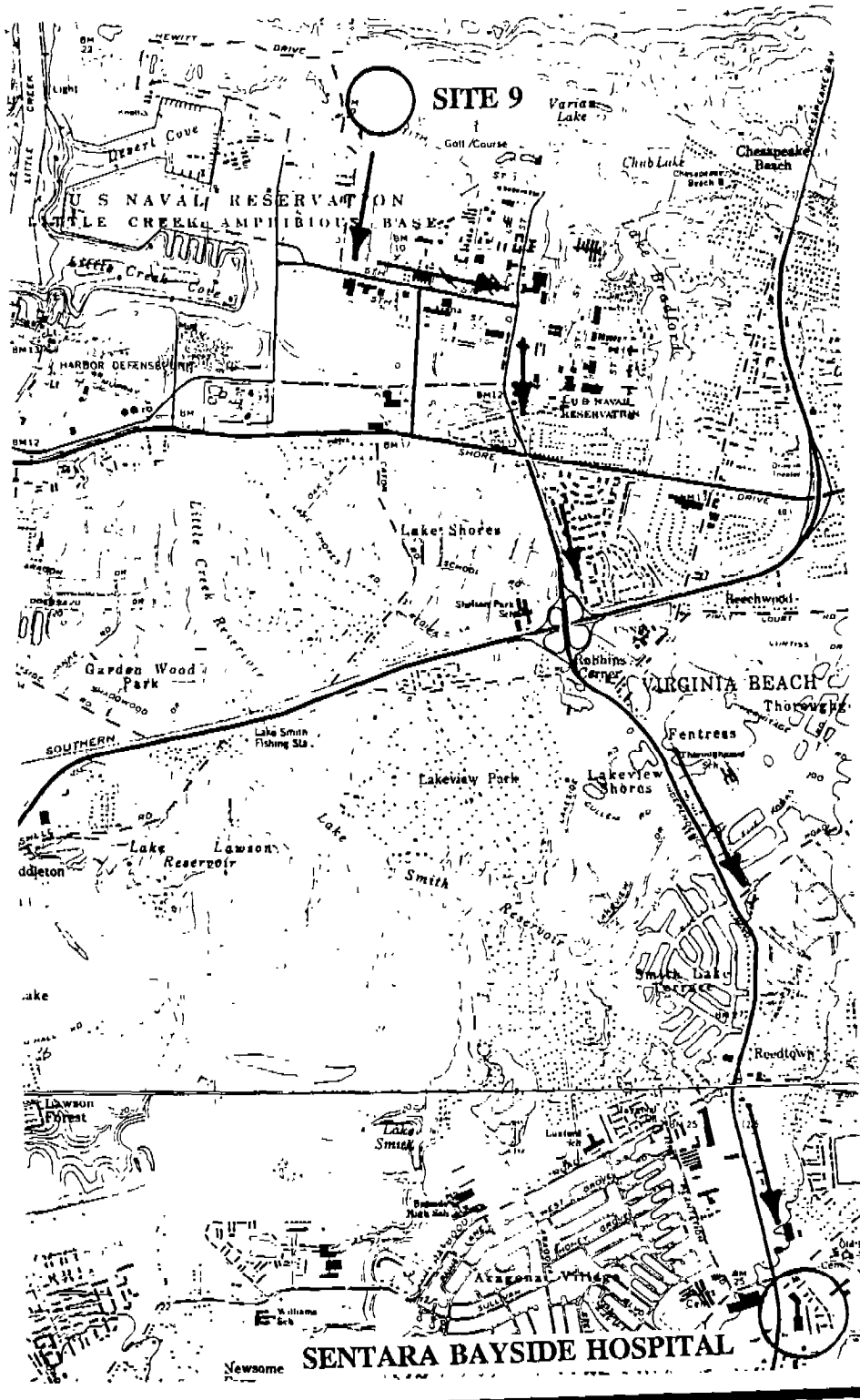


Figure 12-2

DIRECTIONS TO SENTARA BAYSIDE HOSPITAL FROM SITE 9
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

Little Creek, VA Quadrangle
7.5 Minute Series (Topographic)

Prepared by:
FWES

Date: May 1996

Scale: 1" =2000'

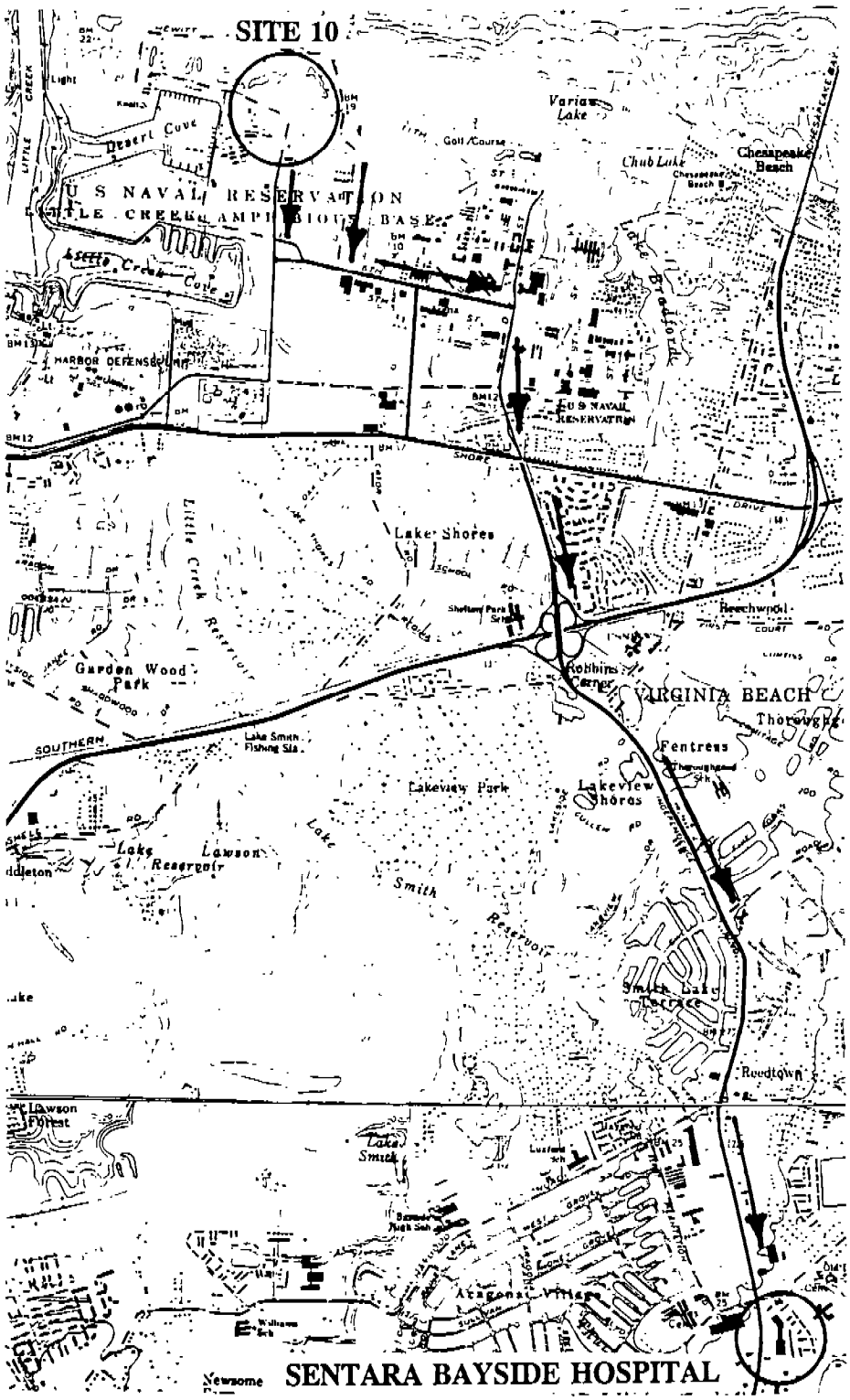


Figure 12-3

DIRECTIONS TO SENTARA BAYSIDE HOSPITAL FROM SITE 10
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

Little Creek, VA Quadrangle
7.5 Minute Series (Topographic)

Prepared by:
FWES

Date: May 1996

Scale: 1" = 2000'

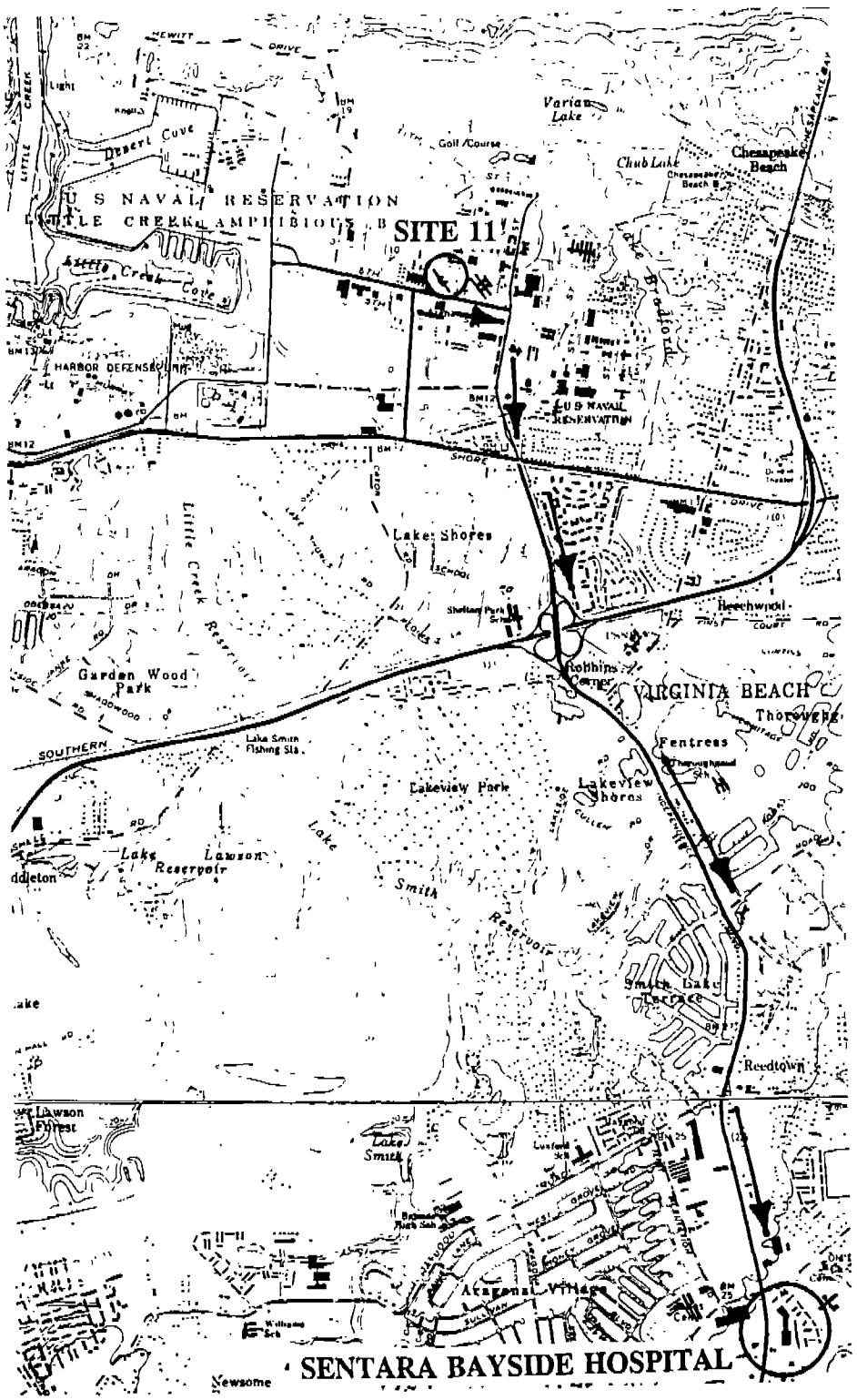


Figure 12-4

DIRECTIONS TO SENTARA BAYSIDE HOSPITAL FROM SITE 11
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA

Little Creek, VA Quadrangle
7.5 Minute Series (Topographic)

Prepared by:
FWES

Date: May 1996

Scale: 1" = 2000'

13 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.

CH2M HILL Medical Consultant

Dr. Elayne F. Theriault
Environmental Medical Resources, Inc.
Atlanta, Georgia
800/229-3674 OR 770/455-0818
(After-hours calls will be returned within 20 minutes.)

Occupational Physician (Regional or Local)

Dr. Laura Staton
46440 Benedict Drive, Suite 108
Sterling, Virginia 22170
(703) 444-5656

Corporate Director Health and Safety

Name: Mollie Netherland/SEA
Phone: 206/453-5005

Site Safety Coordinator (SSC)

Name: To be determined
Phone: (703) 471-1441

Medical and Training Administrator

Name: Susan Robinson/COR
Phone: 303/771-0900

Regional Manager

Name: Dick Bedard
Phone: (617) 723-9036

Health and Safety Manager (HSM)

Name: John Longo
Phone: (201) 316-9300

Project Manager

Name: Scott MacEwen
Phone: (703) 471-1441

Radiation Health Manager (RHM)

Name: Frank Petelka/ORO
Phone: 615/483-9032 (H)615/482-8667

Regional Human Resources Department

Name: Michelle Riley-Jones
Phone: (703) 471-1441

Client

Name: Scott Park, NTR/LANTDIV
Phone: (757) 322-4788

Name: Kelly Greaser/Litle Creek
Phone: (757) 363-4571

Corporate Human Resources Department

Name: Julie Zimmerman/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

GAB Business Services, Inc.
Phone: 800/747-7222 After hours 800/621-5410

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

14 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.

14.1 ORIGINAL PLAN

WRITTEN BY: Anne Estabrook **DATE:** 9/12/96

APPROVED BY: Lisa D. Martin **DATE:** 9-18-96

14.2 REVISIONS

REVISIONS MADE BY: **DATE:**

REVISIONS TO PLAN:

REVISIONS APPROVED BY: **DATE:**

15 DISTRIBUTION

Name	Office	Responsibility	Number of Copies
Jerri McCauslin	COR	Senior Program Assistant	1
John Longo	NJO	Health and Safety Manager/Approver	1
Scott MacEwen	WDC	Project Manager	1
_____	WDC	Site Safety Coordinator	1
Client	N/A	Client Project manager	1

16 ATTACHMENTS

Attachment 1: Employee Signoff
Attachment 2: Applicable Material Safety Data Sheets

09/18/96 09:35 FAX 714 429 2050 CH2M HILL SCO →→→ WDC 002/002

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
Material Safety Data Sheets

List of MSDS

Decontamination Fluids/Calibration Gases/Preservatives

Pentane

Hydrochloric Acid

Nitric Acid

Sulfuric Acid

Methanol

Hexane

Alconox ®

Site Contaminants

Cadmium

Chloroform

Chromium

Copper

Cyanide

1,1-Dichloroethane

1,2-Dichloroethane

Lead

Manganese

Silver

1,1,1-Trichlorethane

Trichloroethylene

Zinc

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: PENTANE
FORMULA: CH3(CH2)3CH3
FORMULA WT: 72.15
CAS NO.: 00109-66-0
NIOSH/RTECS NO.: RZ9450000
COMMON SYNONYMS: AMYL HYDRIDE
PRODUCT CODES: 9333,9331,T007,9340
EFFECTIVE: 09/05/86
REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	1	SLIGHT
FLAMMABILITY	-	4	EXTREME (FLAMMABLE)
REACTIVITY	-	0	NONE
CONTACT	-	1	SLIGHT

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

SAFETY GLASSES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

PRECAUTIONARY LABEL STATEMENTS

DANGER
HARMFUL IF INHALED
EXTREMELY FLAMMABLE

KEEP AWAY FROM HEAT, SPARKS, FLAME.
AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF FIRE, USE ALCOHOL FOAM, DRY CHEMICAL, CARBON DIOXIDE - WATER MAY BE INEFFECTIVE. FLUSH SPILL AREA WITH WATER SPRAY.

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
PENTANE	90-100	109-66-0

3 - PHYSICAL DATA

BOILING POINT:	36 C (97 F)	VAPOR PRESSURE(MM HG):	425
MELTING POINT:	-130 C (-202 F)	VAPOR DENSITY(AIR=1):	2.5

SPECIFIC GRAVITY: 0.63 (H2O=1)

EVAPORATION RATE: 28.6 (BUTYL ACETATE=1)

SOLUBILITY(H2O): NEGLIGIBLE (LESS THAN 0.1 %) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: CLEAR, COLORLESS LIQUID WITH MILD ODOR.

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP -49 C (-57 F) NFPA 704M RATING: 1-4-0

FLAMMABLE LIMITS: UPPER - 7.8 % LOWER - 1.4 %

FIRE EXTINGUISHING MEDIA
USE ALCOHOL FOAM, DRY CHEMICAL OR CARBON DIOXIDE.
(WATER MAY BE INEFFECTIVE.)

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS
VAPORS MAY FLOW ALONG SURFACES TO DISTANT IGNITION SOURCES AND FLASH BACK. CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE.

TOXIC GASES PRODUCED
CARBON MONOXIDE, CARBON DIOXIDE

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5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 1800 MG/M3 (600 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): 2250 MG/M3 (750 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 2950 MG/M3 (1000 PPM)

TOXICITY: LD50 (IV-MOUSE) (MG/KG) - 446

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
INHALATION OF VAPORS MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, DROWSINESS, IRRITATION OF RESPIRATORY TRACT, AND LOSS OF CONSCIOUSNESS. REPEATED INHALATION OF VAPORS MAY CAUSE CENTRAL NERVOUS SYSTEM DEPRESSION. CONTACT CAN CAUSE EYE IRRITATION.
PROLONGED EXPOSURE MAY CAUSE DERMATITIS.

TARGET ORGANS
EYES, SKIN, RESPIRATORY SYSTEM

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INHALATION, INGESTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, DO NOT INDUCE VOMITING.
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 WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

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6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION

INCOMPATIBLES: STRONG OXIDIZING AGENTS

DECOMPOSITION PRODUCTS: CARBON MONOXIDE, CARBON DIOXIDE

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7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SUITABLE PROTECTIVE CLOTHING. SHUT OFF IGNITION SOURCES; NO FLARES, SMOKING, OR FLAMES IN AREA. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO CONTAINER FOR LATER DISPOSAL. FLUSH AREA WITH WATER.

J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D001 (IGNITABLE WASTE)

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8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 5000 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH

ORGANIC VAPOR CARTRIDGE IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS RECOMMENDED.

EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, APRON, NEOPRENE GLOVES ARE RECOMMENDED.

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9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

SPECIAL PRECAUTIONS

BOND AND GROUND CONTAINERS WHEN TRANSFERRING LIQUID. KEEP CONTAINER TIGHTLY CLOSED. STORE IN A COOL, DRY, WELL-VENTILATED, FLAMMABLE LIQUID STORAGE AREA.

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10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	PENTANE
HAZARD CLASS	FLAMMABLE LIQUID
UN/NA	UN1265
LABELS	FLAMMABLE LIQUID

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	PENTANES
HAZARD CLASS	3.1
UN/NA	UN1265
LABELS	FLAMMABLE LIQUID

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: HYDROCHLORIC ACID
FORMULA: HCL
FORMULA WT: 36.46
CAS NO.: 7647-01-0
NIOSH/RTECS NO.: MW4025000
COMMON SYNONYMS: MURIATIC ACID; CHLOROHYDRIC ACID; HYDROCHLORIDE
PRODUCT CODES: 9543,9539,9535,5367,9534,9544,9529,9542,4800,9549,9530,9548 9540,9547,9546,9537
EFFECTIVE: 08/07/86
REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	3	SEVERE (POISON)
FLAMMABILITY	-	0	NONE
REACTIVITY	-	2	MODERATE
CONTACT	-	3	SEVERE (CORROSIVE)

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
CAUSES SEVERE BURNS
MAY BE FATAL IF SWALLOWED OR INHALED

DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
DO NOT BREATHE VAPOR. CAUSES DAMAGE TO RESPIRATORY SYSTEM (LUNGS), EYES AND SKIN. KEEP IN TIGHTLY CLOSED CONTAINER. LOOSEN CLOSURE CAUTIOUSLY. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF SPILL NEUTRALIZE WITH SODA ASH OR LIME AND PLACE IN DRY CONTAINER.

SAF-T-DATA(TM) STORAGE COLOR CODE: WHITE (CORROSIVE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
HYDROCHLORIC ACID (23 BAUME)	35-40	7647-01-0

3 - PHYSICAL DATA

BOILING POINT: 110 C (230 F) VAPOR PRESSURE(MM HG): N/A

MELTING POINT: -25 C (-13 F) VAPOR DENSITY(AIR=1): 1.3

SPECIFIC GRAVITY: 1.19 (H2O=1) EVAPORATION RATE: N/A (BUTYL ACETATE=1)

SOLUBILITY(H2O): COMPLETE (IN ALL PROPORTIONS) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: CLEAR, COLORLESS OR SLIGHTLY YELLOW, PUNGENT, FUMING LIQUID.

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A NFPA 704M RATING: 3-0-0

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.
DO NOT GET WATER INSIDE CONTAINERS.

UNUSUAL FIRE & EXPLOSION HAZARDS
MAY EMIT HYDROGEN GAS UPON CONTACT WITH METAL.

TOXIC GASES PRODUCED
HYDROGEN CHLORIDE, HYDROGEN GAS

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5 - HEALTH HAZARD DATA

PEL AND TLV LISTED DENOTE CEILING LIMIT.

THRESHOLD LIMIT VALUE (TLV/TWA): 7 MG/M3 (5 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 7 MG/M3 (5 PPM)

TOXICITY: LD50 (ORAL-RABBIT)(MG/KG) - 900
LD50 (IPR-MOUSE)(MG/KG) - 40
LC50 (INHL-RAT-1H) (PPM) - 3124

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
INHALATION OF VAPORS MAY CAUSE PULMONARY EDEMA, CIRCULATORY SYSTEM COLLAPSE, DAMAGE TO UPPER RESPIRATORY SYSTEM, COLLAPSE.
INHALATION OF VAPORS MAY CAUSE COUGHING AND DIFFICULT BREATHING.
LIQUID MAY CAUSE SEVERE BURNS TO SKIN AND EYES.
INGESTION IS HARMFUL AND MAY BE FATAL.

INGESTION MAY CAUSE SEVERE BURNING OF MOUTH AND STOMACH.

INGESTION MAY CAUSE NAUSEA AND VOMITING.

TARGET ORGANS
RESPIRATORY SYSTEM, EYES, SKIN

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INGESTION, INHALATION, SKIN CONTACT, EYE CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, DO NOT INDUCE VOMITING; IF CONSCIOUS, GIVE WATER, MILK, OR MILK OF MAGNESIA.
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 WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
WASH CLOTHING BEFORE RE-USE.

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6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, MOISTURE

INCOMPATIBLES: MOST COMMON METALS, WATER, AMINES, METAL OXIDES, ACETIC ANHYDRIDE, PROPIOLACTONE, VINYL ACETATE, MERCURIC SULFATE, CALCIUM PHOSPHIDE, FORMALDEHYDE, ALKALIES, CARBONATES, STRONG BASES, SULFURIC ACID, CHLOROSULFONIC ACID

DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE, HYDROGEN, CHLORINE

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7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. VENTILATE AREA. NEUTRALIZE SPILL WITH SODA ASH OR LIME. WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

J. T. BAKER NEUTRASORB(R) OR NEUTRASOL(R) "LOW NA+" ACID NEUTRALIZERS ARE RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D002 (CORROSIVE WASTE)

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8 - PROTECTIVE EQUIPMENT

VENTILATION:	USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.
RESPIRATORY PROTECTION:	RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 100 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH ACID CARTRIDGE IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.
EYE/SKIN PROTECTION:	SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, ACID-RESISTANT GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: WHITE (CORROSIVE)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. STORE IN CORROSION-PROOF AREA.
ISOLATE FROM INCOMPATIBLE MATERIALS.
DO NOT STORE NEAR OXIDIZING MATERIALS.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	HYDROCHLORIC ACID
HAZARD CLASS	CORROSIVE MATERIAL (LIQUID)
UN/NA	UN1789
LABELS	CORROSIVE
REPORTABLE QUANTITY	5000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	HYDROCHLORIC ACID, SOLUTION
HAZARD CLASS	8
UN/NA	UN1789
LABELS	CORROSIVE

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: NITRIC ACID
FORMULA: HNO3
FORMULA WT: 63.01
CAS NO.: 7697-37-2
NIOSH/RTECS NO.: QU5775000
COMMON SYNONYMS: HYDROGEN NITRATE; AZOTIC ACID
PRODUCT CODES: 4801,9605,9602,9598,9606,9601,5371,9597,9600,5113,9616
EFFECTIVE: 09/10/86
REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	3	SEVERE (POISON)
FLAMMABILITY	-	0	NONE
REACTIVITY	-	3	SEVERE (OXIDIZER)
CONTACT	-	4	EXTREME (CORROSIVE)

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
STRONG OXIDIZER - CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE
LIQUID AND VAPOR CAUSE SEVERE BURNS - MAY BE FATAL IF SWALLOWED
HARMFUL IF INHALED AND MAY CAUSE DELAYED LUNG INJURY
SPILLAGE MAY CAUSE FIRE OR LIBERATE DANGEROUS GAS
KEEP FROM CONTACT WITH CLOTHING AND OTHER COMBUSTIBLE MATERIALS. DO NOT STORE NEAR COMBUSTIBLE MATERIALS. DO NOT GET IN EYES, ON SKIN, ON CLOTHING. DO NOT BREATHE VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. IN CASE OF FIRE, USE WATER SPRAY, ALCOHOL FOAM, DRY CHEMICAL, OR CARBON DIOXIDE. FLUSH SPILL AREA WITH WATERSPRAY.

SAF-T-DATA(TM) STORAGE COLOR CODE: YELLOW (REACTIVE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
NITRIC ACID	65-75	7697-37-2

3 - PHYSICAL DATA

BOILING POINT: 121 C (250 F) VAPOR PRESSURE(MM HG):

MELTING POINT: -42 C (-44 F) VAPOR DENSITY(AIR=1):

SPECIFIC GRAVITY: 1.41 (H2O=1) EVAPORATION RATE: N/A (BUTYL ACETATE=1)

SOLUBILITY(H2O): COMPLETE (IN ALL PROPORTIONS) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: COLORLESS LIQUID, WITH CHOKING ODOR.

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A NFPA 704M RATING: 3-0-0 OXY

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA
USE WATER SPRAY.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE EXPOSED CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL; DO NOT GET WATER INSIDE CONTAINERS.

UNUSUAL FIRE & EXPLOSION HAZARDS
STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE.

TOXIC GASES PRODUCED
NITROGEN OXIDES, HYDROGEN GAS

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5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 5 MG/M3 (2 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): 10 MG/M3 (4 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 5 MG/M3 (2 PPM)

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
INHALATION OF VAPORS MAY CAUSE NAUSEA, VOMITING, LIGHTHEADEDNESS OR HEADACHE.
INHALATION OF VAPORS MAY CAUSE SEVERE IRRITATION OF THE RESPIRATORY SYSTEM.
INHALATION OF VAPORS MAY CAUSE COUGHING, CHEST PAINS, DIFFICULTY BREATHING, OR UNCONSCIOUSNESS.
CONTACT WITH LIQUID OR VAPOR MAY CAUSE SEVERE IRRITATION OR BURNS OF THE SKIN, EYES, AND MUCOUS MEMBRANES.
INGESTION MAY CAUSE SEVERE BURNS TO MOUTH, THROAT, AND STOMACH. MAY HAVE ADVERSE EFFECT ON KIDNEY FUNCTION AND MAY BE FATAL.

INGESTION IS HARMFUL AND MAY BE FATAL.

TARGET ORGANS
EYES, SKIN, RESPIRATORY SYSTEM, TEETH

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INHALATION, INGESTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, DO NOT INDUCE VOMITING; IF CONSCIOUS, GIVE WATER, MILK, OR MILK OF MAGNESIA.
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 WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
WASH CLOTHING BEFORE RE-USE.

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6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, LIGHT, MOISTURE

INCOMPATIBLES: STRONG BASES, COMBUSTIBLE MATERIALS, STRONG REDUCING AGENTS, ALKALIES, MOST COMMON METALS, ORGANIC MATERIALS, ALCOHOLS, CARBIDES

DECOMPOSITION PRODUCTS: OXIDES OF NITROGEN, HYDROGEN

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7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. VENTILATE AREA. NEUTRALIZE SPILL WITH SODA ASH OR LIME. WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER. KEEP COMBUSTIBLES (WOOD, PAPER, OIL, ETC.) AWAY FROM SPILLED MATERIAL.

J. T. BAKER NEUTRASORB(R) OR NEUTRASOL(R) "LOW NA+" ACID NEUTRALIZERS ARE RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D002 (CORROSIVE WASTE)

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8 - PROTECTIVE EQUIPMENT

MSDS for NITRIC ACID Page 4

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION:	RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 100 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH ACID CARTRIDGE IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.
EYE/SKIN PROTECTION:	SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, ACID-RESISTANT GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: YELLOW (REACTIVE)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. STORE SEPARATELY AND AWAY FROM FLAMMABLE AND COMBUSTIBLE MATERIALS.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	NITRIC ACID (OVER 40%) POISON - INHALATION HAZARD
HAZARD CLASS	OXIDIZER
UN/NA	UN2031
LABELS	OXIDIZER, CORROSIVE, POISON
REPORTABLE QUANTITY	1000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	NITRIC ACID
HAZARD CLASS	8
UN/NA	UN2031
LABELS	CORROSIVE

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: SULFURIC ACID
FORMULA: H_2SO_4
FORMULA WT: 98.08
CAS NO.: 7664-93-9
NIOSH/RTECS NO.: WS5600000
COMMON SYNONYMS: OIL OF VITRIOL
PRODUCT CODES: 5030,9691,9675,5340,9679,9687,9674,9686,9694,9681,5374,9688 9673,5432,5137,9685,4802,9684,9683,5643,9680
EFFECTIVE: 09/08/86
REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	3	SEVERE (POISON)
FLAMMABILITY	-	0	NONE
REACTIVITY	-	3	SEVERE (WATER REACTIVE)
CONTACT	-	4	EXTREME (CORROSIVE)

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
HARMFUL IF INHALED
CAUSES SEVERE BURNS
MAY BE FATAL IF SWALLOWED
REACTS VIOLENTLY WITH WATER.

DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
DO NOT BREATHE VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. LOOSEN CLOSURE CAUTIOUSLY. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF SPILL NEUTRALIZE WITH SODA ASH OR LIME AND PLACE IN DRY CONTAINER.

SAF-T-DATA(TM) STORAGE COLOR CODE: WHITE (CORROSIVE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
SULFURIC ACID	90-100	7664-93-9

3 - PHYSICAL DATA

BOILING POINT: 327 C (621 F) VAPOR PRESSURE(MM HG): <0.3

MELTING POINT: -2 C (28 F) VAPOR DENSITY(AIR=1): 3.4

SPECIFIC GRAVITY: 1.84 (H2O=1) EVAPORATION RATE: <1 (BUTYL ACETATE=1)

SOLUBILITY(H2O): COMPLETE (IN ALL PROPORTIONS) % VOLATILES BY VOLUME: N/A

APPEARANCE & ODOR: CLEAR, COLORLESS TO LIGHT YELLOW, OILY ODORLESS LIQUID.

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A NFPA 704M RATING: 3-0-2 W

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA
USE DRY CHEMICAL OR CARBON DIOXIDE. DO NOT USE WATER.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. DO NOT GET WATER INSIDE CONTAINERS.

UNUSUAL FIRE & EXPLOSION HAZARDS
REACTS WITH MOST METALS TO PRODUCE HYDROGEN GAS, WHICH CAN FORM AN EXPLOSIVE MIXTURE WITH AIR.
A VIOLENT EXOTHERMIC REACTION OCCURS WITH WATER. SUFFICIENT HEAT MAY BE PRODUCED TO IGNITE COMBUSTIBLE MATERIALS.

TOXIC GASES PRODUCED
SULFUR DIOXIDE

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5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 1 MG/M3 (PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 1 MG/M3 (PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 2140

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
INHALATION OF VAPORS MAY CAUSE SEVERE IRRITATION OF THE RESPIRATORY SYSTEM.
LIQUID MAY CAUSE SEVERE BURNS TO SKIN AND EYES.
INGESTION IS HARMFUL AND MAY BE FATAL.
INGESTION MAY CAUSE NAUSEA AND VOMITING.
INGESTION MAY CAUSE SEVERE BURNS TO MOUTH, THROAT, AND STOMACH. MAY HAVE ADVERSE EFFECT ON KIDNEY FUNCTION AND MAY BE FATAL.

CHRONIC OVEREXPOSURE MAY RESULT IN LUNG DAMAGE.

TARGET ORGANS
RESPIRATORY SYSTEM, EYES, SKIN, TEETH

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INHALATION, INGESTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, DO NOT INDUCE VOMITING; IF CONSCIOUS, GIVE WATER, MILK, OR MILK OF MAGNESIA.
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 WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
WASH CLOTHING BEFORE RE-USE.

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6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: MOISTURE, HEAT

INCOMPATIBLES: WATER, MOST COMMON METALS, ORGANIC MATERIALS, STRONG REDUCING AGENTS, COMBUSTIBLE MATERIALS, STRONG BASES, STRONG OXIDIZING AGENTS

DECOMPOSITION PRODUCTS: OXIDES OF SULFUR

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7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
STOP LEAK IF YOU CAN DO SO WITHOUT RISK. DO NOT USE WATER.
NEUTRALIZE SPILL AND/OR WASHINGS WITH SODA ASH OR LIME.
WITH CLEAN SHOVEL, PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER.
MOVE CONTAINER(S) FROM SPILL AREA.

J. T. BAKER NEUTRASORB(R) OR NEUTRASOL(R) "LOW NA+" ACID NEUTRALIZERS ARE RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D002, D003 (CORROSIVE, REACTIVE WASTE)

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8 - PROTECTIVE EQUIPMENT

MSDS for SULFURIC ACID Page 4

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: NONE REQUIRED WHERE APPROPRIATE VENTILATION CONDITIONS EXIST. IF THE TLV IS EXCEEDED, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, RUBBER GLOVES ARE RECOMMENDED.

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9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: WHITE (CORROSIVE)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. STORE IN CORROSION-PROOF AREA.
KEEP CONTAINERS OUT OF SUN AND AWAY FROM HEAT.

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10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	SULFURIC ACID
HAZARD CLASS	CORROSIVE MATERIAL (LIQUID)
UN/NA	UN1830
LABELS	CORROSIVE
REPORTABLE QUANTITY	1000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	SULPHURIC ACID
HAZARD CLASS	8
UN/NA	UN1830
LABELS	CORROSIVE

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: METHANOL
FORMULA: CH3OH
FORMULA WT: 32.04
CAS NO.: 67-56-1
NIOSH/RTECS NO.: PC1400000
COMMON SYNONYMS: METHYL ALCOHOL; WOOD ALCOHOL; CARBINOL; METHYLOL; WOOD SPIRIT
PRODUCT CODES: 9049,9072,9075,9076,9071,5217,5370,9074,P704,9093,5536,9068 9073,9091,9263,9069,9070
EFFECTIVE: 09/26/86
REVISION #04

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	- 3	SEVERE (POISON)
FLAMMABILITY	- 3	SEVERE (FLAMMABLE)
REACTIVITY	- 1	SLIGHT
CONTACT	- 1	SLIGHT

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
FLAMMABLE
HARMFUL IF INHALED
CANNOT BE MADE NON-POISONOUS
MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED

KEEP AWAY FROM HEAT, SPARKS, FLAME. DO NOT GET IN EYES, ON SKIN, ON CLOTHING. AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF FIRE, USE ALCOHOL FOAM, DRY CHEMICAL, CARBON DIOXIDE - WATER MAY BE INEFFECTIVE. FLUSH SPILL AREA WITH WATER SPRAY.

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
METHANOL	90-100	67-56-1

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3 - PHYSICAL DATA

BOILING POINT: 65 C (149 F) VAPOR PRESSURE(MM HG): 96

MELTING POINT: -98 C (-144 F) VAPOR DENSITY(AIR=1): 1.11

SPECIFIC GRAVITY: 0.79 (H2O=1) EVAPORATION RATE: 4.6 (BUTYL ACETATE=1)

SOLUBILITY(H2O): COMPLETE (IN ALL PROPORTIONS) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: CLEAR, COLORLESS LIQUID WITH CHARACTERISTIC PUNGENT ODOR.

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP 12 C (54 F) NFPA 704M RATING: 1-3-0

FLAMMABLE LIMITS: UPPER - 36.0 % LOWER - 6.0 %

FIRE EXTINGUISHING MEDIA
USE ALCOHOL FOAM, DRY CHEMICAL OR CARBON DIOXIDE.
(WATER MAY BE INEFFECTIVE.)

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS
VAPORS MAY FLOW ALONG SURFACES TO DISTANT IGNITION SOURCES AND FLASH BACK. CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE.
BURNS WITH A CLEAR, ALMOST INVISIBLE FLAME.

TOXIC GASES PRODUCED
CARBON MONOXIDE, CARBON DIOXIDE, FORMALDEHYDE

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5 - HEALTH HAZARD DATA

TLV LISTED DENOTES (TLV-SKIN).

THRESHOLD LIMIT VALUE (TLV/TWA): 260 MG/M3 (200 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): 310 MG/M3 (250 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 260 MG/M3 (200 PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 5628
LD50 (IPR-RAT)(MG/KG) - 9540

LD50 (SCU-MOUSE)(MG/KG) - 9800

LD50 (SKN-RABBIT) (G/KG) - 20

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
INHALATION AND INGESTION ARE HARMFUL AND MAY BE FATAL.
INHALATION MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, NARCOSIS, SUFFOCATION, LOWER BLOOD PRESSURE, CENTRAL NERVOUS SYSTEM DEPRESSION.
LIQUID MAY BE IRRITATING TO SKIN AND EYES. PROLONGED SKIN CONTACT MAY RESULT IN DERMATITIS. EYE CONTACT MAY RESULT IN TEMPORARY CORNEAL DAMAGE.
INGESTION MAY CAUSE BLINDNESS.
INGESTION MAY CAUSE NAUSEA, VOMITING, HEADACHES, DIZZINESS, GASTROINTESTINAL IRRITATION.
CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE KIDNEY AND/OR LIVER DAMAGE.

TARGET ORGANS
EYES, SKIN, CENTRAL NERVOUS SYSTEM

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INHALATION, INGESTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.
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 WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
WASH CLOTHING BEFORE RE-USE.

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6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION

INCOMPATIBLES: STRONG OXIDIZING AGENTS, STRONG ACIDS, ALUMINUM

DECOMPOSITION PRODUCTS: CARBON MONOXIDE, CARBON DIOXIDE, FORMALDEHYDE

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7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
SHUT OFF IGNITION SOURCES; NO FLARES, SMOKING OR FLAMES IN AREA. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO CONTAINER FOR LATER DISPOSAL. FLUSH AREA WITH WATER.

J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U154 (TOXIC WASTE)

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8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS ABOVE 200 PPM, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, RUBBER GLOVES ARE RECOMMENDED.

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9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

SPECIAL PRECAUTIONS
BOND AND GROUND CONTAINERS WHEN TRANSFERRING LIQUID. KEEP CONTAINER TIGHTLY CLOSED. STORE IN A COOL, DRY, WELL-VENTILATED, FLAMMABLE LIQUID STORAGE AREA.

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10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	METHANOL
HAZARD CLASS	FLAMMABLE LIQUID
UN/NA	UN1230
LABELS	FLAMMABLE LIQUID
REPORTABLE QUANTITY	5000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	METHANOL
HAZARD CLASS	3.2, 6.1
UN/NA	UN1230
LABELS	FLAMMABLE LIQUID, POISON

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1 - PRODUCT IDENTIFICATION

PRODUCT NAME: HEXANE
FORMULA: C6H14
FORMULA WT: 86.18
CAS NO.: 110-54-3
NIOSH/RTECS NO.: MN9275000
COMMON SYNONYMS: NORMAL HEXANE; HEXYL HYDRIDE
PRODUCT CODES: 9310,9304,N168,9303
EFFECTIVE: 09/26/86
REVISION #01

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	2	MODERATE
FLAMMABILITY	-	3	SEVERE (FLAMMABLE)
REACTIVITY	-	0	NONE
CONTACT	-	2	MODERATE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

SAFETY GLASSES; LAB COAT; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

PRECAUTIONARY LABEL STATEMENTS

DANGER
CAUSES IRRITATION
EXTREMELY FLAMMABLE
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN
KEEP AWAY FROM HEAT, SPARKS, FLAME.
DO NOT BREATHE VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF FIRE, USE ALCOHOL FOAM, DRY CHEMICAL, CARBON DIOXIDE - WATER MAY BE INEFFECTIVE. FLUSH SPILL AREA WITH WATER SPRAY.

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
N - HEXANE	>98	110-54-3
METHYLCYCLOPENTANE	<2	96-37-7

3 - PHYSICAL DATA

BOILING POINT: 69 C (156 F) VAPOR PRESSURE(MM HG): 130

MELTING POINT: -95 C (-139 F) VAPOR DENSITY(AIR=1): 3.0

SPECIFIC GRAVITY: 0.66 (H2O=1) EVAPORATION RATE: 9 (BUTYL ACETATE=1)

SOLUBILITY(H2O): NEGLIGIBLE (LESS THAN 0.1 %) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: COLORLESS LIQUID WITH MILD ODOR.

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP -23 C (-10 F) NFPA 704M RATING: 1-3-0

FLAMMABLE LIMITS: UPPER - 7.7 % LOWER - 1.2 %

FIRE EXTINGUISHING MEDIA
USE ALCOHOL FOAM, DRY CHEMICAL OR CARBON DIOXIDE.
(WATER MAY BE INEFFECTIVE.)

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED (POSITIVE PRESSURE IF AVAILABLE) BREATHING APPARATUS WITH FULL FACEPIECE. MOVE EXPOSED CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS
VAPORS MAY FLOW ALONG SURFACES TO DISTANT IGNITION SOURCES AND FLASH BACK. CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE.

TOXIC GASES PRODUCED
CARBON MONOXIDE, CARBON DIOXIDE

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5 - HEALTH HAZARD DATA

BLOOD CHANGES HAVE BEEN REPORTED IN LABORATORY ANIMALS. FETAL DEATH HAS BEEN REPORTED IN LABORATORY ANIMALS BUT NOT FOUND IN TWO ADDITIONAL STUDIES.

THRESHOLD LIMIT VALUE (TLV/TWA): 180 MG/M3 (50 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 1800 MG/M3 (500 PPM)

TOXICITY: LD50 (ORAL-RAT)(G/KG) - 28.7

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
INHALATION OF VAPORS MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, DROWSINESS, IRRITATION OF RESPIRATORY TRACT, AND LOSS OF CONSCIOUSNESS. INHALATION OF VAPORS MAY CAUSE NARCOSIS.
CONTACT WITH SKIN OR EYES MAY CAUSE IRRITATION.

CONTACT WITH SKIN HAS A DEFATTING EFFECT, CAUSING DRYING AND IRRITATION.

INGESTION MAY CAUSE NAUSEA, VOMITING, HEADACHES, DIZZINESS, GASTROINTESTINAL IRRITATION.
CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE CENTRAL NERVOUS SYSTEM DEPRESSION.

TARGET ORGANS
SKIN, EYES, RESPIRATORY SYSTEM, LUNGS

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INHALATION, INGESTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, DO NOT INDUCE VOMITING.
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.

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6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION

INCOMPATIBLES: STRONG OXIDIZING AGENTS, CHLORINE, FLUORINE, MAGNESIUM PERCHLORATE

DECOMPOSITION PRODUCTS: CARBON MONOXIDE, CARBON DIOXIDE

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7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SUITABLE PROTECTIVE CLOTHING. SHUT OFF IGNITION SOURCES; NO FLARES, SMOKING, OR FLAMES IN AREA. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO CONTAINER FOR LATER DISPOSAL. FLUSH AREA WITH WATER.

J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D001 (IGNITABLE WASTE)

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8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET

TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 1000 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS RECOMMENDED.

EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, APRON, NEOPRENE GLOVES ARE RECOMMENDED.

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9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

SPECIAL PRECAUTIONS
BOND AND GROUND CONTAINERS WHEN TRANSFERRING LIQUID. KEEP CONTAINER TIGHTLY CLOSED. STORE IN A COOL, DRY, WELL-VENTILATED, FLAMMABLE LIQUID STORAGE AREA.

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10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	HEXANE
HAZARD CLASS	FLAMMABLE LIQUID
UN/NA	UN1208
LABELS	FLAMMABLE LIQUID

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	HEXANES
HAZARD CLASS	3.1
UN/NA	UN1208
LABELS	FLAMMABLE LIQUID

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: ALCONOX(R)
FORMULA:
FORMULA WT: .00
CAS NO.: - -
COMMON SYNONYMS: ALKYL ARYL SULFONATES
PRODUCT CODES: A461
EFFECTIVE: 11/22/85
REVISION #01

PRECAUTIONARY LABELLING
BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	1	SLIGHT
FLAMMABILITY	-	0	NONE
REACTIVITY	-	1	SLIGHT
CONTACT	-	2	MODERATE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

SAFETY GLASSES; LAB COAT

PRECAUTIONARY LABEL STATEMENTS

WARNING
CAUSES IRRITATION
KEEP IN TIGHTLY CLOSED CONTAINER. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
ALCONOX(R)	90-100	

3 - PHYSICAL DATA

BOILING POINT: N/A
VAPOR PRESSURE(MM HG): N/A

MELTING POINT: N/A
VAPOR DENSITY(AIR=1): N/A

SPECIFIC GRAVITY: 0.00
(H2O=1)
EVAPORATION RATE: N/A
(BUTYL ACETATE=1)

SOLUBILITY(H2O): APPRECIABLE (MORE THAN 10 %) % VOLATILES BY VOLUME: N/A

APPEARANCE & ODOR: WHITE OPAQUE POWDER.

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP: N/A

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

---

5 - HEALTH HAZARD DATA

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
CONTACT WITH SKIN OR EYES MAY CAUSE IRRITATION.
INGESTION MAY BE HARMFUL.

TARGET ORGANS
NONE IDENTIFIED

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
NONE INDICATED

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.

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6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: NONE DOCUMENTED

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7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE

DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

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8 - PROTECTIVE EQUIPMENT

VENTILATION:	USE ADEQUATE GENERAL OR LOCAL EXHAUST VENTILATION TO KEEP FUME OR DUST LEVELS AS LOW AS POSSIBLE.
RESPIRATORY PROTECTION:	NONE REQUIRED WHERE ADEQUATE VENTILATION CONDITIONS EXIST. IF AIRBORNE CONCENTRATION IS HIGH, USE AN APPROPRIATE RESPIRATOR OR DUST MASK.
EYE/SKIN PROTECTION:	SAFETY GLASSES WITH SIDESHIELDS, PROPER GLOVES ARE RECOMMENDED.

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9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE AREA.

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10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME CHEMICALS, N.O.S. (NON-REGULATED)

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME CHEMICALS, N.O.S. (NON-REGULATED)

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: CADMIUM
FORMULA: CD
FORMULA WT: 112.40
CAS NO.: 07440-43-9
NIOSH/RTECS NO.: EU9800000
PRODUCT CODES: 1184,1182
EFFECTIVE: 09/10/86
REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	3	SEVERE (CANCER CAUSING)
FLAMMABILITY	-	0	NONE
REACTIVITY	-	0	NONE
CONTACT	-	0	NONE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

WARNING
HARMFUL IF SWALLOWED OR INHALED
NOTE: REPORTED AS CAUSING CANCER IN LABORATORY ANIMALS. EXERCISE DUE CARE.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING DUST. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
CADMIUM	90-100	07440-43-9

3 - PHYSICAL DATA

BOILING POINT: 767 C (1413 F)
MELTING POINT: 321 C (610 F)
SPECIFIC GRAVITY: 8.64 (H2O=1)
VAPOR PRESSURE(MM HG): N/A
VAPOR DENSITY(AIR=1): 3.9
EVAPORATION RATE: N/A (BUTYL ACETATE=1)

SOLUBILITY(H2O): NEGLIGIBLE (LESS THAN 0.1 %) % VOLATILES BY VOLUME: 0

APPEARANCE & ODOR: SOFT, BLUE-WHITE SOLID.

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP: N/A

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

UNUSUAL FIRE & EXPLOSION HAZARDS
CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE OR EXPLOSION.

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5 - HEALTH HAZARD DATA

THIS SUBSTANCE IS LISTED AS NTP ANTICIPATED HUMAN CARCINOGEN, IARC PROBABLE HUMAN CARCINOGEN (GROUPS 2A AND 2B). THE ACCEPTABLE CEILING CONCENTRATION (PEL) IS 0.6 MG/M3.

THRESHOLD LIMIT VALUE (TLV/TWA): 0.05 MG/M3 (PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 0.2 MG/M3 (PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 225
LD50 (IPR-RAT)(MG/KG) - 4
LD50 (SCU-RAT)(MG/KG) - 9

CARCINOGENICITY: NTP: YES IARC: YES Z LIST: NO OSHA REG: YES

EFFECTS OF OVEREXPOSURE
OVEREXPOSURE TO VAPORS MAY CAUSE IRRITATION OF MUCOUS MEMBRANES, DRYNESS OF MOUTH AND THROAT, HEADACHE, NAUSEA AND DIZZINESS.
INHALATION MAY BE HARMFUL OR FATAL.
CHRONIC EFFECTS OF CADMIUM COMPOUNDS FROM LOW LEVEL EXPOSURE IN THE AIR MAY CAUSE IRREVERSIBLE LUNG INJURY, KIDNEY DISEASE, AND OTHER ADVERSE EFFECTS.
DUST MAY IRRITATE EYES.

TARGET ORGANS
RESPIRATORY SYSTEM, KIDNEYS, BLOOD, PROSTATE

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INGESTION, INHALATION

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.

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6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: NONE DOCUMENTED

INCOMPATIBLES: STRONG OXIDIZING AGENTS, NITRATES, NITRIC ACID

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7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D006 (EP TOXIC WASTE)

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8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 1 PPM, A HIGH-EFFICIENCY PARTICULATE RESPIRATOR IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, APRON, RUBBER GLOVES ARE RECOMMENDED.

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9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	CADMIUM
HAZARD CLASS	ORM-E
LABELS	NONE
REPORTABLE QUANTITY	1 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	POISONOUS SOLIDS, N.O.S. (CADMIUM)
HAZARD CLASS	6.1
UN/NA	UN2811
LABELS	POISON

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: CHLOROFORM
FORMULA: CHCL3
FORMULA WT: 119.38
CAS NO.: 67-66-3
NIOSH/RTECS NO.: FS9100000
COMMON SYNONYMS: TRICHLOROMETHANE; METHYL TRICHLORIDE
PRODUCT CODES: 9175,9182,E910,9183,9174,9181,9257,9186,9180
EFFECTIVE: 01/22/87
REVISION #03

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH - 3 SEVERE (CANCER CAUSING)
FLAMMABILITY - 0 NONE
REACTIVITY - 1 SLIGHT
CONTACT - 2 MODERATE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
MAY BE FATAL IF SWALLOWED OR INHALED
EXCEPTIONAL HEALTH HAZARD - READ MATERIAL SAFETY DATA SHEET
NOTE: REPORTED AS CAUSING CANCER IN LABORATORY ANIMALS. EXERCISE DUE CARE.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
DO NOT BREATHE VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
CHLOROFORM	90-100	67-66-3

3 - PHYSICAL DATA

BOILING POINT: 61 C (142 F) VAPOR PRESSURE(MM HG): 159

MELTING POINT: -64 C (-83 F) VAPOR DENSITY(AIR=1): 4.1

SPECIFIC GRAVITY: 1.48 (H2O=1)

EVAPORATION RATE: 0.09 (BUTYL ACETATE=1)

SOLUBILITY(H2O): SLIGHT (0.1 TO 1 %)

% VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: CLEAR, COLORLESS LIQUID WITH PLEASANT, SWEET ODOR.

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP: N/A

NFPA 704M RATING: 2-0-0

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

TOXIC GASES PRODUCED
HYDROGEN CHLORIDE, CHLORINE, PHOSGENE

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5 - HEALTH HAZARD DATA

PEL LISTED DENOTES CEILING LIMIT.

THRESHOLD LIMIT VALUE (TLV/TWA): 50 MG/M3 (10 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 240 MG/M3 (50 PPM)

TOXICITY:	LD50 (ORAL-RAT)(MG/KG)	-	1194
	LD50 (SCU-MOUSE)(MG/KG)	-	704
	LC50 (INHAL-MOUSE) (G/M3)	-	28
	LD50 (IPR-MOUSE)(G/KG)	-	1

CARCINOGENICITY: NTP: YES IARC: YES Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
INHALATION AND INGESTION ARE HARMFUL AND MAY BE FATAL.
INHALATION OF VAPORS MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, DROWSINESS, IRRITATION OF RESPIRATORY TRACT, AND LOSS OF CONSCIOUSNESS.
LIQUID MAY BE IRRITATING TO SKIN AND EYES. PROLONGED SKIN CONTACT MAY RESULT IN DERMATITIS. EYE CONTACT MAY RESULT IN TEMPORARY CORNEAL DAMAGE.
LIQUID IS READILY ABSORBED THROUGH THE SKIN. CONTACT WITH SKIN HAS A DEFATTING EFFECT, CAUSING DRYING AND IRRITATION. OVER EXPOSURE TO VAPORS MAY CAUSE IRRITATION OF MUCOUS MEMBRANES, DRYNESS OF MOUTH AND THROAT, HEADACHE, NAUSEA AND DIZZINESS.
INGESTION MAY CAUSE NAUSEA, VOMITING, GASTROINTESTINAL IRRITATION, AND BURNS TO MOUTH AND THROAT.
CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE KIDNEY AND/OR LIVER DAMAGE.

TARGET ORGANS
LIVER, KIDNEYS, HEART, EYES, SKIN

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
KIDNEY DISORDERS, LIVER DISORDERS, HEART DISORDERS, SKIN DISORDERS

ROUTES OF ENTRY
INHALATION, INGESTION, SKIN CONTACT, EYE CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.
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 WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

THIS SUBSTANCE IS LISTED AS ACGIH ANTICIPATED HUMAN CARCINOGEN, NTP ANTICIPATED HUMAN CARCINOGEN, AND IARC PROBABLE HUMAN CARCINOGEN (GROUPS 2A & 2B).

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6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION, LIGHT, AIR, MOISTURE

INCOMPATIBLES: STRONG BASES, ALKALI METALS, ALUMINUM, MAGNESIUM, STRONG OXIDIZING AGENTS

DECOMPOSITION PRODUCTS: CHLORINE, HYDROGEN CHLORIDE, PHOSGENE

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7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS.
TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO CONTAINER FOR LATER DISPOSAL. FLUSH SPILL AREA WITH WATER.

J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U044 (TOXIC WASTE)

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8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET

TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS ABOVE 10 PPM, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, POLYVINYL ALCOHOL GLOVES ARE RECOMMENDED.

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9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA.

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10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	CHLOROFORM (AIR AND WATER ONLY)
HAZARD CLASS	ORM-A
UN/NA	UN1888
LABELS	NONE
REPORTABLE QUANTITY	5000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	CHLOROFORM
HAZARD CLASS	6.1
UN/NA	UN1888
LABELS	POISON

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: CHROMIUM
FORMULA: CR
FORMULA WT: 52.00
CAS NO.: 7440-47-3
NIOSH/RTECS NO.: CB4200000
PRODUCT CODES: 4961
EFFECTIVE: 09/10/86
REVISION #03

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	0	NONE
FLAMMABILITY	-	0	NONE
REACTIVITY	-	0	NONE
CONTACT	-	0	NONE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

SAFETY GLASSES; LAB COAT

PRECAUTIONARY LABEL STATEMENTS

DURING USE AVOID CONTACT WITH EYES, SKIN, CLOTHING. WASH THOROUGHLY AFTER HANDLING. WHEN NOT IN USE KEEP IN TIGHTLY CLOSED CONTAINER.

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
CHROMIUM	90-100	7440-47-3

3 - PHYSICAL DATA

BOILING POINT: 2200 C (3992 F)
VAPOR PRESSURE(MM HG): N/A

MELTING POINT: 1900 C (3452 F)
VAPOR DENSITY(AIR=1): N/A

SPECIFIC GRAVITY: 7.14 (H2O=1)
EVAPORATION RATE: N/A (BUTYL ACETATE=1)

SOLUBILITY(H2O): NEGLIGIBLE (LESS THAN 0.1 %) % VOLATILES BY VOLUME: 0

APPEARANCE & ODOR: STEEL GRAY TO SILVER PELLETS.

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA
USE WATER SPRAY, ALCOHOL FOAM, DRY CHEMICAL OR CARBON DIOXIDE.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS
CAN BE AN EXPLOSION HAZARD, ESPECIALLY WHEN HEATED.

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5 - HEALTH HAZARD DATA

NOTE: WHILE THE SPECIFIC COMPOUNDS CANNOT BE IDENTIFIED, THERE IS EVIDENCE THAT CERTAIN CHROMIUM COMPOUNDS CAUSE CANCER IN HUMANS AND EXPERIMENTAL ANIMALS. CHROMIUM IS WIDELY DISTRIBUTED IN AIR, WATER, SOIL AND FOOD. TRIVALENT CHROMIUM MAY BE AN ESSENTIAL TRACE INGREDIENT IN THE HUMAN DIET. ALL CHROMIUM COMPOUNDS ARE REGULATED BY THE EPA, BUT NO SPECIFIC DATA IS AVAILABLE TO LINK TRIVALENT CHROMIUM TO CANCER. PRUDENT JUDGEMENT DICTATES THAT EXPOSURE SHOULD BE MINIMIZED AS MUCH AS POSSIBLE. (SEE IARC MONOGRAPH ON EVALUATION OF CARCINOGENIC RISK OF CHEMICALS TO HUMANS, VOLUME 23 LYON, FRANCE IARC, 1980, PP. 205-323).

THRESHOLD LIMIT VALUE (TLV/TWA): 0.5 MG/M3 (PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 1 MG/M3 (PPM)

CARCINOGENICITY: NTP: YES IARC: YES Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
CONTACT WITH SKIN OR EYES MAY CAUSE SEVERE IRRITATION OR BURNS.
DUST MAY ULCERATE MUCOUS MEMBRANES.
EXCESSIVE INHALATION OF DUST IS IRRITATING AND MAY BE SEVERELY DAMAGING TO RESPIRATORY PASSAGES AND/OR LUNGS.
INGESTION MAY RESULT IN SEVERE INTESTINAL IRRITATION WITH BURNS TO MOUTH.
NOTE: PRODUCT IS A SOLID MASS; HOWEVER, WARNINGS ARE BASED ON INHALATION DUST, MIST OR FUME EMISSIONS THAT ARE POSSIBLE DURING MANUFACTURING OR CHEMICAL REACTIONS.

TARGET ORGANS
RESPIRATORY SYSTEM

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INGESTION, INHALATION

EMERGENCY AND FIRST AID PROCEDURES

INGESTION:	IF SWALLOWED AND THE PERSON IS CONSCIOUS, IMMEDIATELY GIVE LARGE AMOUNTS OF WATER. GET MEDICAL ATTENTION.
INHALATION:	IF A PERSON BREATHES IN LARGE AMOUNTS, MOVE THE EXPOSED PERSON TO FRESH AIR. GET MEDICAL ATTENTION.
EYE CONTACT:	IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. GET MEDICAL ATTENTION.
SKIN CONTACT:	IMMEDIATELY WASH WITH PLENTY OF SOAP AND WATER FOR AT LEAST 15 MINUTES.

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: FLAME

INCOMPATIBLES: CARBONATES, STRONG BASES, MINERAL ACIDS

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SUITABLE PROTECTIVE CLOTHING. CAREFULLY SWEEP UP AND REMOVE.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D007 (EP TOXIC WASTE)

8 - PROTECTIVE EQUIPMENT

VENTILATION:	USE ADEQUATE GENERAL OR LOCAL EXHAUST VENTILATION TO KEEP FUME OR DUST LEVELS AS LOW AS POSSIBLE.
RESPIRATORY PROTECTION:	A RESPIRATOR WITH DUST/MIST FILTER IS RECOMMENDED. IF AIRBORNE CONCENTRATION EXCEEDS TLV, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.
EYE/SKIN PROTECTION:	SAFETY GLASSES WITH SIDESHIELDS, PROPER GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE AREA.

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10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	CHROMIUM
HAZARD CLASS	ORM-E
LABELS	NONE
REPORTABLE QUANTITY	1 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	CHEMICALS, N.O.S. (NON-REGULATED)

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: COPPER
FORMULA: CU
FORMULA WT: 63.55
CAS NO.: 07440-50-8
NIOSH/RTECS NO.: GL5325000
COMMON SYNONYMS: BRONZE POWDER; C.I. 77400; ARWOOD COPPER
PRODUCT CODES: 1732,1736,1720,1714,1728
EFFECTIVE: 06/25/86
REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	0	NONE
FLAMMABILITY	-	0	NONE
REACTIVITY	-	0	NONE
CONTACT	-	1	SLIGHT

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

SAFETY GLASSES; LAB COAT

PRECAUTIONARY LABEL STATEMENTS

CAUTION
MAY CAUSE IRRITATION

DURING USE AVOID CONTACT WITH EYES, SKIN, CLOTHING. WASH THOROUGHLY AFTER HANDLING. WHEN NOT IN USE KEEP IN TIGHTLY CLOSED CONTAINER.

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
COPPER	90-100	07440-50-8

3 - PHYSICAL DATA

BOILING POINT: 2595 C (4703 F)
MELTING POINT: 1083 C (1981 F)
SPECIFIC GRAVITY: 8.92 (H2O=1)
VAPOR PRESSURE(MM HG): N/A
VAPOR DENSITY(AIR=1): N/A
EVAPORATION RATE: N/A (BUTYL ACETATE=1)

SOLUBILITY(H2O): NEGLIGIBLE (LESS THAN 0.1 %) % VOLATILES BY VOLUME: 0

APPEARANCE & ODOR: REDDISH, LUSTROUS, MALLEABLE METAL.

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

TOXIC GASES PRODUCED
COPPER FUMES

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5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 1.0 MG/M3 (PPM)

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
DUST MAY CAUSE SNEEZING AND COUGHING.
DUST MAY IRRITATE SKIN OR EYES.
PROLONGED EXPOSURE MAY CAUSE DERMATITIS.
INGESTION MAY CAUSE NAUSEA, VOMITING, HEADACHES, DIZZINESS, GASTROINTESTINAL IRRITATION.
NOTE: PRODUCT IS A SOLID MASS; HOWEVER, WARNINGS ARE BASED ON INHALATION DUST, MIST OR FUME EMISSIONS THAT ARE POSSIBLE DURING MANUFACTURING OR CHEMICAL REACTIONS.

TARGET ORGANS
NONE IDENTIFIED

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
NONE INDICATED

EMERGENCY AND FIRST AID PROCEDURES
INGESTION: IF SWALLOWED AND THE PERSON IS CONSCIOUS, IMMEDIATELY GIVE LARGE AMOUNTS OF WATER. GET MEDICAL ATTENTION.
INHALATION: IF A PERSON BREATHES IN LARGE AMOUNTS, MOVE THE EXPOSED PERSON TO FRESH AIR. GET MEDICAL ATTENTION.
EYE CONTACT: IMMEDIATELY FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. GET MEDICAL ATTENTION.
SKIN CONTACT: IMMEDIATELY WASH WITH PLENTY OF SOAP AND WATER FOR AT LEAST 15 MINUTES.

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6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: MOISTURE

INCOMPATIBLES: STRONG ACIDS, ACTIVE HALOGEN COMPOUNDS, CHLORINE, FLUORINE, IODINE, BROMINE, AMMONIA

DECOMPOSITION PRODUCTS: COPPER FUMES

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SUITABLE PROTECTIVE CLOTHING. CAREFULLY SWEEP UP AND REMOVE.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: NONE REQUIRED WHERE ADEQUATE VENTILATION CONDITIONS EXIST. IF AIRBORNE CONCENTRATION EXCEEDS TLV, A DUST/MIST RESPIRATOR IS RECOMMENDED. IF CONCENTRATION EXCEEDS CAPACITY OF RESPIRATOR, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GLASSES WITH SIDESHIELDS, PROPER GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME COPPER, HEAVY FOIL

HAZARD CLASS	ORM-E
LABELS	NONE
REPORTABLE QUANTITY	5000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	CHEMICALS, N.O.S. (NON-REGULATED)

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: SODIUM CYANIDE
FORMULA: NACN
FORMULA WT: 49.01
CAS NO.: 00143-33-9
NIOSH/RTECS NO.: VZ7525000
COMMON SYNONYMS: HYDROCYANIC ACID, SODIUM SALT; CYANOGRAN
PRODUCT CODES: 3662
EFFECTIVE: 08/28/86
REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	3	SEVERE (POISON)
FLAMMABILITY	-	0	NONE
REACTIVITY	-	2	MODERATE
CONTACT	-	3	SEVERE (LIFE)

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

POISON DANGER
EXCEPTIONAL CONTACT HAZARD - READ MATERIAL SAFETY DATA SHEET
MAY BE FATAL IF SWALLOWED OR INHALED
CONTACT WITH ACID LIBERATES POISONOUS GAS.
CAUSES EYE BURNS AND MAY IRRITATE SKIN.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
DO NOT BREATHE GAS OR DUST. KEEP IN TIGHTLY CLOSED CONTAINER. STORE IN DRY AREA AWAY FROM ACIDS. SWEEP UP SPILLAGE. DO NOT FLUSH TO SEWER.

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
SODIUM CYANIDE	90-100	143-33-9

3 - PHYSICAL DATA

BOILING POINT: 1496 C (2725 F) VAPOR PRESSURE(MM HG): N/A

MELTING POINT: 564 C (1047 F) VAPOR DENSITY(AIR=1): 1.7

SPECIFIC GRAVITY: 1.60 (H2O=1)

EVAPORATION RATE: N/A (BUTYL ACETATE=1)

SOLUBILITY(H2O): APPRECIABLE (MORE THAN 10 %) % VOLATILES BY VOLUME: 0

APPEARANCE & ODOR: WHITE GRANULES (ODORLESS WHEN DRY).

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A

NFPA 704M RATING: 3-0-0

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA
USE WATER SPRAY, ALCOHOL FOAM, OR DRY CHEMICAL. DO NOT USE CARBON DIOXIDE.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS
GIVES OFF FLAMMABLE VAPORS. VAPORS MAY FORM EXPLOSIVE MIXTURE WITH AIR. CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE.

TOXIC GASES PRODUCED
HYDROGEN CYANIDE

---

5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 5 MG/M3 (PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 5 MG/M3 (PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 6.4
LD50 (IPR-RAT)(MG/KG) - 4.3

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
INHALATION AND INGESTION ARE HARMFUL AND MAY BE FATAL.
INHALATION AND INGESTION MAY CAUSE CYANOSIS. THE EFFECTS OF EXPOSURE MAY INCLUDE HEADACHE, NAUSEA, VOMITING, DIZZINESS, WEAKNESS, RAPID INEFFECTIVE BREATHING, LOW BLOOD PRESSURE, LOSS OF CONSCIOUSNESS, OR CONVULSIONS.
CONTACT WITH SKIN OR EYES MAY CAUSE SEVERE IRRITATION OR BURNS.

TARGET ORGANS
CARDIOVASCULAR SYSTEM, CENTRAL NERVOUS SYSTEM, LIVER, KIDNEYS, SKIN

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INHALATION, INGESTION, ABSORPTION, SKIN CONTACT, EYE CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
KEEP CYANIDE ANTIDOTE KIT ON HAND AT ALL TIMES IF SWALLOWED, IF UNCONSCIOUS, BREAK AN AMYL NITRITE PEARL IN A CLOTH AND HOLD LIGHTLY UNDER NOSE FOR 15 SECONDS. WHEN CONSCIOUSNESS RETURNS, INDUCE VOMITING.
IF INHALED, BREAK AN AMYL NITRITE PEARL IN A CLOTH AND HOLD LIGHTLY UNDER NOSE FOR 15 SECONDS. REPEAT 5 TIMES AT ABOUT 15 SECOND INTERVALS. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION.
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES.

---

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: MOISTURE

INCOMPATIBLES: STRONG OXIDIZING AGENTS, STRONG ACIDS, WATER

DECOMPOSITION PRODUCTS: HYDROGEN CYANIDE

---

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.
USE WATER SPRAY TO REDUCE VAPORS.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: P106 (ACUTE HAZARDOUS WASTE)

---

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: NONE REQUIRED WHERE ADEQUATE VENTILATION CONDITIONS EXIST. IF AIRBORNE CONCENTRATION EXCEEDS TLV, A DUST/MIST RESPIRATOR IS RECOMMENDED. IF CONCENTRATION EXCEEDS CAPACITY OF

RESPIRATOR, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, APRON, RUBBER GLOVES ARE RECOMMENDED.

---

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA.

---

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	SODIUM CYANIDE, SOLID
HAZARD CLASS	POISON B
UN/NA	UN1689
LABELS	POISON
REPORTABLE QUANTITY	10 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	SODIUM CYANIDE
HAZARD CLASS	6.1
UN/NA	UN1689
LABELS	POISON

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 830
1,1-Dichloroethane

Issued: 6/92

Section 1. Material Identification

38

1,1-Dichloroethane (CH_3CHCl_2) Description: Derived by various methods; by direct chlorination of ethane, as a side product of chloral manufacture, by treating ethylene and chlorine with calcium chloride, by action of phosphorus chloride on acetaldehyde, and the reaction of hydrogen chloride and vinyl chloride at 20 to 55 °C in the presence of an aluminum, ferric, or zinc chloride catalyst. Found as an air contaminant in submarines and space craft. Its largest industrial use is in the production of 1,1,1-trichloroethane. Also used as a cleansing agent, degreaser, solvent for plastics, oils, and fats, grain fumigant, chemical intermediate; in insecticide sprays, rubber cementing, fabric spreading, paint and varnish removers, in ore flotation, vinyl chloride production, and as a coupling agent in anti-knock gasoline. Formerly used as an anesthetic.

Other Designations: CAS No. 75-34-3; assymetrical dichloroethane; chlorinated hydrochloric ether; ethylidene chloride; ethylidene dichloride.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*[73] for a suppliers list.

Cautions: 1,1-Dichloroethane is volatile and highly flammable. It is irritating to the eyes and respiratory tract and inhalation of high concentrations causes an anesthetic effect.

R	1
I	3
S	2
K	4

NFPA

HMIS
H 2
F 3
R 0
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

1,1-Dichloroethane, reagent grade (99.7%). Impurities consist of ethyl chloride (0.02%), trichloroethylene (0.08%), butylene oxide (0.08%), ethylene dichloride (0.01%), and unknown (0.14%).

1991 OSHA PEL
8-hr TWA: 100 ppm (400 mg/m³)

1990 IDLH Level
4000 ppm

1990 NIOSH REL
8-hr TWA: 100 ppm (400 mg/m³)

1991-92 ACGIH TLVs*
TWA: 200 ppm (810 mg/m³)
STEL: 250 ppm (1010 mg/m³)

1990 DFG (Germany) MAK
100 ppm (400 mg/m³)
Half-life: < 2hr
Peak Exposure Limit: 200 ppm/30 min. average value/maximum of 4 peaks per shift

1985-86 Toxicity Data†
Mouse, oral, TD_{Lo}: 185 g/kg administered intermittently for 78 wk produced uterine tumors.
Rat, oral, LD_{50}: 725 mg/kg; toxic effects not yet reviewed.‡
Rat, inhalation, TC_{Lo}: 6000 ppm/7 hr administered during 6 to 15 days of pregnancy caused developmental abnormalities of the musculoskeletal system.

* Notice of intended change to 100 ppm/405 mg/m³.
†See NIOSH, *RTECS* (KI0175000), for additional reproductive, tumorigenic and toxicity data.
‡ Considered a possible error since subsequent studies at higher concentrations failed to produce comparative results.[133]

Section 3. Physical Data

Boiling Point: 135 °F (57.3 °C)
Melting Point: -143 °F (-96.98 °C)
Vapor Pressure: 230 mm Hg at 77 °F (25 °C)
Saturated Vapor Density (air = 1.2 kg/m³ or 0.075 lbs/ft³): 2.076 kg/m³ or 0.129 lbs/ft³
Refraction Index: 1.4166 at 68 °F (20 °C)
Surface Tension: 24.75 dyne/cm at 68 °F (20 °C)

Molecular Weight: 98.97
Specific Gravity: 1.174 at 68 °F (20/4 °C)
Water Solubility: Slightly, 0.5%
Other Solubilities: Very soluble in alcohol and ether, soluble in acetone, benzene, and fixed and volatile oils.
Relative Evaporation Rate (BuAc=1): 11.6
Odor Threshold: 49 to 1359 ppm; odor is not sufficient to warn against overexposure

Appearance and Odor: Colorless, mobile, oily liquid with a chloroform odor and a saccharin taste.

Section 4. Fire and Explosion Data

Flash Point: 17 °F (-8.33 °C) CC*	Autoignition Temperature: 856 °F (493 °C)	LEL: 5.6% v/v	UEL: 11.4% v/v

Extinguishing Media: A Class 1B Flammable Liquid. For small fires, use dry chemical, carbon dioxide (CO_2), or "alcohol-resistant" foam. For large fires, use fog or "alcohol-resistant" foam. Water may be ineffective unless used as a "blanket".

Unusual Fire or Explosion Hazards: Vapors may travel to an ignition source and flash back. Container may explode in heat of fire.

Special Fire-fighting Procedures: Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing will provide only limited protection. If possible without risk, move container from fire area. Apply cooling water to sides of containers until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if this is impossible, withdraw from area and let fire burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. Do not release runoff from fire control methods to sewers (explosion) or waterways.

* 22 °F (-5.5 °C), OC[148]

Section 5. Reactivity Data

Stability/Polymerization: 1,1-Dichloroethane is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Incompatible with strong oxidizers and forms acetaldehyde in contact with caustics. 1,1-Dichloroethane will attack some forms of plastics, rubber, and coatings.

Conditions to Avoid: Exposure to heat and ignition sources and contact with incompatibles.

Hazardous Products of Decomposition: Thermal oxidative decomposition of 1,1-dichloroethane can produce carbon dioxide (CO_2), irritating hydrogen chloride (HCl) and toxic phosgene ($COCl_2$) fumes.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] NTP,[169] and OSHA[164] do not list 1,1-dichloroethane as a carcinogen. However, the National Cancer Institute as recommended caution due to analogy to other chloroethanes such as 1,2-dichlorothane which are shown to cause cancer in animals.

Summary of Risks: 1,1-Dichloroethane is irritating to the eyes and respiratory system. It causes varying degrees of central nervous system (CNS) disturbance depending on the concentration and duration of exposure. Liver and kidney toxicity is controversial.

Continue on next page

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Section 6. Health Hazard Data, *continued*

Some sources report that severe, acute exposures can cause damage, some quote recent detailed chronic studies which indicate little capacity for damage; still others refute the possibility of acute damage even from very high exposures. In reviewing the data it appears likely that chronic exposure will not cause kidney or liver damage but acute exposures to high concentrations may. There is definite evidence that 1,1-dichloroethane produces liver damage in monkeys, dogs, and rats when exposed to 98 ppm/90 days. It is also unclear whether or not 1,1-dichloroethane is absorbed through the skin. There are reports of absorption (although not in toxic amounts) and others claiming there is no absorption. Given this controversial data it is best to take precautions as if skin absorption, and liver and kidney damage were proven to occur. **Medical Conditions Aggravated by Long-term Exposure:** Chronic respiratory and skin disease, neurological damage, and liver or kidney disorders. **Target Organs:** Skin, CNS, liver, kidney. **Primary Entry Routes:** Inhalation and skin contact. **Acute Effects:** Inhalation symptoms include eye, nose, and throat irritation, headache, dizziness, coughing, staggering, disturbed vision, irregular heartbeat (can result in sudden death), unconsciousness, narcosis, coma, and death due to cardiac or respiratory failure. There is the risk of pulmonary edema (fluid in lungs). Skin contact is irritating and causes defatting, redness and swelling. Vapor contact with the eyes causes irritation, watering eyes and lid inflammation. Splashes to the eyes produces a burning sensation, watering, and lid inflammation. **Chronic Effects:** Repeated skin contact can cause a rash and scaliness. Repeated inhalation may have neurological effects.

FIRST AID *Emergency personnel should protect against contamination.*

Eyes: Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Do *not* allow victim to rub or keep eyes tightly shut. Immediately consult an ophthamlologist. **Skin:** 1,1-Dichloroethane vaporizes easily and poses an inhalation hazard as well. *Quickly and carefully* remove contaminated clothing; *1,1-dichloroethane is flammable!* Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have that *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting. After vomiting, give 2 tbsp activated charcoal in 8 oz water to drink.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Proper ventilation is the main treatment for acute exposure. Be prepared to support respiration if needed. Monitor liver function studies, urine analysis, and creatinine with acute and chronic exposure.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Immediately notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Cleanup personnel should protect against inhalation and skin contact. For small spills, take up with earth, sand, vermiculite, or other absorbent, noncombustible material and using nonsparking tools, place in a suitable container. For large spills, dike far ahead of liquid spill for disposal or reclamation. Do not allow 1,1-dichloroethane to enter confined areas such as a sewer because of potential explosion. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Degradation:** In soil, 1,1-dichloroethane volatilizes rapidly but may leach into groundwater. In water it will volatilize from a pond, lake, or river with a half-life of 6 to 9 days, 5 to 8 days, and 24 to 32 hr, respectively. In the atmosphere it will degrade by reaction with photochemically produced hydroxyl radicals with a 62 day half-life. It may also be carried back to soil via rain.

Ecotoxicity Values: *Artemia salina*, brine shrimp, TLm 320 mg/L/24 hr; *Lagodon rhomboides*, pinperch, TLm 160 mg/L/24 hr; *Poecilia reticulata*, guppies, LC_{50} 202 ppm/7 days.

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
Listed as a RCRA Hazardous Waste (40 CFR 261.33): No. U076
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1000 lb (454 kg)
[* per RCRA, Sec. 3001 & CWA, Sec. 307(a)]

OSHA Designations Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH/MSHA-approved respirator. For < 1000 ppm, use any supplied-air respirator or SCBA. For < 2500 ppm, use any supplied-air respirator operated in a continuous flow mode. For < 4000 ppm, use any supplied-air respirator or SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a respiratory protection program that includes at least: training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent repeated or prolonged skin contact. Polyvinyl alcohol is recommended as suitable material for PPG. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Thoroughly decontaminate personal protective equipment. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Prevent physical damage to containers. Store in a cool, dry, well-ventilated area away from ignition sources and incompatibles (Sec. 5). Label containers to indicate the contents' high flammability. Periodically inspect containers for cracks and leaks. To prevent static sparks, electrically ground and bond all equipment used in 1,1-dichloroethane manufacture, use, storage, transfer, and shipping.

Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers emphasizing the skin, CNS, liver, and kidney. Educate workers about the hazards of 1,1-dichloroethane and the necessary precautions to reduce or prevent exposure.

Transportation Data (49 CFR 172.102)

IMO Shipping Name: 1,1-Dichloroethane
IMO Hazard Class: 3.2
ID No.: UN2362
IMO Label: Flammable Liquid
IMDG Packaging Group: II

MSDS Collection References: 73, 89, 101, 103, 126, 127, 131, 132, 133, 136, 140, 148, 149, 153, 159, 162, 163, 164, 167, 168, 171
Prepared by: M Gannon, BA; Industrial Hygiene Review: PA Roy, MPH, CIH; Medical Review: AC Darlington, MPH, MD

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1 - PRODUCT IDENTIFICATION

PRODUCT NAME: 1,2-DICHLOROETHANE
FORMULA: CLCH2CH2CL
FORMULA WT: 98.96
CAS NO.: 107-06-2
NIOSH/RTECS NO.: KL0525000
COMMON SYNONYMS: ETHYLENE DICHLORIDE; 1,2-BICHLOROETHANE; ETHYLENE CHLORIDE
PRODUCT CODES: H076,9302
EFFECTIVE: 01/22/87
REVISION #04

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	3	SEVERE (CANCER CAUSING)
FLAMMABILITY	-	3	SEVERE (FLAMMABLE)
REACTIVITY	-	1	SLIGHT
CONTACT	-	2	MODERATE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

PRECAUTIONARY LABEL STATEMENTS

WARNING
FLAMMABLE
CAUSES IRRITATION
HARMFUL IF SWALLOWED OR INHALED

NOTE: REPORTED AS CAUSING CANCER IN LABORATORY ANIMALS. EXERCISE DUE CARE. KEEP AWAY FROM HEAT, SPARKS, FLAME. AVOID CONTACT WITH EYES, SKIN, CLOTHING. AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING. IN CASE OF FIRE, USE ALCOHOL FOAM, DRY CHEMICAL, CARBON DIOXIDE - WATER MAY BE INEFFECTIVE. FLUSH SPILL AREA WITH WATER SPRAY.

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
1,2-DICHLOROETHANE	90-100	107-06-2

3 - PHYSICAL DATA

BOILING POINT: 84 C (183 F) VAPOR PRESSURE(MM HG): 62

MELTING POINT: -36 C (-33 F) VAPOR DENSITY(AIR=1): 3.4

SPECIFIC GRAVITY: 1.25 (H2O=1) EVAPORATION RATE: 6.5 (BUTYL ACETATE=1)

SOLUBILITY(H2O): SLIGHT (0.1 TO 1 %) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: CLEAR LIQUID WITH SWEET ODOR LIKE CHLOROFORM.

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP 13 C (56 F) NFPA 704M RATING: 2-3-0

FLAMMABLE LIMITS: UPPER - 15.9 % LOWER - 6.2 %

FIRE EXTINGUISHING MEDIA
USE ALCOHOL FOAM, DRY CHEMICAL OR CARBON DIOXIDE.
(WATER MAY BE INEFFECTIVE.)

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS
VAPORS MAY FLOW ALONG SURFACES TO DISTANT IGNITION SOURCES AND FLASH BACK. CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE.

TOXIC GASES PRODUCED
HYDROGEN CHLORIDE, PHOSGENE, CARBON MONOXIDE, CARBON DIOXIDE

---

5 - HEALTH HAZARD DATA

THIS SUBSTANCE IS LISTED AS AN NTP ANTICIPATED HUMAN CARCINOGEN, IARC ANIMAL CARCINOGEN. ACCEPTABLE MAXIMUM PEAK ABOVE THE ACCEPTANCE CEILING CONCENTRATION FOR AN EIGHT-HOUR SHIFT = 200 PPM FOR 5 MINUTES IN ANY 3 HOURS. (PEL) CEILING = 100 PPM.

THRESHOLD LIMIT VALUE (TLV/TWA): 40 MG/M3 (10 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): 60 MG/M3 (15 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): MG/M3 (50 PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 670

CARCINOGENICITY: NTP: YES IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
INHALATION AND INGESTION ARE HARMFUL AND MAY BE FATAL.

INHALATION MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, NARCOSIS, SUFFOCATION, LOWER BLOOD PRESSURE, CENTRAL NERVOUS SYSTEM DEPRESSION.
INHALATION OF VAPORS MAY CAUSE PULMONARY EDEMA.
CONTACT WITH SKIN OR EYES MAY CAUSE SEVERE IRRITATION OR BURNS. PROLONGED CONTACT MAY CAUSE SKIN SENSITIZATION. SUBSTANCE IS READILY ABSORBED THROUGH THE SKIN.
INGESTION MAY CAUSE NAUSEA, VOMITING, HEADACHES, DIZZINESS, GASTROINTESTINAL IRRITATION.
CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE DAMAGE TO KIDNEYS, LIVER, LUNGS, BLOOD, OR CENTRAL NERVOUS SYSTEM.

TARGET ORGANS
KIDNEYS, LIVER, EYES, SKIN, CENTRAL NERVOUS SYSTEM

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
BRONCHITIS, KIDNEY, LIVER, OR BLOOD DISORDERS, HEART DISORDERS, ASTHMA, CIRCULATOY DISORDERS

ROUTES OF ENTRY
INGESTION, INHALATION, ABSORPTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, DO NOT INDUCE VOMITING.
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 WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION

INCOMPATIBLES: STRONG OXIDIZING AGENTS, ALUMINUM, MAGNESIUM, AMMONIA, STRONG BASES, NITRIC ACID, POTASSIUM METAL

DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE, PHOSGENE, CARBON MONOXIDE, CARBON DIOXIDE

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
SHUT OFF IGNITION SOURCES; NO FLARES, SMOKING OR FLAMES IN AREA. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO

CONTAINER FOR LATER DISPOSAL. FLUSH AREA WITH WATER.

J. T. BAKER SOLUSORB(R) SOLVENT ADSORBENT IS RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D001 (IGNITABLE WASTE)

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8 - PROTECTIVE EQUIPMENT

VENTILATION:	USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.
RESPIRATORY PROTECTION:	RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS ABOVE 10 PPM, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.
EYE/SKIN PROTECTION:	SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, NEOPRENE GLOVES ARE RECOMMENDED.

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9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: RED (FLAMMABLE)

SPECIAL PRECAUTIONS
BOND AND GROUND CONTAINERS WHEN TRANSFERRING LIQUID. KEEP CONTAINER TIGHTLY CLOSED. STORE IN A COOL, DRY, WELL-VENTILATED, FLAMMABLE LIQUID STORAGE AREA.

---

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	ETHYLENE DICHLORIDE
HAZARD CLASS	FLAMMABLE LIQUID
UN/NA	UN1184
LABELS	FLAMMABLE LIQUID
REPORTABLE QUANTITY	5000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	ETHYLENE DICHLORIDE
HAZARD CLASS	3.2, 6.1
UN/NA	UN1184
LABELS	FLAMMABLE LIQUID, POISON

Section 6. Health Hazard Data, *continued*

Target Organs: Blood, central and peripheral nervous systems, kidneys, and gastrointestinal (GI) tract.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: An acute, short-term dose of lead could cause acute encephalopathy with seizures, coma, and death. However, short-term exposures of this magnitude are rare. Reversible kidney damage can occur from acute exposure, as well as anemia.
Chronic Effects: Symptoms of chronic long-term overexposure include appetite loss, nausea, metallic taste in the mouth, lead line on gingival (gum) tissue, constipation, anxiety, anemia, pallor of the face and the eye grounds, excessive tiredness, weakness, insomnia, headache, nervous irritability, fine tremors, numbness, muscle and joint pain, and colic accompanied by severe abdominal pain. Paralysis of wrist and, less often, ankle extensor muscles may occur after years of increased lead absorption. Kidney disease may also result from chronic overexposure, but few, if any, symptoms appear until severe kidney damage has occurred. Reproductive damage is characterized by decreased sex drive, impotence, and sterility in men; and decreased fertility, abnormal menstrual cycles, and miscarriages in women. Unborn children may suffer neurologic damage or developmental problems due to excessive lead exposure in pregnant women. Lead poisoning's severest result is encephalopathy manifested by severe headache, convulsions, coma, delirium, and possibly death.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Consult a physician if any health complaints develop.
Inhalation: Remove exposed person to fresh air and support breathing as needed. Consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If large amounts of lead were ingested, induce vomiting with Ipecac syrup. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: For diagnosis, obtain blood pressure, blood lead level (PbB), zinc protoporphyrin (ZPP), complete blood count for microcytic anemia and basophilic stippling, urinalysis, and blood urea nitrogen (BUN) of creatinine. Examine peripheral motor neuropathy, pallor, and gingival lead line. Use Ca-EDTA to treat poison, but *never* chelate prophylactically. Consult an occupational physician or toxicologist.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel immediately. Cleanup personnel should protect against inhalation of dusts or fume and contact with skin or eyes. Avoid creating dusty conditions. Water sprays may be used in large quantities to prevent the formation of dust. Cleanup methods such as vacuuming (with an appropriate filter) or wet mopping minimizes dust dispersion. Scoop the spilled material into closed containers for disposal or reclamation. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33, Appendix II—EP Toxicity Test Procedures)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Protective clothing made of man-made fibers and lacking turn-ups, pleats, or pockets retain less dust from lead.
Ventilation: Provide general and local ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[140]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially washing hands before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all incompatible materials, direct sunlight, and heat and ignition sources.
Engineering Controls: Educate worker about lead's hazards. Follow and inform employees of the lead standard (29 CFR 1910.1025). Avoid inhalation of lead dust and fumes and ingestion of lead. Use only with appropriate personal protective gear and adequate ventilation. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Avoid creating dusty conditions. Segregate and launder contaminated clothing. Take precautions to protect laundry personnel. Practice good personal hygiene and housekeeping procedures. For a variety of reasons, the lead concentration in workroom air may not correlate with the blood lead levels in individuals.
Other Precautions: Provide preplacement and periodic medical examinations which emphasize blood, nervous system, gastrointestinal tract, and kidneys, including a complete blood count and urinalysis. Receive a complete history including previous surgeries and hospitalization, allergies, smoking history, alcohol consumption, proprietary drug intake, and occupational and nonoccupational lead exposure. Maintain records for medical surveillance, airborne exposure monitoring, employee complaints, and physician's written opinions for at least 40 years or duration of employment plus 20 years. Measurement of blood lead level (PbB) and zinc protoporphyrin (ZPP) are useful indicators of your body's lead absorption level. Maintain worker PbBs at or below 40 µg/100 g of whole blood. To minimize adverse reproductive health effects to parents and developing fetus, maintain the PbBs of workers intending to have children below 30 µg/100 g. Elevated PbBs increase your risk of disease, and the longer you have elevated PbBs, the greater your chance of substantial permanent damage.

Transportation Data (49 CFR 172.102)
IMO Shipping Name: Lead compounds, soluble, n.o.s.
IMO Hazard Class: 6.1
ID No.: UN2291
IMO Label: St. Andrews Cross (X, Stow away from foodstuffs)
IMDG Packaging Group: III

MSDS Collection References: 26, 38, 73, 84, 85, 88, 89, 90, 100, 101, 103, 109, 124, 126, 132, 133, 134, 136, 138, 139, 142, 143
Prepared by: MJ Allison, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: MJ Upfal, MD, MPH; Edited by: JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 713
Lead (Inorganic)

Issued: 8/90

Section 1. Material Identification

Lead (Inorganic) (Pb) Description: Exists widely throughout the world in a number of ores. Its main commercial source is galena (lead sulphide). Lead mineral is separated from crude ores by blast-furnace smelting, drossing, or electrolytic refining. Lead is used mostly in manufacturing storage batteries. Other uses are in manufacturing tetraethyllead and both organic and inorganic lead compounds in ceramics, plastics, and electronic devices; in producing ammunition, solder, cable covering, sheet lead, and other metal products (brass, pipes, caulking); in metallurgy; in weights and as ballast; as a chemical intermediate for lead alkyls and pigments; as a construction material for the tank linings, piping, and equipment used to handle the corrosive gases and liquids used in sulfuric acid manufacturing, petroleum refining, halogenation, sulfonation, extraction, and condensation; and for x-ray and atomic radiation protection.
Other Designations: CAS No. 7439-92-1, lead oxide; lead salts, inorganic; metallic lead; plumbum.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R	0	
I	4	
S	-	
K	0	

Genium

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PPG*
* Sec. 8

Cautions: *Inorganic lead is a potent systemic poison.* Organic lead (for example, tetraethyl lead) has severe, but different, health effects. Occupational lead poisoning is due to inhalation of dust and fumes. Major affected organ systems are the nervous, blood, and reproductive systems, and kidneys. Health impairment or disease may result from a severe acute short- or long-term exposure.

Section 2. Ingredients and Occupational Exposure Limits

Lead (inorganic) fumes and dusts, as Pb, ca 100%

1989 OSHA PELs (Lead, inorganic compounds)
8-hr TWA: 50 µg/m³
Action Level TWA*: 30 µg/m³

29 CFR 1910.1025 Lead Standard
Blood Lead Level: 40 µg/100 g

1989-90 ACGIH TLV (Lead, inorganic, fumes and dusts)
TLV-TWA: 150 µg/m³

1988 NIOSH REL
10-hr TWA: <100 µg/m³

1985-86 Toxicity Data†
Human, inhalation, TC_{Lo}: 10 µg/m³ affects gastrointestinal tract and liver
Human, oral, TD_{Lo}: 450 mg/kg ingested over 6 yr affects peripheral and central nervous systems
Rat, oral, TD_{Lo}: 790 mg/kg affects multigeneration reproduction

* Action level applies to employee exposure without regard to respirator use.
† See NIOSH, *RTECS* (OF7525000), for additional mutative, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 3164 °F (1740 °C)
Melting Point: 621.3 °F (327.4 °C)
Vapor Pressure: 1.77 mm Hg at 1832 °F (1000 °C)
Viscosity: 3.2 cp at 621.3 °F (327.4 °C)
Molecular Weight: 207.20
Specific Gravity (20 °C/4 °C): 11.34
Water Solubility: Relatively insoluble in hot or cold water*

Appearance and Odor: Bluish-white, silvery, gray, very soft metal.

* Lead dissolves more easily at a low pH.

Section 4. Fire and Explosion Data

Flash Point: None reported	Autoignition Temperature: None reported	LEL: None reported	UEL: None reported

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or foam to extinguish fire.
Unusual Fire or Explosion Hazards: Flammable and moderately explosive in the form of dust when exposed to heat or flame.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Lead is stable at room temperature in closed containers under normal storage and handling conditions. It tarnishes on exposure to air. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Mixtures of hydrogen peroxide + nitroxane explode on contact with lead. Lead is incompatible with sodium azide, zirconium, disodium acetylide, and oxidants. A violent reaction on ignition may occur with concentrated hydrogen peroxide, chlorine trifluoride, sodium acetylide (with powdered lead), ammonium nitrate (below 200 °C with powdered lead). Lead is attacked by pure water and weak organic acids in the presence of oxygen. Lead is resistant to tap water, hydrofluoric acid, brine, and solvents.
Conditions to Avoid: Rubber gloves containing lead may ignite in nitric acid.
Hazardous Products of Decomposition: Thermal oxidative decomposition of lead can produce highly toxic fumes of lead.

Section 6. Health Hazard Data

Carcinogenicity: Although the NTP and OSHA do not list lead as a carcinogen, the IARC lists it as probably carcinogenic to humans, but having (usually) no human evidence. However, the literature reports instances of lead-induced neoplasms, both benign and malignant, of the kidney and other organs in laboratory rodents. Excessive exposure to lead has resulted in neurologic disorders in infants. Experimental studies show lead has reproductive and teratogenic effects in laboratory animals. Human male and female reproductive effects are also documented.
Summary of Risks: Lead is a potent, systemic poison that affect a variety of organ systems, including the nervous system, kidneys, reproductive system, blood formation, and gastrointestinal (GI) system. The most important way lead enters the body is through inhalation, but it can also be ingested when lead dust or unwashed hands contaminate food, drink, or cigarettes. Much of ingested lead passes through feces without absorption into the body. Adults may absorb only 5 to 15% of ingested lead; children may absorb a much larger fraction. Once in the body, lead enters the bloodstream and circulates to various organs. Lead concentrates and remains in bone for many years. The amount of lead the body stores increases as exposure continues, with possibly cumulative effects. Depending on the dose entering the body, lead can be deadly within several days or affect health after many years. Very high doses can cause brain damage (encephalopathy).
Medical Conditions Aggravated by Exposure: Lead may aggravate nervous system disorders (e.g., epilepsy, neuropathies), kidney diseases, high blood pressure (hypertension), infertility, and anemia. Lead-induced anemia and its effect on blood presssure can aggravate cardiovascular disease.

Continue on next page

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1 - PRODUCT IDENTIFICATION

PRODUCT NAME: MANGANESE, FLAKES
FORMULA: MN
FORMULA WT: 54.94
CAS NO.: 7439-96-5
NIOSH/RTECS NO.: OO9275000
PRODUCT CODES: 5825
EFFECTIVE: 11/12/86
REVISION #03

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	1	SLIGHT
FLAMMABILITY	-	0	NONE
REACTIVITY	-	1	SLIGHT
CONTACT	-	0	NONE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES; LAB COAT; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

CAUTION
MAY CAUSE IRRITATION
HARMFUL IF SWALLOWED OR INHALED

DURING USE AVOID CONTACT WITH EYES, SKIN, CLOTHING. WASH THOROUGHLY AFTER HANDLING. WHEN NOT IN USE KEEP IN TIGHTLY CLOSED CONTAINER.

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
MANGANESE	90-100	7439-96-5

3 - PHYSICAL DATA

BOILING POINT:	2097 C (3807 F)	VAPOR PRESSURE(MM HG):	1.9
MELTING POINT:	1260 C (2300 F)	VAPOR DENSITY(AIR=1):	N/A
SPECIFIC GRAVITY: (H2O=1)	7.20	EVAPORATION RATE: (BUTYL ACETATE=1)	N/A

SOLUBILITY(H2O): DECOMPOSES % VOLATILES BY VOLUME: 0

APPEARANCE & ODOR: SILVER OR GRAYISH FLAKES WITH NO ODOR.

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA
USE DRY CHEMICAL OR CARBON DIOXIDE. DO NOT USE WATER.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

UNUSUAL FIRE & EXPLOSION HAZARDS
DUST MAY FORM EXPLOSIVE MIXTURE WITH AIR.
REACTS VIOLENTLY WITH WATER PRODUCING HIGHLY FLAMMABLE VAPORS.
CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE OR EXPLOSION.

TOXIC GASES PRODUCED
HYDROGEN GAS

---

5 - HEALTH HAZARD DATA

PEL AND TLV LISTED DENOTE CEILING LIMIT.

THRESHOLD LIMIT VALUE (TLV/TWA): 5 MG/M3 (PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 5 MG/M3 (PPM)

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
DUST INHALATION MAY CAUSE TIGHTNESS AND PAIN IN CHEST, COUGHING, AND DIFFICULTY IN BREATHING.
INHALATION OF DUST MAY CAUSE HEADACHE, NAUSEA, VOMITING, SHORTNESS OF BREATH, OR BLURRED VISION.
DUST MAY IRRITATE SKIN OR EYES.
INGESTION MAY CAUSE CENTRAL NERVOUS SYSTEM DEPRESSION.
PROLONGED INHALATION OF MANGANESE IN THE FORM OF ITS INORGANIC COMPOUNDS MAY CAUSE MANGANISM.
NOTE: PRODUCT IS A SOLID MASS; HOWEVER, WARNINGS ARE BASED ON INHALATION DUST, MIST OR FUME EMISSIONS THAT ARE POSSIBLE DURING MANUFACTURING OR CHEMICAL REACTIONS.

TARGET ORGANS
RESPIRATORY SYSTEM, CENTRAL NERVOUS SYSTEM, BLOOD, KIDNEYS

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
CHRONIC RESPIRATORY DISEASE, LIVER OR KIDNEY DISORDERS, PSYCHIATRIC DISORDERS, ALCOHOLISM, NERVE SYSTEM DISORDERS

ROUTES OF ENTRY
INHALATION, INGESTION

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, IF CONSCIOUS, IMMEDIATELY INDUCE VOMITING.
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 WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

---

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION, MOISTURE, STEAM, DUSTING

INCOMPATIBLES: WATER, STRONG OXIDIZING AGENTS, STRONG ACIDS, PHOSPHORUS

DECOMPOSITION PRODUCTS: HYDROGEN

---

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SUITABLE PROTECTIVE CLOTHING. CAREFULLY SWEEP UP AND REMOVE.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

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8 - PROTECTIVE EQUIPMENT

EYE/SKIN PROTECTION: THIS IS A LABORATORY-USE PRODUCT FOR WHICH NO INDUSTRIAL PROTECTIVE EQUIPMENT HAS BEEN DESIGNATED.

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9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE

AREA.

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10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME CHEMICALS, N.O.S. (NON-REGULATED)

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME CHEMICALS, N.O.S. (NON-REGULATED)

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: SILVER, 1000 PPM (0.100% W/V)
FORMULA: AG
FORMULA WT: 107.90
CAS NO.: - -
PRODUCT CODES: 6940
EFFECTIVE: 11/24/86
REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	2	MODERATE
FLAMMABILITY	-	0	NONE
REACTIVITY	-	1	SLIGHT
CONTACT	-	3	SEVERE (CORROSIVE)

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

DANGER
CAUSES BURNS
HARMFUL IF SWALLOWED

DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: WHITE (CORROSIVE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
SILVER	0-1	7440-22-4
NITRIC ACID (1.0 MOLAR)	4-5	7697-37-2

3 - PHYSICAL DATA

BOILING POINT: N/A
VAPOR PRESSURE(MM HG): N/A

MELTING POINT: N/A
VAPOR DENSITY(AIR=1): N/A

SPECIFIC GRAVITY: N/A (H2O=1)
EVAPORATION RATE: N/A (BUTYL ACETATE=1)

SOLUBILITY(H2O): COMPLETE (IN ALL PROPORTIONS) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: CLEAR, COLORLESS SOLUTION.

---

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A NFPA 704M RATING: 3-0-0

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

TOXIC GASES PRODUCED
NITROGEN OXIDES

---

5 - HEALTH HAZARD DATA

TOXICITY TEST RESULTS AND SAFETY AND HEALTH EFFECTS ARE BASED ON THE SOLUTE.

THRESHOLD LIMIT VALUE (TLV/TWA): 0.01 MG/M3 (PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 0.01 MG/M3 (PPM)

TOXICITY: LD50 (ORAL-MOUSE)(MG/KG) - 50
LD50 (IPR-MOUSE)(MG/KG) - 22

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
VAPORS MAY BE IRRITATING TO SKIN, EYES, AND MUCOUS MEMBRANES.
LIQUID MAY CAUSE BURNS TO SKIN AND EYES.
INGESTION MAY CAUSE IRRITATION AND BURNING TO MOUTH AND STOMACH.

TARGET ORGANS
EYES, SKIN

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INGESTION, INHALATION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.

IF SWALLOWED, DO NOT INDUCE VOMITING; IF CONSCIOUS, GIVE WATER, MILK, OR

MILK OF MAGNESIA.
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 WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
WASH CLOTHING BEFORE RE-USE.

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: LIGHT

INCOMPATIBLES: ORGANIC MATERIALS, STRONG REDUCING AGENTS, STRONG BASES

DECOMPOSITION PRODUCTS: OXIDES OF NITROGEN

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING. STOP LEAK IF YOU CAN DO SO WITHOUT RISK. VENTILATE AREA. NEUTRALIZE SPILL WITH SODA ASH OR LIME. WITH CLEAN SHOVEL, CAREFULLY PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; REMOVE FROM AREA. FLUSH SPILL AREA WITH WATER.

J. T. BAKER NEUTRASORB(R) OR NEUTRASOL(R) "LOW NA+" ACID NEUTRALIZERS ARE RECOMMENDED FOR SPILLS OF THIS PRODUCT.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: D002 (CORROSIVE WASTE)

8 - PROTECTIVE EQUIPMENT

EYE/SKIN PROTECTION: THIS IS A LABORATORY-USE PRODUCT FOR WHICH NO INDUSTRIAL PROTECTIVE EQUIPMENT HAS BEEN DESIGNATED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: WHITE (CORROSIVE)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. STORE IN CORROSION-PROOF AREA.

KEEP PRODUCT OUT OF LIGHT.

---

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	NITRIC ACID, 40% OR LESS SOLUTION
HAZARD CLASS	CORROSIVE MATERIAL (LIQUID)
UN/NA	NA1760
LABELS	CORROSIVE
REPORTABLE QUANTITY	1000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	NITRIC ACID, SOLUTION
HAZARD CLASS	8
UN/NA	UN2031
LABELS	CORROSIVE

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: 1,1,1-TRICHLOROETHANE
FORMULA: CH3CCL3
FORMULA WT: 133.41
CAS NO.: 71-55-6
NIOSH/RTECS NO.: KJ2975000
COMMON SYNONYMS: CHLOROETHENE; METHYLCHLOROFORM; METHYLTRICHLOROMETHANE; ALPHA-TRICHLOROETHANE
PRODUCT CODES: W509,5381,W510,9436,9437
EFFECTIVE: 07/30/86
REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	1	SLIGHT
FLAMMABILITY	-	1	SLIGHT
REACTIVITY	-	1	SLIGHT
CONTACT	-	2	MODERATE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

SAFETY GLASSES; LAB COAT; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

WARNING
CAUSES IRRITATION
HARMFUL IF SWALLOWED OR INHALED

AVOID CONTACT WITH EYES, SKIN, CLOTHING.
AVOID BREATHING VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
1,1,1-TRICHLOROETHANE	90-100	71-55-6

3 - PHYSICAL DATA

BOILING POINT: 74 C (165 F) VAPOR PRESSURE(MM HG): 100

MELTING POINT: -33 C (-27 F) VAPOR DENSITY(AIR=1): 4.6

SPECIFIC GRAVITY: 1.32 (H2O=1) EVAPORATION RATE: 12.8 (BUTYL ACETATE=1)

SOLUBILITY(H2O): NEGLIGIBLE (LESS THAN 0.1 %) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: COLORLESS LIQUID WITH A MILD ETHER-LIKE ODOR.

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4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A NFPA 704M RATING: 2-1-0

FLAMMABLE LIMITS: UPPER - 15.0 % LOWER - 7.5 %

FIRE EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE.

TOXIC GASES PRODUCED
HYDROGEN CHLORIDE, PHOSGENE, CHLORINE

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5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 1900 MG/M3 (350 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): 2450 MG/M3 (450 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): 1900 MG/M3 (350 PPM)

TOXICITY: LD50 (ORAL-RAT)(G/KG) - 10.3
LD50 (IPR-RAT)(MG/KG) - 5100

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
INHALATION OF VAPORS MAY CAUSE NARCOSIS AND DEPRESSION OF CENTRAL NERVOUS SYSTEM.
INHALATION OF VAPORS MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS, DROWSINESS, IRRITATION OF RESPIRATORY TRACT, AND LOSS OF CONSCIOUSNESS.
CONTACT WITH SKIN OR EYES MAY CAUSE IRRITATION.
PROLONGED EXPOSURE MAY CAUSE DERMATITIS.
INGESTION MAY CAUSE NAUSEA AND VOMITING.
CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE KIDNEY AND/OR LIVER DAMAGE.

TARGET ORGANS
CENTRAL NERVOUS SYSTEM, SKIN, EYES, CARDIOVASCULAR SYSTEM

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
LIVER DISORDERS, HEART DISORDERS, SENSITIVE SKIN

ROUTES OF ENTRY
INGESTION, INHALATION, SKIN CONTACT, EYE CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, DO NOT INDUCE VOMITING.
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 WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

---

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: MOISTURE, INSUFFICIENT INHIBITOR, HEAT, FLAME, OTHER SOURCES OF IGNITION, SUNLIGHT AND ULTRAVIOLET LIGHT

INCOMPATIBLES: WATER, STRONG BASES, ALUMINUM, CHEMICALLY ACTIVE METALS, STRONG OXIDIZING AGENTS

DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE, PHOSGENE, CHLORINE, CARBON MONOXIDE

---

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS.
TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO CONTAINER FOR LATER DISPOSAL. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U226 (TOXIC WASTE)

---

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: NONE REQUIRED WHERE ADEQUATE VENTILATION CONDITIONS EXIST. IF AIRBORNE CONCENTRATION IS HIGH, A CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE IS RECOMMENDED. IF CONCENTRATION EXCEEDS CAPACITY OF CARTRIDGE RESPIRATOR, A SELF-CONTAINED BREATHING APPARATUS IS ADVISED.

EYE/SKIN PROTECTION: SAFETY GOGGLES, UNIFORM, APRON, POLYVINYL ALCOHOL GLOVES ARE RECOMMENDED.

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE AREA.

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	1,1,1-TRICHLOROETHANE (AIR ONLY)
HAZARD CLASS	ORM-A
UN/NA	UN2831
LABELS	NONE
REPORTABLE QUANTITY	1000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	1,1,1-TRICHLOROETHANE
HAZARD CLASS	6.1
UN/NA	UN2831
LABELS	HARMFUL - STOW AWAY FROM FOOD STUFFS

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: ZINC
FORMULA: ZN
FORMULA WT: 65.37
CAS NO.: 7440-66-6
NIOSH/RTECS NO.: ZG8600000
COMMON SYNONYMS: BLUE POWDER
PRODUCT CODES: 4244,4290,4240,4252,4260,4248,4274,5828,4264,4270
EFFECTIVE: 06/25/86
REVISION #02

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	0	NONE
FLAMMABILITY	-	1	SLIGHT
REACTIVITY	-	2	MODERATE
CONTACT	-	0	NONE

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

SAFETY GLASSES; LAB COAT

PRECAUTIONARY LABEL STATEMENTS

WARNING
CAUSES IRRITATION

DURING USE AVOID CONTACT WITH EYES, SKIN, CLOTHING. WASH THOROUGHLY AFTER HANDLING. WHEN NOT IN USE KEEP IN TIGHTLY CLOSED CONTAINER.

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
ZINC	90-100	7440-66-6

3 - PHYSICAL DATA

BOILING POINT: 908 C (1666 F)
MELTING POINT: 420 C (788 F)
SPECIFIC GRAVITY: 7.14 (H2O=1)
VAPOR PRESSURE(MM HG): 1
VAPOR DENSITY(AIR=1): N/A
EVAPORATION RATE: N/A (BUTYL ACETATE=1)

1 - PRODUCT IDENTIFICATION

PRODUCT NAME: TRICHLOROETHYLENE
FORMULA: C2HCL3
FORMULA WT: 131.40
CAS NO.: 79-01-6
NIOSH/RTECS NO.: KX4550000
COMMON SYNONYMS: TRICHLOROETHENE; ETHINYL TRICHLORIDE; ACETYLENE TRICHLORIDE; TCE
PRODUCT CODES: 5376,9458,9454,9455,9464,9473
EFFECTIVE: 01/22/87
REVISION #03

PRECAUTIONARY LABELLING

BAKER SAF-T-DATA(TM) SYSTEM

HEALTH	-	3	SEVERE (CANCER CAUSING)
FLAMMABILITY	-	1	SLIGHT
REACTIVITY	-	1	SLIGHT
CONTACT	-	1	SLIGHT

HAZARD RATINGS ARE 0 TO 4 (0 = NO HAZARD; 4 = EXTREME HAZARD).

LABORATORY PROTECTIVE EQUIPMENT

GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES

PRECAUTIONARY LABEL STATEMENTS

WARNING
HARMFUL IF SWALLOWED OR INHALED
CAUSES IRRITATION
NOTE: THIS MATERIAL OR ITS VAPORS IN CONTACT WITH FLAMES OR HOT GLOWING SURFACES MAY FORM CORROSIVE ACID FUMES.
NOTE: REPORTED AS CAUSING CANCER IN LABORATORY ANIMALS. EXERCISE DUE CARE.
AVOID CONTACT WITH EYES, SKIN, CLOTHING.
DO NOT BREATHE VAPOR. KEEP IN TIGHTLY CLOSED CONTAINER. USE WITH ADEQUATE VENTILATION. WASH THOROUGHLY AFTER HANDLING.

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

2 - HAZARDOUS COMPONENTS

COMPONENT	%	CAS NO.
TRICHLOROETHYLENE	90-100	79-01-6

3 - PHYSICAL DATA

BOILING POINT: 87 C (189 F) VAPOR PRESSURE(MM HG): 58

MELTING POINT: -73 C (-99 F) VAPOR DENSITY(AIR=1): 4.53

SPECIFIC GRAVITY: 1.47 (H2O=1) EVAPORATION RATE: N/A (BUTYL ACETATE=1)

SOLUBILITY(H2O): SLIGHT (0.1 TO 1 %) % VOLATILES BY VOLUME: 100

APPEARANCE & ODOR: COLORLESS LIQUID WITH CHLOROFORM ODOR.

---

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A NFPA 704M RATING: 2-1-0

FLAMMABLE LIMITS: UPPER - 10.5 % LOWER - 8.0 %

FIRE EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

SPECIAL FIRE-FIGHTING PROCEDURES
FIREFIGHTERS SHOULD WEAR PROPER PROTECTIVE EQUIPMENT AND SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN POSITIVE PRESSURE MODE. MOVE CONTAINERS FROM FIRE AREA IF IT CAN BE DONE WITHOUT RISK. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL.

UNUSUAL FIRE & EXPLOSION HAZARDS
GIVES OFF FLAMMABLE VAPORS. VAPORS MAY FORM EXPLOSIVE MIXTURE WITH AIR. CLOSED CONTAINERS EXPOSED TO HEAT MAY EXPLODE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRE.

TOXIC GASES PRODUCED
HYDROGEN CHLORIDE, PHOSGENE, CHLORINE, CARBON MONOXIDE, CARBON DIOXIDE

---

5 - HEALTH HAZARD DATA

SOME EXPERIMENTS WITH TEST ANIMALS INDICATED THAT THIS SUBSTANCE MAY BE ANTICIPATED TO BE A CARCINOGEN.

THRESHOLD LIMIT VALUE (TLV/TWA): 270 MG/M3 (50 PPM)

SHORT-TERM EXPOSURE LIMIT (STEL): 1080 MG/M3 (200 PPM)

PERMISSIBLE EXPOSURE LIMIT (PEL): MG/M3 (100 PPM)

TOXICITY: LD50 (ORAL-RAT)(MG/KG) - 7193
LD50 (IPR-MOUSE)(MG/KG) - 3000
LD50 (IV-MOUSE) (MG/KG) - 34

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
INHALATION OF VAPORS MAY CAUSE HEADACHE, NAUSEA, VOMITING, DIZZINESS,

---

DROWSINESS, IRRITATION OF RESPIRATORY TRACT, AND LOSS OF CONSCIOUSNESS.

INHALATION OF VAPORS MAY CAUSE PULMONARY EDEMA.
CONTACT WITH SKIN OR EYES MAY CAUSE IRRITATION.
PROLONGED EXPOSURE MAY CAUSE DERMATITIS.
INGESTION MAY CAUSE NAUSEA, VOMITING, HEADACHES,DIZZINESS,
GASTROINTESTINAL IRRITATION, CENTRAL NERVOUS SYSTEM DEPRESSION AND
HEARING LOSS.
CHRONIC EFFECTS OF OVEREXPOSURE MAY INCLUDE DAMAGE TO KIDNEYS, LIVER,
LUNGS, BLOOD, OR CENTRAL NERVOUS SYSTEM.

TARGET ORGANS
RESPIRATORY SYSTEM, HEART, LIVER, KIDNEYS, CENTRAL NERVOUS SYSTEM

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
INHALATION, INGESTION, EYE CONTACT, SKIN CONTACT

EMERGENCY AND FIRST AID PROCEDURES
CALL A PHYSICIAN.
IF SWALLOWED, DO NOT INDUCE VOMITING.
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 WITH PLENTY OF WATER FOR AT
LEAST 15 MINUTES. FLUSH SKIN WITH WATER.

ACCEPTABLE MAXIMUM PEAK ABOVE THE ACCEPTANCE CEILING CONCENTRATION FOR AN
EIGHT-HOUR SHIFT = 300 PPM FOR 5 MINUTES IN ANY 2 HOURS. (PEL)
CEILING = 200 PPM.

---

6 - REACTIVITY DATA

STABILITY: STABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: HEAT, FLAME, OTHER SOURCES OF IGNITION, LIGHT

INCOMPATIBLES: CHEMICALLY ACTIVE METALS, STRONG BASES,
STRONG OXIDIZING AGENTS

DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE, PHOSGENE, CHLORINE,
CARBON MONOXIDE, CARBON DIOXIDE

---

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE CLOTHING.
STOP LEAK IF YOU CAN DO SO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS.
TAKE UP WITH SAND OR OTHER NON-COMBUSTIBLE ABSORBENT MATERIAL AND PLACE
INTO CONTAINER FOR LATER DISPOSAL. FLUSH SPILL AREA WITH WATER.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL

ENVIRONMENTAL REGULATIONS.

EPA HAZARDOUS WASTE NUMBER: U228 (TOXIC WASTE)

---

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE GENERAL OR LOCAL EXHAUST VENTILATION TO MEET TLV REQUIREMENTS.

RESPIRATORY PROTECTION: RESPIRATORY PROTECTION REQUIRED IF AIRBORNE CONCENTRATION EXCEEDS TLV. AT CONCENTRATIONS UP TO 1000 PPM, A CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE IS RECOMMENDED. ABOVE THIS LEVEL, A SELF-CONTAINED BREATHING APPARATUS IS RECOMMENDED.

EYE/SKIN PROTECTION: SAFETY GOGGLES AND FACE SHIELD, UNIFORM, PROTECTIVE SUIT, NEOPRENE GLOVES ARE RECOMMENDED.

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9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: BLUE (HEALTH)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. STORE IN SECURE POISON AREA.

---

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	TRICHLOROETHYLENE (AIR ONLY)
HAZARD CLASS	ORM-A
UN/NA	UN1710
LABELS	NONE
REPORTABLE QUANTITY	1000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME	TRICHLOROETHYLENE
HAZARD CLASS	6.1
UN/NA	UN1710
LABELS	HARMFUL - STOW AWAY FROM FOOD STUFFS

SOLUBILITY(H2O): NEGLIGIBLE (LESS THAN 0.1 %) % VOLATILES BY VOLUME: 0

APPEARANCE & ODOR: BLUISH-WHITE ODORLESS SOLID.

---

4 - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (CLOSED CUP N/A

FLAMMABLE LIMITS: UPPER - N/A % LOWER - N/A %

FIRE EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE FOR SURROUNDING FIRE.

UNUSUAL FIRE & EXPLOSION HAZARDS
REACTS VIOLENTLY WITH WATER LIBERATING AND IGNITING HYDROGEN.

---

5 - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV/TWA): 10 MG/M3 (PPM)

CARCINOGENICITY: NTP: NO IARC: NO Z LIST: NO OSHA REG: NO

EFFECTS OF OVEREXPOSURE
CONTACT WITH SKIN OR EYES MAY CAUSE SEVERE IRRITATION OR BURNS.
INHALATION OF DUST MAY CAUSE IRRITATION TO UPPER RESPIRATORY TRACT.
PROLONGED EXPOSURE MAY CAUSE DERMATITIS.
NOTE: PRODUCT IS A SOLID MASS; HOWEVER, WARNINGS ARE BASED ON INHALATION DUST, MIST OR FUME EMISSIONS THAT ARE POSSIBLE DURING MANUFACTURING OR CHEMICAL REACTIONS.

TARGET ORGANS
NONE IDENTIFIED

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE
NONE IDENTIFIED

ROUTES OF ENTRY
NONE INDICATED

EMERGENCY AND FIRST AID PROCEDURES
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 WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
WASH CLOTHING BEFORE RE-USE.

---

6 - REACTIVITY DATA

STABILITY: UNSTABLE HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: MOISTURE

INCOMPATIBLES: STRONG ACIDS, STRONG BASES, STRONG OXIDIZING AGENTS, ALKALI METALS, HALOGENATED HYDROCARBONS

DECOMPOSITION PRODUCTS: OXIDES OF ZINC

---

7 - SPILL AND DISPOSAL PROCEDURES

STEPS TO BE TAKEN IN THE EVENT OF A SPILL OR DISCHARGE
WEAR SUITABLE PROTECTIVE CLOTHING. CAREFULLY SWEEP UP AND REMOVE.

DISPOSAL PROCEDURE
DISPOSE IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL ENVIRONMENTAL REGULATIONS.

---

8 - PROTECTIVE EQUIPMENT

VENTILATION: USE ADEQUATE GENERAL OR LOCAL EXHAUST VENTILATION TO KEEP FUME OR DUST LEVELS AS LOW AS POSSIBLE.

RESPIRATORY PROTECTION: NONE REQUIRED WHERE ADEQUATE VENTILATION CONDITIONS EXIST. IF AIRBORNE CONCENTRATION IS HIGH, USE AN APPROPRIATE RESPIRATOR OR DUST MASK.

EYE/SKIN PROTECTION: SAFETY GLASSES WITH SIDESHIELDS, PROPER GLOVES ARE RECOMMENDED.

---

9 - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA(TM) STORAGE COLOR CODE: ORANGE (GENERAL STORAGE)

SPECIAL PRECAUTIONS
KEEP CONTAINER TIGHTLY CLOSED. SUITABLE FOR ANY GENERAL CHEMICAL STORAGE AREA.

---

10 - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

PROPER SHIPPING NAME	ZINC
HAZARD CLASS	ORM-E
LABELS	NONE
REPORTABLE QUANTITY	1000 LBS.

INTERNATIONAL (I.M.O.)

PROPER SHIPPING NAME CHEMICALS, N.O.S. (NON-REGULATED)

Field Sampling Plan

Appendix B

Monitoring Well Construction Details

Table B-1				
Monitoring Well Survey Data - NAB Little Creek				
Site	Well	Casing	Horizontal Coordinates	
		Elevation	N	E
Site 5	LC5-GW01			
	LC5-GW02			
	LC5-GW03			
	LC5-GW04			
Site 7	LC7-GW1			
	LC7-GW2			
	LC7-GW3			
	LC7-GW4			
	LC7-GW5			
	LC7-GW6			
	LC7-GW7			
	LC7-GW8			
	LC7-GW9			
Site 9	LC9-GW2	5.59		
	LC9-GW4	10.57		
	LC9-GW5	12.52		
	LC9-GW6	8.53		
	LC9-UST1			
	LC9-UST3			
Site 10	LC10-GW1	16.33		
	LC10-GW2	13.67		
	LC10-GW3			
	LC10-GW4	14.43		
	LC10-GW5	13.14		
	LC10-GW6	11.68		
	LC10-GW7	12.85		
	LC10-GW8	10.8		
Site 11	LC11-GW01	8.11		
	LC11-GW02	6.98		
	LC11-GW03	6.42		

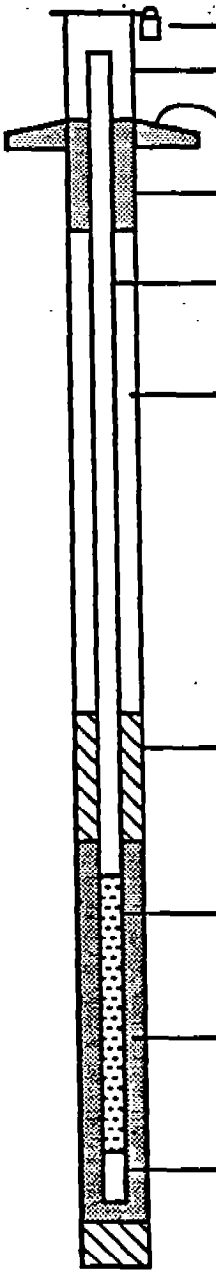
CONSTRUCTION SKETCH
MONITORING WELL

EBASCO

JECT LITTLE CREEK PRELIMINARY SITE INSPECTION
JOB NO. NAVY 1812001
DRILLING SUBCONTRACTOR Fishburne Drilling Co.
DRILLER J. Fishburne

DRILLING METHOD Hollow Stem Auger
MONITORING WELL NUMBER LC5-GW01
DATE OF WELL INSTALLATION 12/10/90
DATE OF WELL DEVELOPMENT 12/12/90
GEOLOGIST S. MAHMUD

ELEVATION (M.S.L.)	DEPTH OR HEIGHT FROM GROUND SURFACE		
		LOCKING CAP	
		O.D. OF OUTER PROTECTIVE CASING	4"
	0.0	DIMENSION OF CONCRETE PAD	3' x 3'
		TYPE OF SURFACE SEAL	cement with grout
	2'	I.D. OF RISER PIPE	2"
		TYPE OF RISER PIPE	PVC
		TYPE OF BACKFILL	sand
		EMPLACEMENT METHOD	poured
	7'	TYPE OF SEAL	Bentonite
		EMPLACEMENT METHOD	Poured
	9'		
	10'	I.D. OF SCREEN	1.75"
		SLOT SIZE OF SCREEN	0.010"
		TYPE OF SCREEN	Slotted
		SIZE OF FILTER SAND	20-40 mesh poured
		EMPLACEMENT METHOD	or natural
	20'	LENGTH OF TAILPIPE (IF PRESENT)	n/a



N/A - NOT APPLICABLE

WATER LEVEL EASUREMENTS	DATE									
	DEPTH FROM TOP OF RISER PIPE									
	ELEVATION									

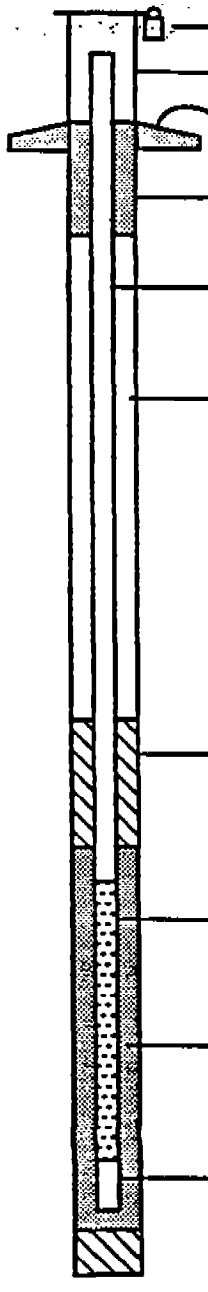
CONSTRUCTION SKETCH
MONITORING WELL

EBASCO

PROJECT: LITTLE CREEK PRELIMINARY SITE INSPECTION
JOB NO.: NAVY 1812001
DRILLING SUBCONTRACTOR: Fishburne Drilling Co.
DRILLER: J. Fishburne

DRILLING METHOD: Hollow Stem Auger
MONITORING WELL NUMBER: LC5-GW02
DATE OF WELL INSTALLATION: 12/10/90
DATE OF WELL DEVELOPMENT: 12/12/90
GEOLOGIST: S. MAHMUD

ELEVATION (M.S.L.)	DEPTH OR HEIGHT FROM GROUND SURFACE		
		LOCKING CAP	
		O.D. OF OUTER PROTECTIVE CASING	4"
	0.0	DIMENSION OF CONCRETE PAD	3' x 3'
		TYPE OF SURFACE SEAL	cement with grout
	2'	I.D. OF RISER PIPE	2"
		TYPE OF RISER PIPE	PVC
		TYPE OF BACKFILL	sand
		EMPLACEMENT METHOD	poured
	7'	TYPE OF SEAL	Bentonite
		EMPLACEMENT METHOD	Poured
	9'		
	10'	I.D. OF SCREEN	1.75"
		SLOT SIZE OF SCREEN	0.010"
		TYPE OF SCREEN	Slotted
		SIZE OF FILTER SAND	20-40 mesh poured
		EMPLACEMENT METHOD	or natural
	20'	LENGTH OF TAILPIPE (IF PRESENT)	n/a



N/A - NOT APPLICABLE

WATER LEVEL MEASUREMENTS	DATE									
	DEPTH FROM TOP OF RISER PIPE									
	ELEVATION									

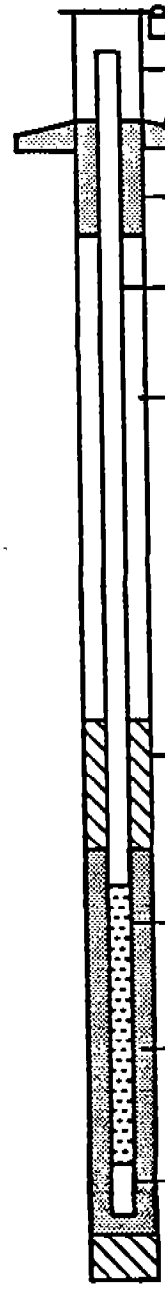
CONSTRUCTION SKETCH
MONITORING WELL

EBASCO

PROJECT: LITTLE CREEK PRELIMINARY SITE INSPECTION
JOB NO.: NAVY 1812001
DRILLING SUBCONTRACTOR: Fishburne Drilling Co.
DRILLER: J. Fishburne

DRILLING METHOD: Hollow Stem Auger
MONITORING WELL NUMBER: LC5-GW03
DATE OF WELL INSTALLATION: 12/10/90
DATE OF WELL DEVELOPMENT: 12/12/90
GEOLOGIST: S. MAHMUD

ELEVATION (M.S.L.)	DEPTH OR HEIGHT FROM GROUND SURFACE		
		LOCKING CAP	
		O.D. OF OUTER PROTECTIVE CASING	Flush mount
	0.0	DIMENSION OF CONCRETE PAD	3' x 3'
		TYPE OF SURFACE SEAL	cement with grout
	2'		
		I.D. OF RISER PIPE	2"
		TYPE OF RISER PIPE	PVC
		TYPE OF BACKFILL	sand
		EMPLACEMENT METHOD	poured
	7'		
		TYPE OF SEAL	Bentonite
		EMPLACEMENT METHOD	Poured
	9'		
	10'		
		I.D. OF SCREEN	1.75"
		SLOT SIZE OF SCREEN	0.010"
		TYPE OF SCREEN	Slotted
		SIZE OF FILTER SAND	20-40 mesh poured
		EMPLACEMENT METHOD	or natural
	20'		
		LENGTH OF TAILPIPE (IF PRESENT)	n/a



N/A - NOT APPLICABLE

WATER LEVEL MEASUREMENTS	DATE									
	DEPTH FROM TOP OF RISER PIPE									
	ELEVATION									

WELL CONSTRUCTION LOG
(UNCONSOLIDATED)

Project NAB-Little Creek CTO-0042 Well LC5-GW04

Location Site 5 - Builings 9-11 Motor Oil Disposal Area

Town/City Virginia Beach

County N/A State Virginia

Permit No. N/A

Land-Surface Elevation and Datum 9.70 feet

Installation Date (s) 5/11/93

Drilling Method 4 1/4" hollow stem auger

Drilling Contractor McCallum

Drilling Fluid N/A

Development Technique(s) and Dates (s) Pump - 5/11/93 & 5/12/93

Water Removed During Development 18 gallons

Static Depth to Water 9.44 feet below ground level

Pumping Depth to Water N/A feet below ground level

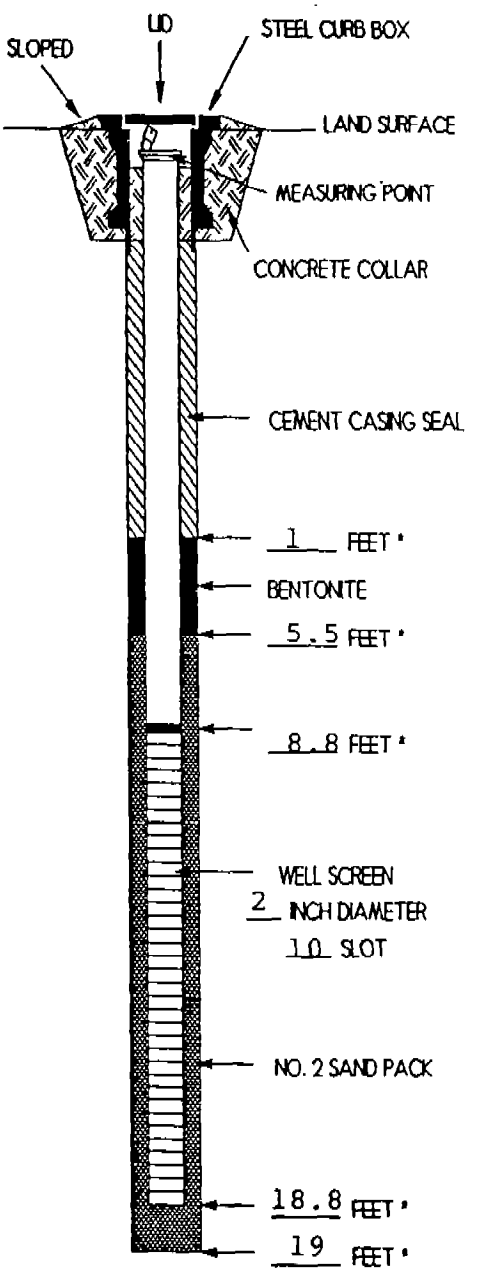
Total Pumping Duration 25 minutes

Yield 0.72 gpm

Well Purpose Groundwater monitoring

Remarks

Geologist/# A. Garibaldi



* DEPTH BELOW LAND SURFACE

FOSTER WHEELER ENVIRONMENTAL SERVICES
TEST BORING LOG

BORING NO.: 05 - SB - 04 DATE: 5/11/93
PROJECT NO./NAME: 4-22-00-192071 / NAB - Little Creek LOCATION: Site 5
GEOLOGIST/OFFICE: A. Garibaldi / Livingston, NJ DRILLING CONTRACTOR: McCallum, Inc.
DRILLER: Raleigh Smith

DRILLING EQUIPMENT/METHOD: Hollow Stem Auger SIZE/TYPE OF BIT: 4 1/4" ID
SAMPLE METHOD: Continuous split-spoon START/FINISH DATE: 5/11/93 - 5/11/93

WELL INSTALLED? YES X NO___ SCREEN:_____ LENGTH:_____ ___TO___ FEET

REMARKS:_____

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/6"	SAMPLE DESCRIPTION	PID READING (PPM)
0-2	01	1.00	9-2-2-1	Top 5" gravel fill material, light brown M SAND, trace silt.	2
2-4	02	0.91	2-1-2-4	Top 5" light brown M-SAND, trace silt, rest well sorted M- SAND with brown mottling, damp.	22
4-6	03	1.50	4-4-5-5	Top 6.5" M- well sorted SAND, brown, trace silt, moist, then 4" light brown well sorted M SAND with brown mottles. Wet shell fragments. Rest dark gray M SILTY SAND with shell fragments.	3
6-8	04	2.00	4-1-1-1	Top 3.5" sluff, rest dark gray M-F SILTY SAND with shell fragments, grading into dark gray silt. Lower 4" saturated.	-
8-10	05	2.00	2-2-2-3	Top 3" sluff, then 3" dark gray CLAY, damp with root material grading into light tan SILTY CLAY with brown rust colored mottling.	-
10-12	06	2.00	2-2-2-3	Top 6" sluff, then 2" gray damp CLAY, rest light brown SILTY CLAY with rusty brown mottles.	-
12-14	07	2.00	2-1-2-4	Top 7" dark gray SILTY CLAY with root material, then light gray CLAYEY SILT grading into light brown SILTY CLAY with some sand and rusty mottling.	-

FOSTER WHEELER ENVIRONMENTAL SERVICES
TEST BORING LOG (continued)

BORING NO.: 05 - SB - 04
PROJECT NO./NAME: 4-22-00-192071 / NAB - Little Creek
GEOLOGIST/OFFICE: A. Garibaldi / Livingston, NJ

DATE: 5/11/93
LOCATION: Site 5
DRILLING CONTRACTOR: McCallum, Inc.
DRILLER: Raleigh Smith

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/6"	SAMPLE DESCRIPTION	PID READING (PPM)
14-16	08	2.00	8-6-6-8	Top 4" sluff, then light brown SILTY CLAY with some sand grading into M-F light brown SILTY SAND. Wet at bottom of spoon.	3

PROJECT NUMBER	BORING NUMBER	
W20368	LC9-GW1	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 7.62' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 4', 4/28/86 START FINISH LOGGER SEXTON

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION: 2 inch PVC
								GROUT
								BENTONITE
	5	4-6	S1	1.4	2-3-5-5	F-M sand; yel. brown (10YR6/2); wet at 4'		SAND
	10	9-11	S2	2.0	0-0-2-2			
	15	14-16	S3	2.0	0-1-1-1	Fine sand w/some clay; ol. gray(5Y4/1)		
	20							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W20368	LC9-GW2	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 6.42' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 4'. 4/28/86 START FINISH LOGGER SEXTON

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION: 2 inch PVC
								GROUT
								BENTONITE
	5	4-6	S1	1.5	3-5-5-9	F-M sand; yellow, orange (10YR6/6); olive gray(5Y6/1) at 9'; wet at 4'		
	10	9-11	S2	2.0	3-4-4-2			SAND
	15	14-16	S3	2.0	0-1-1-3	Fine sand and clay;olive/gray(5Y4/1);wet		
	20							

PROJECT NUMBER	BORING NUMBER	
W20368	LC9-GW3	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 7.86' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 5', 4/25/86 START FINISH LOGGER SEXTON

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION: 2 inch PVC
	5	4-6	S1	1.1	1-1-3-1	F-M sand; roots and wood to 5'; br. gray(5YR4/1)-olive black (5Y2/1)		GROUT; BENTONITE
	10	9-11	S2	2.0	3-5-12-13			SAND
	15	14-16	S3	2.0	1-2-4-7			
	20							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W20368	LC9-GW4	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 8.45' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 6', 4/22/86 START FINISH LOGGER SEXTON

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION (2 inch PVC)
		0-2	S1	1.6	2-8-8-10	Fine sandy clay; yel. brown(10YR5/4); dry		GROUT
	5	4-6	S2	1.6	2-5-6-8	F-M sand w/some silt; yel. brown (10YR6/2); moist-wet		BENTONITE
						Fine sandy clay; brown black(5YR2/1); wet; roots		
	10	9-11	S3	2.0	3-4-6-8			SAND
						F-M sand w/some silt and c. sand; yell. brown(10YR4/2)-olivegray (5Y4/1); roots, wood.		
	15	14-16	S4	2.0	2-2-2-1			
	20							

REV 11/82 FORM D1586

PROJECT NUMBER	BORING NUMBER	
W20368	LC9-GW5	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 10.59' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 8' 4/29/86 START FINISH LOGGER DRONFIELD

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (IN)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION: 2 inch PVC
	5	3.5-5	S1	14	3-5-8	F-C sand; pale orange(10YR8/2)-yel. orange(10YR8/6); wet at 8'		GROUT
								BENTONITE
	10	8.5-10	S2	11	3-2-3			SAND
	15	13.5-15	S3	11	5-7-7	F-M sand; gray(N5), wet		
	20	18.5-20	S4	18	1-1-0	Sandy clay; gr. gray(5G4/1); sl. plastic sl. sticky		

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W20368	LC9-GW6	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

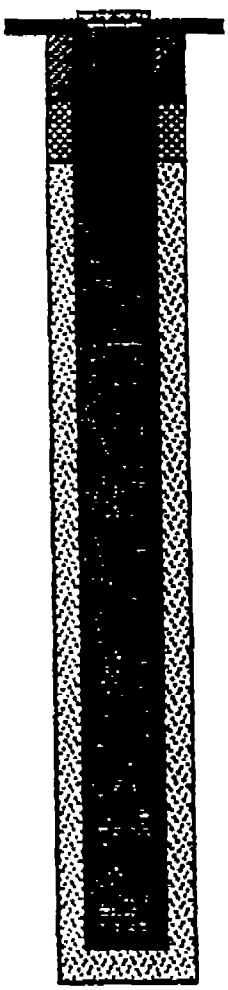
ELEVATION 5.68' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 3', 4/29/86 START FINISH LOGGER DRONFIELD

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (IN)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION (2 inch PVC)
		3.5-5	S1	15	3-5-7	F-M sand w/some f. gravel; gray(N7)-gr. gray(5G6/1); wet		GROUT; BENTONITE; SAND
	5							
		8.5-10	S2	16	2-4-2			
	10							
		13.5-15	S3	24	1-1-1	Sandy clay; gr.gray(5G4/1); sl. plastic, sl. sticky		
	15							
	20							

Soil Boring MW-1 LC 9-UST 1
Date drilled 09-30-91
Project NAB Little Creek
Location Building 3699
Water level 9.50' B.G.



GROUT 0 - 1 Feet

BENTONITE SEAL 1 - 2 Feet

0 - 7 Feet SOLID RISER

SAND PACK 2 - 17 Feet

7 - 17 Feet SLOTTED SCREEN

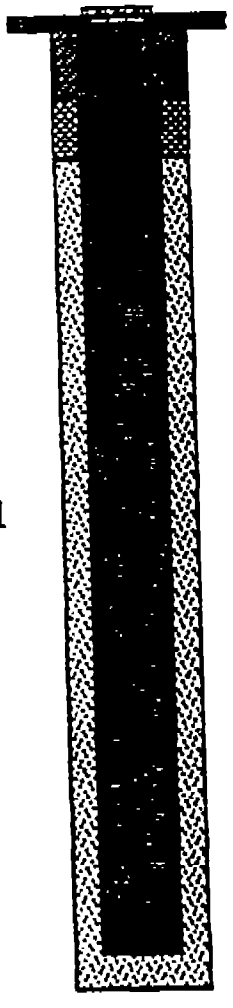
Well riser constructed of 4" schedule 40 PVC
with .020 " slotted screen.

SOIL BORING MW #1 LC9 -UST 1
DATE DRILLED 9/30/91
CLIENT PRC, Inc.
PROJECT NAB Little Creek
LOCATION Building #3699
GEOLOGIC FORMATION Yorktown and Bacons Castle Formations

DEPTH (feet)	SAMPLE	BLOWS/6 IN	PID (ppm) 0 5 10	GRAPHIC LOG	SOIL CLASS	LITHOLOGIC DESCRIPTION
0						Asphalt, Crushed Stone Base.
					SP	Brown medium sand. Petro Odor.
5					SP	Tan medium sand
10						
15						

METHOD OF DRILLING: Hollow Stem Drilling
HOLE DIAMETER: 12 inches
END OF BORING: 17 feet
WELL DIAMETER: 4 inches
WELL MATERIAL: PVC
SAMPLING METHOD: Split Spoon

Soil Boring MW-2 LC9-UST 2
Date drilled 09-30-91
Project NAB Little Creek
Location Building 3699
Water level 8.41' B.G.



GROUT 0 - 1 Feet

BENTONITE SEAL 1 - 2 Feet

0 - 5 Feet SOLID RISER

SAND PACK 2 - 15 Feet

5 - 15 Feet SLOTTED SCREEN

Well riser constructed of 4" schedule 40 PVC
with .020 " slotted screen.

1797

SOIL BORING MW #2 LC9-UST 2
DATE DRILLED 9/30/91
CLIENT PRC Inc.
PROJECT NAB Little Creek
LOCATION Building #3699
GEOLOGIC FORMATION Yorktown and Bacons Castle Formations

DEPTH (feet)	SAMPLE	BLOWS/6 IN	PID (ppm) 0 5 10	GRAPHIC LOG	SOIL CLASS	LITHOLOGIC DESCRIPTION
0					SC	Black clay w/ some sand.
5		6 3 2				
					SP	Black medium sand.
10		15 15 11				
					SP	Gray medium sand.
15		5 1 3				

METHOD OF DRILLING: Hollow Stem Drilling
HOLE DIAMETER: 12 inches
END OF BORING: 16 feet
WELL DIAMETER: 4 inches
WELL MATERIAL: PVC
SAMPLING METHOD: Split Spoon

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W20368	LC10-GW1	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 14.85' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 10', 4/28/86 START FINISH LOGGER DRONFIELD

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (IN)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION: 2 inch PVC
	5	3.5-5	S1	14	6-7-10	F-M sand; gray-orange (10YR7/4)-gray(N3,N7); moist		GROUT
								BENTONITE
	10	8.5-10	S2	16	5-7-9			
	15	13.5-15	S3	15	5-6-7	As above; gr. gray(5GY4/1); occasional clay lenses; wet		SAND
	20	18.5-20	S4	6	6-7-7			

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W20368	LC10-GW2	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 12.16' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 8', 4/24/86 START FINISH LOGGER DRONFIELD

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (IN)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION: 2 inch PVC
	5	3.5-5	S1	16	3-9-8	F-M sand w/some clay lenses; yel. orange(10YR6/6) - yel. brown(10YR5/4); moist		GROUT; BENTONITE
	10	8.5-10	S2	13	1-1-0	F-C clayey sand; gray green (5GY4/1); occasional clay lenses, sl plastic, sl. sticky; wet		SAND
	15	13.5-15	S3	15	4-5-6			
	20	18.5-20	S4	15	2-2-3			

PROJECT NUMBER	BORING NUMBER	
W20368	LC10-GW3	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 10.43' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 8', 4/28/86 START FINISH LOGGER DRONFIELD

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (IN)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION: 2 inch PVC
		3.5-5	S1	15	4-6-6	F-M sand; pale orange(10YR8/2)-gray(N7), dry-moist		GROUT
	5							BENTONITE
		8.5-10	S2	11	4-5-7	F-M sand; olive gray(5Y6/1)-gr. gray(5GY4/1); wet		SAND
	10							
		13.5-15	S3	13	3-3-4			
	15					Sandy clay and clayey sand; gray green(5GY4/1); plastic, sl. sticky, wet		
		18.5-20	S4	24	1-1-2			
	20							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W20368	LC10-GW4	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 11.23' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 4/24/86 START FINISH LOGGER SEXTON

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION
								GROUT
								BENTONITE
	5	4-6	S1	1.5	4-6-4-9	F-M sand; pale orange(10YR6/2)-yel. brown(10YR5/4); moist-wet; occasional sandy clay patches.		
	10	9-11	S2	1.6	3-5-6-6	F-M sand; gray(N5); wet		SAND
	15	14-16	S3	2.0	0-1-3-4	Clay w/some sand at 16'; olive black (5Y2/1); soft, sticky, plastic		
	20							

REV 11/82 FORM D1586

PROJECT NUMBER	BORING NUMBER	
W20368	LC10-GW5	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 10.69' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 8', 4/24/86 START FINISH LOGGER DRONFIELD

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (IN)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION (NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL)	SYMBOLIC LOG	WELL CONSTRUCTION (2 inch PVC)
	5	3.5-5	S1	16	4-5-9	F-M sand; yel. orange(10YR6/6)-yel. brown(10YR5/4); moist		GROUT; BENTONITE
	10	8.5-10	S2	13	4-3-2	As above; gray(N5); wet		SAND
						Silty clay; gr. black(5GY2/1); sl. sticky, plastic, shell fragments		
	15	13.5-15	S3	18	4-4-7	F-C sand; gr. gray(5GY4/1); wet		
	20	18.5-20	S4	18	4-4-2			

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W20368	LC10-GW6	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 9.28' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 7', 4/24/86 START FINISH LOGGER SEXTON

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION: 2 inch PVC
						F-M sand; pale orange(10YR8/2)-olive gray(5Y4/1): moist-wet		GROUT; BENTONITE
	5	4-6	S1	1.6	2-3-5-3			SAND
	10	9-11	S2	1.4	2-6-3-3	F-C sand; black; wood, glass, brick, sludge		
						F-M sand; gray(N6-N5)		
	15	14-16	S3	1.3	7-1-1-1	Sandy clay; olive gray(5Y4/1);soft, sticky		
	20							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER		
W20368	LC10-GW7	SHEET	OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 10.67' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 4/23/86 START FINISH LOGGER SEXTON

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION (2 inch PVC)
						F-M sand; yel. brown(10YR5/4); v. moist at 5'		GROUT; BENTONITE
	5	4-6	S1	1.7	5-5-9-10	F-C sand; br. black; wood, glass, ash		
	10	9-11	S2	1.6	2-2-5-5	F-M sand w/some patches of clay; l. olive gray(5Y4/1); wet		SAND
	15	14-16	S3	1.6	4-5-7-8			
	20	19-21	S4	1.7	4-2-3-4	As above; l. brown(5YR5/6)-gr. orange		
	25							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W20368	LC10-GW8	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 11.70' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 4/22/86 START FINISH LOGGER SEXTON

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION 2 inch PVC
		0-2	S1	1.7	3-8-9-10	Sandy clay; yel. brown(10YR4/2); dry-moist		
						F-M sand; w/some gravel; yell. orange (10YR6/6); moist		GROUT
								BENTONITE
	5	4-6	S2	1.8	15-20-18-14	F-M sand; br. black(5YR2/1); sludge/ash?		
	10	9-11	S3	1.25	5-8-9-7	F-M sand w/some c. sand; yel. brown(10YR6/2)-gr. gray (5GY6/1); wet		SAND
	15	14-16	S4	1.5	1-0-2-2			
	20	19-21	S5	2.0	4-7-7-8	F-M sand; l. brown(5YR5/6)-yel. orange(10YR6/6); some sandy clay lenses; wet		
	25	24-26	S6	1.4	2-3-5-8			
	30	29-31	S7	1.4	6-10-14-23			

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W20368	LC11-GW1	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 8.75' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 8', 4/30/86 START FINISH LOGGER DRONFIELD

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (IN)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION: 2 inch PVC
		0-1.5	S1	14	5-6-12	sand-silt; yel. brown(10YR4/2)-pale orange(10YR8/2), dry, hard		GROUT
		3.5-5	S2	16	2-3-2	Sandy clay; yel. orange(10YR6/6); sl. plastic; moist		
	5							BENTONITE
	10	8.5-10	S3	17	7-7-9	F-M sand; yel. orange (10YR6/6); wet		SAND
	15	13.5-15	S4	15	6-9-9			
	20	18.5-20	S5	18	1-1-1	Sandy clay; gray(N4); sl.plastic, sl. sticky		

REV 11/82 FORM D1586

PROJECT NUMBER	BORING NUMBER	
W20368	LC11-GW2	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 7.56' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 8', 5/1/86 START FINISH LOGGER DRONFIELD

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (IN)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION: 2 inch PVC
						Sandy silt and sandy clay; yel. brown (10YR4/2)-yel. orange (10YR6/6); moist, stiff, sl. plastic		GROUT; BENTONITE
	5	3.5-5	S1	14	2-2-1			
						F-M sand w/some f. gravel; yel. orange(10YR6/6); black specs in sand; wet		SAND
	10	8.5-10	S2	14	7-11-12			
	15	13.5-15	S3	18	5-7-12			
	20	18.5-20	S4	18	5-6-4			

PROJECT NUMBER	BORING NUMBER	
W20368	LC11-GW3	SHEET OF

SOIL BORING LOG

PROJECT CONFIRMATION STUDY LOCATION LITTLE CREEK

ELEVATION 7.40' DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT AUGER

WATER LEVEL AND DATE 8', 5/1/86 START FINISH LOGGER DRONFIELD

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (IN)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	WELL CONSTRUCTION 2 inch PVC
		3.5-5	S1	17	2-2-2	Sandy clay; gray(N6)-yel. orange(10YR6/6); sl. plastic, stiff, moist		GROUT
	5							BENTONITE
		8.5-10	S2	15	6-9-10	F-M sand; yel. orange (10YR8/6); some black specs in sand; coarse sand at 19', wet		SAND
	10							
		13.5-15	S3	18	6-8-13			
	15							
		18.5-20	S4	16	4-4-5			
	20							

Field Sampling Plan

Appendix C

Results of First Round of Sampling, May 1996

TABLE 1

SUMMARY OF
VOLATILE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER SAMPLES
SITE 5
BUILDINGS 9-11 MOTOR OIL DISPOSAL AREA
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA
MAY 21 and JUNE 6, 1996

SAMPLE NUMBER MATRIX UNITS	05GW-101 WATER UG/L	05GW-102 WATER UG/L	05GW-103 WATER UG/L	05GW-103MS WATER UG/L	05GW-103MSD WATER UG/L	05GW-103R WATER UG/L	05GW-104 WATER UG/L
Chloroethane	10 U	25	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethene	10 U	10 U	10 U	43	42	10 U	10 U
1,1-Dichloroethane	10 U	31	10 U	10 U	10 U	10 U	10 U
Trichloroethene	10 U	10 U	10 U	44	47	10 U	10 U
Benzene	10 U	10 U	10 U	44	46	10 U	10 U
Toluene	10 U	10 U	10 U	45	45	10 U	10 U
Chlorobenzene	10 U	10 U	10 U	45	47	10 U	10 U
TOTAL VOCS	0	56	0	221	227	0	0
TOTAL TICS	1 NJ	2.7 NJ	0	0	0	0	0

NOTES:
Sample numbers followed by an R indicate sample recollected on June 6, 1996
UG/L indicates micrograms per liter
U indicates compound not detected above detection limit
NJ indicates presumptive evidence for the presence of the material at an estimated value
MS indicates matrix spike sample
MSD indicates matrix spike duplicate sample

TABLE 2

SUMMARY OF
SEMI-VOLATILE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER SAMPLES
SITE 5
BUILDINGS 9-11 MOTOR OIL DISPOSAL AREA
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA
MAY 21, 1996

SAMPLE NUMBER MATRIX UNITS	05GW-101 WATER UG/L	05GW-102 WATER UG/L	05GW-103 WATER UG/L	05GW-103MS WATER UG/L	05GW-103MSD WATER UG/L	05GW-104 WATER UG/L
Phenol	10 U	10 U	10 U	50	58	10 U
2-Chlorophenol	10 U	10 U	10 U	53	61	10 U
1,4-Dichlorobenzene	10 U	10 U	10 U	31	35	10 U
N-Nitrosodipropylamine	10 U	10 U	10 U	39	46	10 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	35	38	10 U
4-Chloro-3-methylphenol	10 U	10 U	10 U	57	64	10 U
Acenaphthene	10 U	10 U	10 U	37	39	10 U
4-Nitrophenol	25 U	25 U	25 U	74	84 E	25 U
2,4-Dinitrotoluene	10 U	10 U	10 U	38	41	10 U
Pentachlorophenol	25 U	25 U	25 U	84 E	90 E	25 U
Pyrene	10 U	10 U	10 U	33	37	10 U
TOTAL SVOCS	0	0	0	531	593	0
TOTAL TICS	219 NJ	173 NJ	36 NJ	NA	NA	99 NJ

NOTES:
UG/L indicates micrograms per liter
U indicates compound not detected above detection limit
E indicates exceedance of quantitation limit
NJ indicates presumptive evidence for the presence of the material at an estimated value
MS indicates matrix spike sample
MSD indicates matrix spike duplicate sample

TABLE 3

SUMMARY OF
VOLATILE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER SAMPLES
SITE 9
DRIVING RANGE LANDFILL
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA
MAY 21 - 23, and JUNE 6, 1996

SAMPLE NUMBER MATRIX UNITS	9UST-101R WATER UG/L	9UST-103R WATER UG/L	9GW-102R WATER UG/L	9GW-108R* WATER UG/L	9GW-104 WATER UG/L	9GW-105R WATER UG/L	9GW-106R WATER UG/L
TOTAL VOCS	0	0	0	0	0	0	0
TOTAL TICS	0	45 NJ	0	0	3.5 NJ	0	0

NOTES:
Sample numbers followed by an R indicate sample recollected on June 6, 1996
* indicates sample is quality control duplicate of preceeding sample
UG/L indicates micrograms per liter
NJ indicates presumptive evidence for the presence of the material at an estimated value

TABLE 4

SUMMARY OF
INORGANIC COMPOUNDS DETECTED IN GROUNDWATER SAMPLES
SITE 9
DRIVING RANGE LANDFILL
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA
MAY 21 - 23, 1996

SAMPLE NUMBER MATRIX UNITS	9UST-101 (T) WATER UG/L	9UST-101 (D) WATER UG/L	9UST-103 (T) WATER UG/L	9UST-103 (D) WATER UG/L	9GW-102 (T) WATER UG/L	9GW-102 (D) WATER UG/L	9GW-104 (T) WATER UG/L	9GW-104 (D) WATER UG/L
Aluminum	1,720	124 B	256	14.8 U	939	62.0 B	9,350	10.0 U
Antimony	4.0 U	7.3 B	7.8 B	4.0 U	4.0 U	5.6 B	4.0 U	4.0 U
Arsenic	18.3	5.6 B	5.0 U	13.6 U	5.0 U	6.0 B	13.1	5.0 U
Barium	209	32.1 B	335	365	23.2 B	167 B	79.6 B	48.6 B
Beryllium	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium	3.0 B	1.7 B	1.0 U	1.0 U	1.8 B	1.0 U	1.0 U	1.0 U
Calcium	69,000	12,700	132,000	141,000	13,400	67,900	41,400	42,400
Chromium	3.9 B	1.9 B	1.0 U	1.0 U	3.0 B	1.3 B	19.1	1.0 U
Cobalt	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ
Copper	63.1	39.4	23.2 B	5.2 U	41.2	27.2	16.4 B	3.3 U
Iron	30,000	417	20,300	19,300	2,400	1,270	17,600	79.6 U
Lead	3.0 J	3.0 U	6.3	3.0 UJ	3.0 U	3.0 U	7.9	3.0 U
Magnesium	11,200	2,060 B	17,900	19,000	2,350 B	11,100	5,750	3,970
Manganese	840	30.8	553	587	65.0	730	62.0	4.0 U
Nickel	8.0 B	5.9 B	1.0 U	1.0 U	6.1 B	1.0 U	2.0 B	1.0 U
Potassium	24,800	3,140 B	15,700	17,400	3,740 B	25,300	9,760	6,340
Selenium	R	R	5.0 U	5.0 U	R	R	R	R
Sodium	87,000 J	11,800	18,900	21,100	11,800 J	89,300 J	13,400 J	14,800 J
Vanadium	22.3 B	4.8 B	1.3 B	1.9 B	8.8 B	1.0 B	34.6 B	1.0 U
Zinc	434	642	261	128	654	315	75.8	29.3

NOTES:
T following sample number indicates sample analyzed for total metals
D following sample number indicates sample analyzed for dissolved metals
*** indicates sample is quality control duplicate of preceeding sample**
UG/L indicates micrograms per liter
U indicates compound not detected above detection limit
J indicates an estimated value
B indicates compound detected in laboratory blank
UJ indicates reported quantitation limit is qualified as estimated
R indicates data rejected by validator and is unusable

TABLE 4 (CONTINUED)

SUMMARY OF
INORGANIC COMPOUNDS DETECTED IN GROUNDWATER SAMPLES
SITE 9
DRIVING RANGE LANDFILL
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA
MAY 21 - 23, 1996

SAMPLE NUMBER MATRIX UNITS	9GW-107 (T) * WATER UG/L	9GW-107 (D) * WATER UG/L	9GW-105 (T) WATER UG/L	9GW-105 (D) WATER UG/L	9GW-106 (T) WATER UG/L	9GW-106 (D) WATER UG/L
Aluminum	3,280	14.3 B	9,580	65.6 U	3,870	1,110
Antimony	4.0 U	6.5 B	16.3 B	8.8 U	4.1 B	4.0 U
Arsenic	12.3	5.7 B	28.5	5.0 U	7.6 B	5.0 U
Barium	73.7 B	48.1 B	115 B	53.5 B	106 B	82.0 B
Beryllium	1.0 U	1.0 U	1.0 U	1.0 U	0.59 B	1.0 U
Cadmium	1.0 U	1.0 U	1.8 B	1.0 U	0.97 B	1.0 U
Calcium	41,300	43,800	30,100	22,100	2,660 B	2,320 B
Chromium	16.3	1.0 U	25.0	1.2 B	15.8	1.9 B
Cobalt	1.0 UJ	1.0 UJ	1.5 J	1.0 UJ	0.98 J	1.0 UJ
Copper	15.3 B	4.6 U	49.4	15.6 B	29.6	15.7 B
Iron	15,400	38.0 B	23,100	61.6 U	9,760	1,020
Lead	7.8	3.0 U	24.5	3.0 U	7.4	3.0 UJ
Magnesium	5,560	4,240 B	6,210	3,740 B	3,880 B	2,560 B
Manganese	54.8	4.3 U	74.3	7.2 B	59.4	24.3
Nickel	1.8 B	1.0 U	7.2 B	1.0 U	4.9 B	3.0 U
Potassium	9,390	7,910	8,330	4,770 B	3,100 B	1,450 B
Selenium	R	R	5.0 U	5.0 U	4.0 U	5.0 U
Sodium	13,200 J	15,500	6,920	6,440	13,800	14,100
Vanadium	31.6 B	1.0 U	46.1 B	1.0 U	19.7 B	1.0 U
Zinc	68.5	31.9	820	428	894	768

NOTES:
T following sample number indicates sample analyzed for total metals
D following sample number indicates sample analyzed for dissolved metals
*** indicates sample is quality control duplicate of preceeding sample**
UG/L indicates micrograms per liter
U indicates compound not detected above detection limit
J indicates an estimated value
B indicates compound detected in laboratory blank
UJ indicates reported quantitation limit is qualified as estimated
R indicates data rejected by validator and is unusable

TABLE

ANIONS DETECTED IN GROUNDWATER SAMPLES
SITE 9
DRIVING RANGE LANDFILL
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA
MAY 21 - 23, 1996

SAMPLE NUMBER MATRIX UNITS	9UST-101 WATER MG/L	9UST-103 WATER MG/L	9GW-102 WATER MG/L	9GW-104 WATER MG/L	9GW-107 * WATER MG/L	9GW-105 WATER MG/L	9GW-106 WATER MG/L
Bicarbonate Alkalinity	161	401	17	95	95	53	0
Chloride	107	34	12	17	7	16.4	30.7
Sulfate	49.9	23.1	19.7	27.9	29.1	14.4	18.2

NOTES:
*** indicates sample is quality control duplicate of preceeding sample**
MG/L indicates milligrams per liter

TABLE 5

SUMMARY OF
VOLATILE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER SAMPLES
SITE 10
SEWAGE TREATMENT PLANT LANDFILL
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA
MAY 21, 23, and JUNE 6, 1996

SAMPLE NUMBER MATRIX UNITS	10GW-101R WATER UG/L	10GW-102R WATER UG/L	10GW-104 WATER UG/L	10GW-105 WATER UG/L	10GW-109 * WATER UG/L	10GW-106 WATER UG/L	10GW-107 WATER UG/L	10GW-108 WATER UG/L
Acetone	10 U	10 U	10 U	10 U	10 U	50	10 U	10 U
TOTAL VOCS	0	0	0	0	0	50	0	0
TOTAL TICS	0	0	1 NJ	R	2.7 NJ	0	6 NJ	2.9 NJ

NOTES:
Sample numbers followed by an R indicate sample recollected on June 6, 1996
* indicates sample is quality control duplicate of preceeding sample
UG/L indicates micrograms per liter
U indicates compound not detected above detection limit
NJ indicates presumptive evidence for the presence of the material at an estimated value
R indicates data is rejected and unusable

TABLE 6

SUMMARY OF
INORGANIC COMPOUNDS DETECTED IN GROUNDWATER SAMPLES
SITE 10
SEWAGE TREATMENT PLANT LANDFILL
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA
MAY 21 and 23, 1996

SAMPLE NUMBER MATRIX UNITS	10GW-101 (T) WATER UG/L	10GW-101 (D) WATER UG/L	10GW-102 (T) WATER UG/L	10GW-102 (D) WATER UG/L	10GW-104 (T) WATER UG/L	10GW-104 (D) WATER UG/L	10GW-105 (T) WATER UG/L	10GW-105 (D) WATER UG/L	10GW-FB (T) WATER UG/L	10GW-FB (D) WATER UG/L
Aluminum	16,600	1,140	43,700	12.5 U	2,890	10.0 U	3,070	10.0 U	20.0 U	36.5 B
Antimony	5.4 B	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	11.9 B	4.0 U	5.4 B
Arsenic	19.9	20.9 U	37.4	5.1 U	15.9	10.9	5.0 U	5.0 U	5.0 U	6.8 B
Barium	78.5 B	20.7 B	193 B	24.8 B	38.5 B	28.0 B	61.6 B	20.3 B	0.48 B	1.0 U
Beryllium	5.7	1.0 B	2.8 B	1.0 U	1.0 U	1.0 U	1.3 B	1.0 U	0.30 U	1.0 U
Cadmium	5.4	5.1	2.1 B	1.0 U	2.1 B	1.0 U	1.4 B	1.0 U	0.80 U	1.0 U
Calcium	107,000	123,000	76,000	62,100	317,000	306,000	71,300	69,300	140 U	122 U
Chromium	3.1 B	3.1 B	77.7	1.0 U	8.4 B	1.0 U	4.0 B	1.0 U	0.50 U	1.0 U
Cobalt	46.0 B	48.4 B	26.6 B	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	0.70 UJ	1.0 UJ
Copper	39.6	22.9 B	76.1	3.0 U	21.7 B	4.0 U	21.5 B	3.5 U	2.0 U	4.5 U
Iron	2,040	37.1 U	155,000	23.5 U	33,200	466	62,100	477	32.6 U	25.4 B
Lead	3.0 U	3.0 UJ	48.3	3.0 UJ	10.1	3.0 U	3.0 U	3.0 U	2.0 U	4.4 J
Magnesium	15,600	19,400	10,900	3,330 B	24,900	23,700	4,950 B	4,740 B	39.9 U	65.6 U
Manganese	1,780	2,260	678	17.1	359	308	238	89.4	0.30 U	1.4 B
Nickel	163	169	3.1 B	1.0 U	1.0 U	1.0 U	1.5 B	1.0 U	2.0 U	5.4 B
Potassium	6,900	9,760	14,600	6,060	18,600	21100	6,290	8,350	3,000 U	1,000 U
Selenium	5.0 U	5.0 U	10.8	5.0 U	R	R	R	R	4.0 U	5.3
Sodium	14,300	14,400	6,210	5,760	65,100	59,900	16,200	16,900	500 U	722 B
Thallium	2.0 U	2.0 UJ	3.0 U	2.0 UJ	2.0 U	2.0 U	2.0 U	2.0 U	3.0 U	3.7 B
Vanadium	14.[illegible]9	3.9 B	142	1.0 U	9.1 B	1.0 U	4.4 B	1.0 U	0.30 U	1.0 U
Zinc	9,210	9,060	118	13.8 U	47.8	14.0 B	21.8	9.9 U	3.3 U	12.0 U

NOTES:
T following sample number indicates sample analyzed for total metals
D following sample number indicates sample analyzed for dissolved metals
*** indicates sample is quality control duplicate of preceeding sample**
UG/L indicates micrograms per liter
U indicates compound not detected above detection limit
J indicates an estimated value
B indicates compound detected in laboratory blank
UJ indicates reported quantitation limit is qualified as estimated
R indicates data rejected by validator and is unusable
FB indicates field blank sample
RB indicates rinsate blank sample

TABL /NTINUED)

SUMMARY OF
INORGANIC COMPOUNDS DETECTED IN GROUNDWATER SAMPLES
SITE 10
SEWAGE TREATMENT PLANT LANDFILL
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA
MAY 21 and 23, 1996

SAMPLE NUMBER MATRIX UNITS	10GW-105 (T) * WATER UG/L	10GW-105 (D) * WATER UG/L	10GW-106 (T) WATER UG/L	10GW-106 (D) WATER UG/L	10GW-107 (T) WATER UG/L	10GW-107 (D) WATER UG/L	10GW-108 (T) WATER UG/L	10GW-108 (D) WATER UG/L	10GW-RB (T) WATER UG/L	10GW-RB (D) WATER UG/L
Aluminum	2,050	10.0 U	372	10.0 U	373	10.0 U	659	10.0 U	16.3 U	38.5 U
Antimony	4.0 U	4.0 U	4.0 U	5.1 B	4.0 B	4.0 U	4.0 U	6.4 B	4.0 U	4.0 U
Arsenic	5.0 U	5.0 U	7.4 B	5.0 U	11.2	5.1 B	45.1	6.0 B	5.0 U	5.0 U
Barium	35.4 B	19.2 B	166 B	137 B	118 B	121 B	50.7 B	30.2 B	1.0 U	1.0 U
Beryllium	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Calcium	67,600	67,900	44,700	41,800	30,500	29,200	98,300	99,000	135 U	119 U
Chromium	3.0 B	1.0 U	2.9 B	1.0 U	1.4 B	1.0 J	2.1 B	1.0 U	1.0 U	1.0 U
Cobalt	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ
Copper	14.4 B	3.8 U	17.3 B	2.2 U	9.0 B	3.1 U	6.5 B	5.5 U	1.6 U	1.7 U
Iron	33,500	976	25,100	13,000	3,320	1,940	19,700	1,660	14.6 U	23.3 U
Lead	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
Magnesium	4,730 B	4,660 B	12,600	9,720	3,000 B	2,700 B	12,400	13,000	43.0 U	23.8 U
Manganese	177	108	234	207	311	201	885	685	1.0 U	1.2 B
Nickel	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Potassium	7,310	7,130	14,300	11,300	3,530 B	3,850 B	12,000	12,200	1,000 U	1,000 U
Selenium	R	R	R	R	R	R	R	R	5.0 U	5.0 U
Sodium	15,900 J	16,800 J	49,700	32,800	7,060 J	6,770 J	21,700 J	23,200	536 B	535 J
Thallium	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Vanadium	2.9 B	1.0 U	1.9 B	1.0 U	1.2 B	2.0 U	6.7 B	1.0 U	1.0 U	1.0 U
Zinc	13.6 U	9.1 U	20.0 B	9.8 U	164	149	10.3 U	14.0 B	3.4 U	4.6 U

NOTES:
T following sample number indicates sample analyzed for total metals
D following sample number indicates sample analyzed for dissolved metals
* indicates sample is quality control duplicate of preceding sample
UG/L indicates micrograms per liter
U indicates compound not detected above detection limit
J indicates an estimated value
B indicates compound detected in laboratory blank
UJ indicates reported quantitation limit is qualified as estimated
R indicates data rejected by validator and is unusable
FB indicates field blank sample
RB indicates rinsate blank sample

TABLE

ANIONS DETECTED IN GROUNDWATER SAMPLES
SITE 10
SEWAGE TREATMENT PLANT LANDFILL
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA
MAY 21 and 23, 1996

SAMPLE NUMBER MATRIX UNITS	10GW-101 WATER MG/L	10GW-102 WATER MG/L	10GW-104 WATER MG/L	10GW-105 WATER MG/L	10GW-109 * WATER MG/L	10GW-106 WATER MG/L	10GW-107 WATER MG/L	10GW-108 WATER MG/L	10GW-FB WATER MG/L	10GW-RB WATER MG/L
Bicarbonate Alkalinity	4	133	406	125	131	216	84	226	4	4
Chloride	25.9	8.8	40	15.5	14.5	39	13.6	24	1.4	1.4
Sulfate	252	26.3	410	77.4	59.9	2.9	7.5	69.8	0	0

NOTES:
* indicates sample is quality control duplicate of preceeding sample
MG/L indicates milligrams per liter
FB indicates field blank sample
RB indicates rinsate blank sample

LE 7

SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN GROUNDWATER SAMPLES
SITE 11
SCHOOL OF MUSIC PLATING SHOP
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA
JUNE 6, 1996

SAMPLE NUMBER MATRIX UNITS	11GW-101R WATER UG/L	11GW-104R * WATER UG/L	11GW-102R WATER UG/L	11GW-102R MS WATER UG/L	11GW-102R MSD WATER UG/L	11GW-103R WATER UG/L	11GW-RB WATER UG/L	11GW-FB WATER UG/L	11GW-TB WATER UG/L
Methylene chloride	10 U	5 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethane	22	20	10 U	49	49	10 U	10 U	10 U	10 U
1,1-Dichloroethane	21	22	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-Trichloroethane	91	90	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Trichloroethene	250 D	240 D	10 U	49	52	10 U	10 U	10 U	10 U
Benzene	10 U	10 U	10 U	47	50	10 U	10 U	10 U	10 U
Toluene	10 U	10 U	10 U	49	51	10 U	10 U	10 U	10 U
Chlorobenzene	10 U	10 U	10 U	49	53	10 U	10 U	10 U	10 U
TOTAL VOCs	384 D	377 D	0	243	255	0	0	0	0
TOTAL TICs	0	0	0	NA	NA	0	0	0	0

NOTES:
Sample numbers followed by an R indicate sample recollected on June 6, 1996
* indicates sample is quality control duplicate of preceeding sample
UG/L indicates micrograms per liter
U indicates compound not detected above detection limit
J indicates an estimated value
D indicates sample diluted
MS indicates matrix spike sample
MSD indicates matrix spike duplicate sample
RB indicates rinsate blank sample
FB indicates field blank sample
TB indicates trip blank sample
NA indicates not analyzed

TABLE 8

SUMMARY OF
INORGANIC COMPOUNDS DETECTED IN GROUNDWATER SAMPLES
SITE 11
SCHOOL OF MUSIC PLATING SHOP
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA
MAY 22, 1996

SAMPLE NUMBER MATRIX UNITS	11GW-101 (T) WATER UG/L	11GW-101 (D) WATER UG/L	11GW-104 (T) * WATER UG/L	11GW-104 (D) * WATER UG/L	11GW-102 (T) WATER UG/L	11GW-102 (D) WATER UG/L	11GW-103 (T) WATER UG/L	11GW-103 (D) WATER UG/L
Aluminum	433	33.0 U	1,460	31.1 U	19,100	41.4 U	767	57.3 U
Antimony	4.4 B	5.5 U	4.0 U	4.7 U	4.0 U	5.5 U	4.0 U	4.0 U
Barium	36.6 B	43.6 B	41.4 B	42.7 B	96.6 B	56.4 B	23.3 B	32.3 B
Calcium	16,300	17,000	16,800	16,800	14,800	15,000	7,250	7,920
Chromium	1.6 B	1.0 U	3.3 B	1.0 U	25.3	1.0 U	1.7 B	1.0 U
Cobalt	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	2.6 J	1.0 UJ	1.0 UJ	1.0 UJ
Copper	7.3 B	4.7 U	3.0 B	4.1 U	28.8 B	4.9 U	3.3 U	4.7 U
Iron	3,830	910	4,050	893	14,700	103 U	1,260	494
Lead	3.1	3.1 J	4.5	3.0 UJ	9.8	3.0 UJ	3.0 U	3.0 UJ
Magnesium	5,690	5,850	5,870	5,820	5,370	4,570 B	4,270 B	4,610 B
Manganese	355	246	332	247	84.4	45.3	77.2	74.9
Nickel	2.8 B	1.0 U	1.9 B	1.0 U	5.7 B	1.0 U	1.0 U	1.4 U
Potassium	2,860 B	3,210 B	2,960 B	3,180 B	2,180 B	2,320 B	1,450 B	1,620 B
Sodium	14,200	15,700	14,400	15,800	11,800	13,700	11,500	13,300
Vanadium	1.8 B	1.0 U	2.3 B	1.0 U	23.5 B	1.0 U	1.1 B	1.0 U
Zinc	44.7	32.3	50.6	37.3	28.3	32.7	6.4 U	15.0 U

NOTES:
T following sample number indicates sample analyzed for total metals
D following sample number indicates sample analyzed for dissolved metals
*** indicates sample is quality control duplicate of preceeding sample**
UG/L indicates micrograms per liter
U indicates compound not detected above detection limit
J indicates an estimated value
B indicates compound detected in laboratory blank
UJ indicates reported quantitation limit is qualified as estimated

TABLE

ANIONS DETECTED IN GROUNDWATER SAMPLES
SITE 11
SCHOOL OF MUSIC PLATING SHOP
NAVAL AMPHIBIOUS BASE LITTLE CREEK
VIRGINIA BEACH, VIRGINIA
MAY 22, 1996

SAMPLE NUMBER MATRIX UNITS	11GW-101 WATER MG/L	11GW-104 * WATER MG/L	11GW-102 WATER MG/L	11GW-103 WATER MG/L
Bicarbonate Alkalinity	21	25	19	10
Chloride	16.8	17	19.3	11.3
Sulfate	47.5	49.2	32.6	25.7

NOTES:
*** indicates sample is quality control duplicate of preceeding sample**
MG/L indicates milligrams per liter

Final

Investigation-Derived Waste Management Plan for Groundwater Monitoring at Sites 5, 9, 10, and 11

Naval Amphibious Base Little Creek
Virginia Beach, Virginia

Contract Task Order 024

November 19, 1996

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

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Prepared by

CH2M HILL

Herndon, Virginia

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SECTION 1

Introduction

The groundwater monitoring of Sites 5, 9, 10, and 11 at Naval Amphibious Base (NAB) Little Creek will produce investigation-derived wastes (IDW). These wastes will subsequently require waste management and disposal in a manner that eliminates potential hazards to the public. This management plan documents methodologies and procedures that CH2M HILL field personnel will implement to handle, manage, and dispose of all IDW.

The IDW anticipated to be generated during groundwater monitoring include:

- Groundwater purged prior to sampling of the monitoring wells and decontamination fluids.
- Personal protective equipment (PPE) such as nitrile gloves and tyvek, and expendables such as tubing, filters, sample containers, and paper towels.

This IDW Management Plan describes proposed waste handling procedures for these anticipated IDW and documents other general IDW considerations.

SECTION 2

Proposed Waste Handling

This section documents the proposed waste handling procedures for groundwater and decontamination fluids, and PPE.

Water

Water as an IDW will be produced during groundwater purging and sampling and equipment and personal decontamination.

All water will be contained in 55-gallon steel drums, which will be sealed and labeled. The drums will be stockpiled at each site at a location designated by Navy personnel pending analytical results from the monitoring samples.

After receipt of the analytical results, CH2M HILL will assess potential hazards posed by the IDW and submit waste management recommendations to the Navy. TCLP analyses will not be conducted on the drummed water; rather, the IDW water will be characterized using the results of the analysis of groundwater samples. The types of compounds found in the groundwater samples, and the greatest concentration of each compound found, will be used to determine if the water is a characteristic or listed hazardous waste. Maximum total concentrations of organic compounds and dissolved concentration of inorganic chemicals will be compared to TCLP criteria. Also, the types of compounds found will be compared to listed wastes. If potentially-listed wastes are found in the groundwater, the Navy will be requested to provide notification that the contaminants are not derived from listed wastes, otherwise the IDW water will be treated as a listed hazardous waste based on the RCRA derived-from rule. Separate characterizations will be made for each round of sampling.

If the results indicate that the water is not a characteristic or listed hazardous waste, CH2M HILL will recommend that the water be disposed of off site by a subcontractor as a non-hazardous wastewater. If the IDW water is considered a characteristic or listed hazardous waste it will be manifested, handled as hazardous waste, and shipped to a regulated hazardous waste treatment and disposal facility or stockpiled as directed by the Navy.

The proposed steps for accumulating and handling IDW groundwater are as follows:

- Groundwater purged from the wells during groundwater sampling activities will be pumped into 55-gallon drums. Decontamination fluids will be collected in buckets or other convenient containers and transferred to 55-gallon drums as necessary.
- Receive analytical results from the laboratory and write a memorandum to the Navy recommending whether to handle the groundwater as hazardous or to instruct a subcontractor to dispose of the water.
- If necessary, secure notification from the Navy that the wastes are not listed, as specified in 40 CFR 261.

- If groundwater is determined to be hazardous according to analytical results or other criteria, CH2M HILL and the Navy will negotiate a contract modification for handling of hazardous IDW water. By law, the waste must be handled and disposed of within 90 days.
- CH2M HILL will coordinate with a subcontractor for the handling and disposal of hazardous groundwater according to regulations. The Activity will be responsible for signing all manifests.

Personal Protective Equipment and Expendables

The PPE worn by CH2M HILL field personnel will be placed in 55-gallon steel drums lined with plastic bags and labeled appropriately. PPE from all sites will be collected together into one drum and stored at one of the four sites. Examples of PPE to be contained include: gloves, tyvek overalls, and rubber boot covers. In addition, any expendable items contaminated during sampling, such as disposable, in-line water filters, C-flex tubing, and paper towels, will be contained in the same drum.

PPE and sampling expendables will be removed from the drum in plastic bags and discarded as solid waste in dumpsters at NAB Little Creek if analytical results on the water indicate that the waste is not a characteristic or listed hazardous waste. If results indicate that the water is a hazardous waste (characteristic or listed), PPE will be handled as a hazardous waste with the water.

SECTION 3

General Considerations

General considerations pertinent to the generation and handling of IDW are documented below. These include the minimization of waste volume, drum labeling and storage, and disposal and manifesting protocol.

Minimizing Volume of IDW

To minimize the volume of groundwater to be handled, the minimum volume of water will be purged from the monitoring wells to stabilize the pH, conductivity, and temperature of the discharged water. Decontamination water will be minimized by using dedicated sampling equipment at each well.

Labeling

Every 55-gallon drum containing IDW will be labeled with the following information:

- the type of IDW (groundwater or PPE) and the site where it was generated
- the date the drum was filled and sealed
- a brief warning not to handle the drum or its contents without permission from Base Civil Engineering N462 Kelly Greaser

An example of the information to be included on each drum is:

Investigation Derived Wastes
Purge Water from Installation Restoration Program Site 5
12/1/96
Do Not Handle - Analysis Pending
Base Civil Engineering N462
Ms. Kelly Greaser
363-4571

Storing IDW

Drums containing IDW will be stockpiled within the facility at a location designated by Navy personnel, pending the receipt of RCRA characterization results. For planning purposes, it is necessary that IDW be stored at the Activity for no longer than 60 days in order to ensure compliance with the 90-day accumulation time limit.

Disposal and Manifesting

After the receipt of test results, CH2M HILL will formulate a preliminary assessment of any potential hazards posed by the IDW, and submit waste management recommendations to

the Navy. If the test results indicate that the IDW is not hazardous, CH2M HILL will recommend that the water be disposed of off site by a subcontractor as a non-hazardous wastewater, and that the PPE be disposed of in a trash dumpster with other nonhazardous solid wastes generated at the Activity. Otherwise, water and PPE will be manifested, handled, treated and disposed of as a hazardous waste by a subcontractor yet to be identified. The Activity will be responsible for signing all manifests.