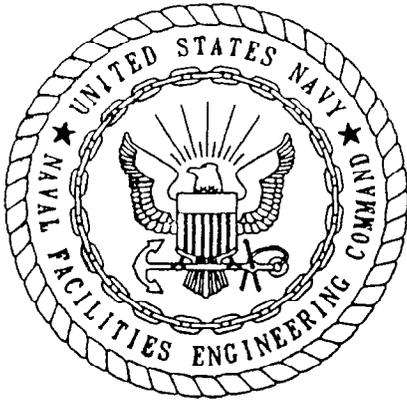


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SCREENING INVESTIGATION WORK PLAN FOR SITE 2 NSB KINGS BAY GA
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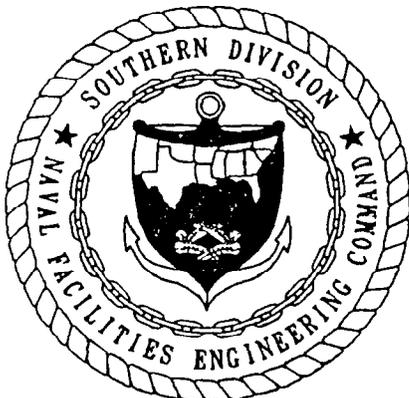


SCREENING INVESTIGATION WORKPLAN FOR SITE 2

**NAVAL SUBMARINE BASE KINGS BAY
KINGS BAY, GEORGIA**

**NAVY CLEAN - DISTRICT 1
UNIT IDENTIFICATION NO. N42237
CONTRACT NO. N62467-89-D-0317**

JULY 1995



**SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010**



The geologic work and professional opinions rendered in this Screening Investigation Workplan for Site 2, Naval Submarine Base, Kings Bay, Georgia, were conducted or developed in accordance with commonly accepted procedures consistent with applicable standards of practice.



Laura B. Harris

Professional Geologist No. 1063
Expires December 31, 1995

ABB Environmental Services, Inc.

SCREENING INVESTIGATION WORKPLAN FOR SITE 2

**NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA**

Unit Identification No. N42237

Contract No. N62467-89-D-0317

Prepared by:

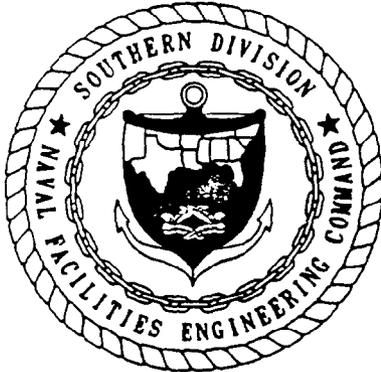
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January 1995



FOREWORD

To meet its mission objectives, the U.S. Department of the Navy performs a variety of operations, some requiring the use, handling, storage, or disposal of hazardous materials. Through accidental spills and leaks and conventional methods of past disposal, hazardous materials may have entered the environment in ways unacceptable by today's standards. With growing knowledge of the long-term effects of hazardous materials on the environment, the Department of Defense (DOD) initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at their facilities.

One of these programs is the Installation Restoration (IR) program. This program complies with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA). The acts, passed by Congress in 1980 and 1986, respectively, established the means to assess and cleanup hazardous waste sites for both private sector and Federal facilities. These acts are the basis for what is commonly known as the Superfund program.

A second program to address present hazardous materials management is the Resource Conservation and Recovery Act (RCRA) Corrective Action Program. This program is designed to identify and cleanup releases of hazardous substances at RCRA-permitted facilities. RCRA is the law that requires solid and hazardous wastes to be managed in an environmentally sound manner. The law applies primarily to facilities that generate or handle hazardous waste.

The investigations at Naval Submarine Base (NSB), Kings Bay, Georgia, are being conducted under the RCRA Corrective Action Program. The Georgia Department of Natural Resources, Environmental Protection Division, oversees the program at the NSB.

The RCRA Corrective Action Program includes the following stages:

- The RCRA Facility Assessment (RFA) and confirmatory sampling identify solid waste management units, evaluate the potential for releases of contaminants, and determine the need for future investigations.
- The RCRA Facility Investigation (RFI) then determines the nature, extent, and fate of contaminant releases.

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- Interim Measures are implemented when necessary to control further migration or release of contaminants.
- The Corrective Measures Study identifies and recommends measures for achieving long-term remedial action goals.

Questions regarding the RCRA program at NSB Kings Bay should be addressed to the Public Affairs Office at (912) 673-4714.

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EXECUTIVE SUMMARY

Under contract to the U.S. Department of the Navy (Navy), Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), this workplan was prepared for Site 2, Fire-Fighting Pit, at the Naval Submarine Base in Kings Bay, Georgia. This workplan was prepared under the Comprehensive Long-term Environmental Action, Navy (CLEAN) Contract No. N62467-89-0317, Contract Task Order No. 094.

Site 2 was originally located during the Initial Assessment Study (IAS) performed in 1985 by C.C. Johnson and Associates, Inc., within the confines of Site 12, Current Dry Dock. Site 2 was an unlined pit used for fire-fighting exercises from 1980 to 1981. Approximately 1,500 gallons of contaminated diesel fuel and small amounts of paints and paint thinners were poured into the pit and burned once every 2 months. In 1980 a one-time disposal of hydrazine was also burned at Site 2. There has been no investigation at the site to date, other than the investigation activities which have occurred at Site 12. The purpose of the investigation at Site 2 is to confirm the presence or absence of contamination in the soil and/or groundwater at the site.

The workplan provides a facility description, regulatory setting, site description, project management plan, sampling and analyses plan, data management plan, and health and safety procedures. The screening investigation will include sampling of soils and groundwater using direct push methodologies, and the installation of piezometers. The soil and groundwater analytical data will be evaluated using a statistical approach for comparison to background concentrations. A proposal for a background data collection program and statistical approach is being developed separately and will be submitted to GEPD for approval.

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Naval Submarine Base
Kings Bay, Georgia

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GLOSSARY

| | |
|---------|---|
| ABB-ES | ABB Environmental Services, Inc. |
| ASTM | American Society for Testing and Materials |
| bls | below land surface |
| BTEX | benzene, toluene, ethylbenzene, and xylenes |
| CAP | Corrective Action Plan |
| CFR | Code of Federal Regulations |
| CLEAN | Comprehensive Long-term Environmental Action, Navy |
| CLP | Contract Laboratory Program |
| CLP-RAS | Contract Laboratory Program (Routine Analytical Services) |
| CMS | Corrective Measure Study |
| COC | chain of custody |
| CPR | Cardiopulmonary resuscitation |
| CRZ | Contamination reduction zone |
| °C | degrees Celsius |
| °F | degrees Fahrenheit |
| DOT | U.S. Department of Transportation |
| DQO | data quality objective |
| EIC | Engineer-in-Charge |
| ELCD | electrolytic conductivity detector |
| EP | Extraction Procedure |
| FID | flame ionization detector |
| FOL | Field Operations Leader |
| g | gram |
| GC | gas chromatograph |
| GC/MS | gas chromatography and mass spectroscopy |
| GEPD | Georgia Environmental Protection Division (Department of Natural Resources) |
| HASP | Health and Safety Plan |
| HCl | hydrochloric acid |
| HSM | Health and safety manager |
| HSO | Health and Safety officer |
| HSWA | Hazardous and Solid Waste Amendments |
| IAS | Initial Assessment Study |
| IDW | investigation-derived waste |
| IR | infrared |
| μl | milliliter |
| μg/l | micrograms per liter |
| MEK | methyl-ethyl-ketone |
| MIBK | 4-methyl-2-pentanone |
| ml | millimeter |
| mlw | mean low water |

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GLOSSARY (Continued)

| | |
|-------------------------------|---|
| MOTKI | Military Ocean Terminal, Kings Bay |
| MS/MSD | matrix spike and matrix spike duplicate |
| N ₂ H ₄ | hydrazine |
| NACIP | Naval Assessment and Control of Installation Pollutants |
| Navy | U.S. Department of the Navy |
| NFA | No Further Action |
| NEESA | Naval Energy and Environmental Support Activity |
| NSB | Naval Submarine Base |
| OVA | organic vapor analyzer |
| oz | ounce |
| PA/SI | Preliminary Assessment and Site Investigation |
| PARCC | precision, accuracy, representativeness, comparability and completeness |
| PCE | tetrachloroethene |
| PID | photoionization detector |
| psi | pounds per square inch |
| PVC | polyvinyl chloride |
| QA/QC | quality assurance and quality control |
| QAM | Quality Assurance Manager |
| QAP | Quality Assurance Plan |
| QC | quality control |
| RCRA | Resource Conservation and Recovery Act |
| RD/RA | Remedial Design and Remedial Action |
| RFI | RCRA Facility Investigation |
| RI/FS | Remedial Investigation and Feasibility Study |
| SARA | Superfund Amendments and Reauthorization Act |
| SI | site investigation |
| SOP | Standard Operating Procedure |
| SOPQAM | Standard Operating Procedures and Quality Assurance Manual |
| SOUTHNAV- FACENCOM | Southern Division, Naval Facilities Engineering Command |
| SW | solid waste |
| SWMU | solid waste management unit |
| TCE | trichloroethene |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TOM | Task Order Manager |
| TPH | total petroleum hydrocarbons |
| U.S. | United States (of America) |
| USEPA | U.S. Environmental Protection Agency |
| VOC | volatile organic compound |

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1.0 INTRODUCTION

Under contract to the U.S. Department of the Navy (Navy), Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), this Screening Investigation Workplan was prepared for Site 2, Fire-fighting Pit, located on the Naval Submarine Base (NSB) in Kings Bay, Georgia. This report was prepared under the Comprehensive Long-term Environmental Action, Navy (CLEAN) Contract No. N62467-89-D-0317, Contract Task Order No. 094. The following sections describe the facility, the site under investigation, the scope of the proposed screening investigation, and regulatory context for this work.

1.1 FACILITY DESCRIPTION. NSB Kings Bay is located in the southeastern corner of Georgia, approximately 8 miles north of the Georgia-Florida border (Figure 1-1). The NSB covers 16,168 acres and is located in Camden County. The facility's history is summarized in the following paragraphs of this section.

The U.S. Army began operations at NSB Kings Bay in the early 1950's. The property originally was developed as a military ocean terminal. From its inception until June 30, 1965, the terminal was known as the Kings Bay Army Terminal. The Kings Bay Army Terminal was constructed to meet the Department of the Army's requirements for East Coast port facilities capable of transporting ammunition and other explosives in the event of a national emergency. During this time, the Kings Bay Army Terminal was used for training purposes by the U.S. Army Reserve.

On April 1, 1965, as a result of a major reorganization, the terminal was placed under the jurisdiction of the newly organized Military Traffic Management and Terminal Service. On July 1, 1965, the terminal became known as the U.S. Army Military Ocean Terminal, Kings Bay (MOTKI). MOTKI was designed to store ammunition or explosives for about 3 months and was directly subordinate to the Military Ocean Terminal, Southport, North Carolina. Facilities constructed at MOTKI included a 2,000-foot wharf, administrative buildings, work shops, utility buildings, and 47 miles of railroad track for transporting explosives. MOTKI had no assigned military personnel and was maintained and operated by 19 U.S. Civil Service employees for reserve training operations and contingency purposes from 1956 to 1978. The mission of MOTKI was to plan programs, make military repairs, and provide fire prevention and protection functions for the terminal. Because there was no immediate operational need for this installation, it was placed on inactive status from 1956 until July 1, 1978. The facility was used by the U.S. Army for reserve training during that time.

In 1978, the Navy selected MOTKI as the east coast location for its Fleet Ballistic Missile submarine support facility. On July 1, 1978, the site was established under a developmental status and was named the Naval Submarine Support Base. Construction of a refit facility for one submarine squadron (T-1) began in 1978 in anticipation of the arrival of 10 Poseidon submarines. In 1979, the Navy moved Squadron 16 from Spain to Kings Bay, and the site's official name became the Naval Submarine Base, Kings Bay.

Currently, NSB Kings Bay supports TRIDENT submarines. New facilities, completed in the early 1990's, are for crew training, weapons handling and storage, submarine maintenance and repair, personnel support, and housing.

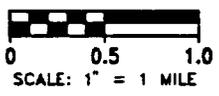
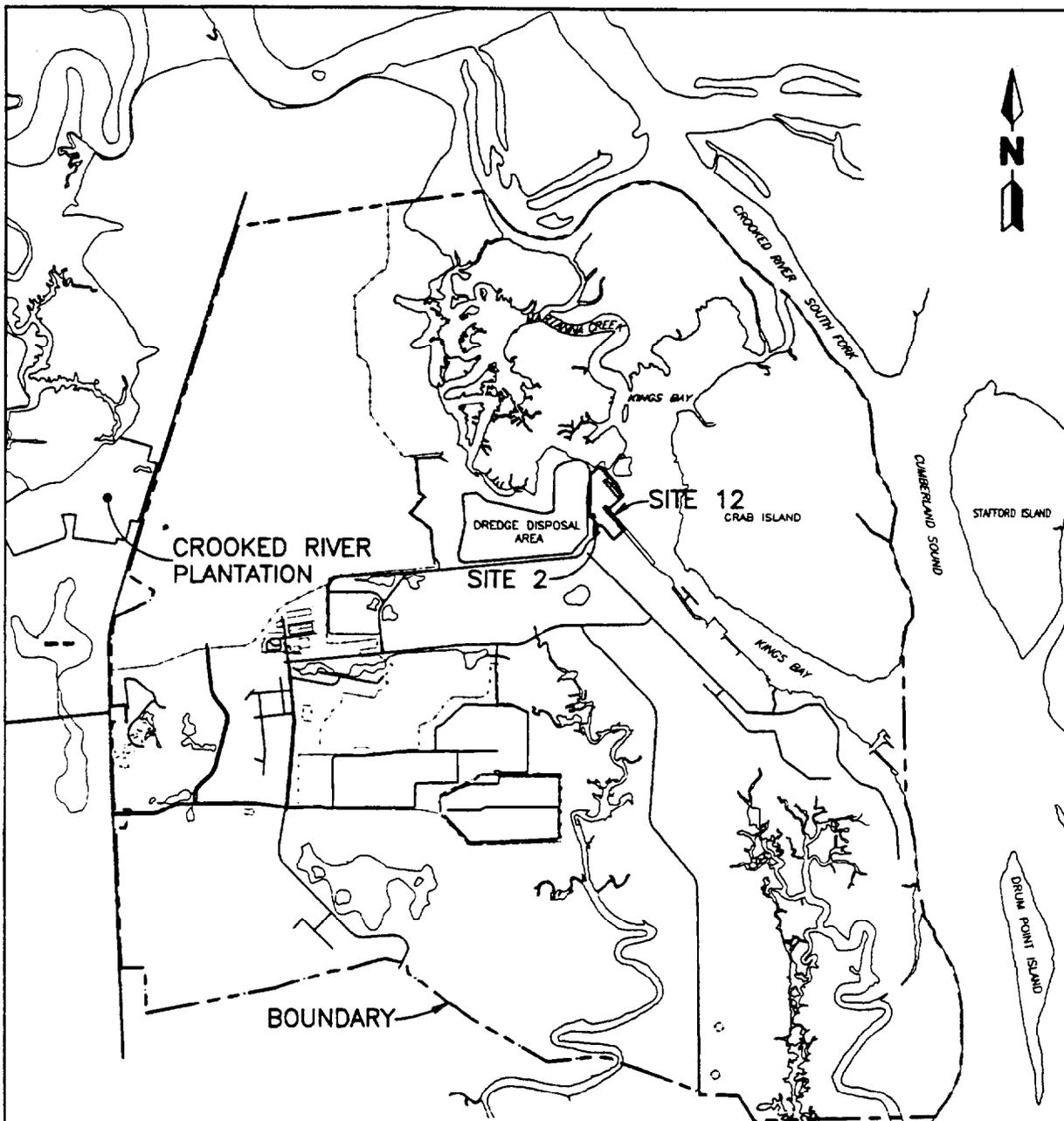


FIGURE 1-2
SITE LOCATION MAP



SCREENING INVESTIGATION
WORKPLAN FOR SITE 2

NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA

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1.2 PURPOSE AND REGULATORY SETTING. As a condition of the current Hazardous and Solid Waste Amendments (HSWA) permit under which NSB Kings Bay is operating, the facility is required to implement a Resource Conservation and Recovery Act (RCRA) corrective action program. The RCRA Corrective Action Plan (CAP) (Interim Final) (U.S. Environmental Protection Agency [USEPA], 1988) was developed by the USEPA to provide a model for corrective action and uses a four-phase approach to evaluate the condition of solid waste management units (SWMUs) and direct corrective action, if necessary. The first step, an RCRA Facility Assessment, was not formally conducted at NSB Kings Bay by representatives of State and Federal regulatory agencies. However, the Georgia Department of Natural Resources, Environmental Protection Division (GEPD) issued an HSWA permit to the NSB on September 29, 1989. Of the 16 SWMUs identified during the Initial Assessment Study (IAS) (prepared by C.C. Johnson and Associates, Inc., in 1985) but recommended for No Further Action (NFA), the permit identified four SWMUs (see Figure 1-1) suspected to be sources of current or past releases of hazardous substances to the environment:

- Site 5, Army Reserve Disposal Area, Towhee Trail;
- Site 11, Old Camden County Landfill;
- Site 12, Army Reserve Disposal Area, Future Dry Dock (now referred to as the Current Dry Dock); and
- Site 16, Army Reserve Disposal Area, Motor Missile Magazines.

An initial RCRA Facility Investigation (RFI) was planned and implemented at Sites 5 and 16. Investigation of these sites will continue under a Supplemental RFI that has been planned separately. Site 12 was included in an initial RFI (ABB Environmental Services, Inc. [ABB-ES], 1994), but was approved for NFA by the GEPD after it was remediated during construction of a dry dock. A fifth site, Site 2, is located within the confines of Site 12. There has been no investigation to date at Site 2. Site 11 has moved into the Interim Corrective Measures phase of corrective action and is being addressed separately.

The second step of corrective action includes development of an RFI Workplan and conducting an RFI to establish the presence or absence of toxic or hazardous substances and obtain information on the nature and extent of the contamination. Information collected during the RFI stage will be used to establish whether there is a need to implement additional phases of the RCRA CAP. A possible third step, Interim Corrective Measures, would involve controlling the further migration of contaminants and/or controlling potential sources of release and would be implemented if needed. The fourth step, Corrective Measure Study (CMS), would evaluate and recommend specific technical methodologies for achieving long-term remedial action goals. GEPD requires a site-specific CAP to address remedial actions at a site but does not require a CMS for the process.

The purpose of the screening investigation at Site 2 is to provide information in support of an NFA proposal or confirmation study. Data gathered during the investigation will be used to evaluate residual soil and groundwater contamination. Based on the results of the screening investigation, further confirmation and characterization activities will be conducted as part of an RFI, if warranted. These activities would be defined in an RFI Workplan and submitted to the Navy and regulatory agencies for review.

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2.0 DESCRIPTION OF CURRENT CONDITIONS

2.1 ENVIRONMENTAL SETTING. In June 1994, an RFI report was submitted to the Navy that addressed the results of the 1992 and 1993 investigations conducted at Sites 5 and 16 (ABB-ES, 1994) at Kings Bay. Chapter 2.0 of the RFI report addressed topography, surface water, drainage, regional and site-specific hydrogeology, soils, and climate and is incorporated into this Workplan by reference. The remainder of this chapter describes conditions at Site 2 as defined by historical information and previous investigations of Site 12.

2.2 SITE DESCRIPTION. Site 2 is located within the boundaries of Site 12, Current Dry Dock, at Kings Bay (Figure 2-1). As described in the IAS performed by C.C. Johnson and Associates, Inc., in 1985 for the Naval Energy and Environmental Support Activity (NEESA), Site 2 was an unlined pit used for fire-fighting exercises from 1980 to 1981. The pit was approximately 30 feet by 30 feet by 2 feet deep. It was located in the waterfront area of Pelican Road near the intersection of Stimson Drive and USS James Monroe Avenue (Figure 2-2).

Approximately 1,500 gallons of contaminated diesel fuel and small amounts of paints and paint thinners were poured into a bermed pit and burned once every 2 months by the fire department. In 1980, a one-time disposal of an unknown quantity of hydrazine (N_2H_4) was also burned at Site 2 (C.C. Johnson and Associates, 1985). Whether water or chemical foam or powder was used to extinguish the fires is unknown (C.C. Johnson and Associates, 1985).

A core sample collected from the pit in August 1980 was tested for Extraction Procedure (EP) Toxicity, which was the appropriate test at the time to classify hazardous waste. Laboratory results identified the sample contents as non-hazardous (Appendix A). Table 2-1 summarizes the results of the EP toxicity test. In 1982, approximately 100 cubic yards of contaminated soil were excavated from the pit and disposed by a waste disposal contractor (C.C. Johnson and Associates, 1985).

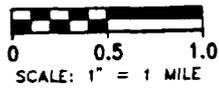
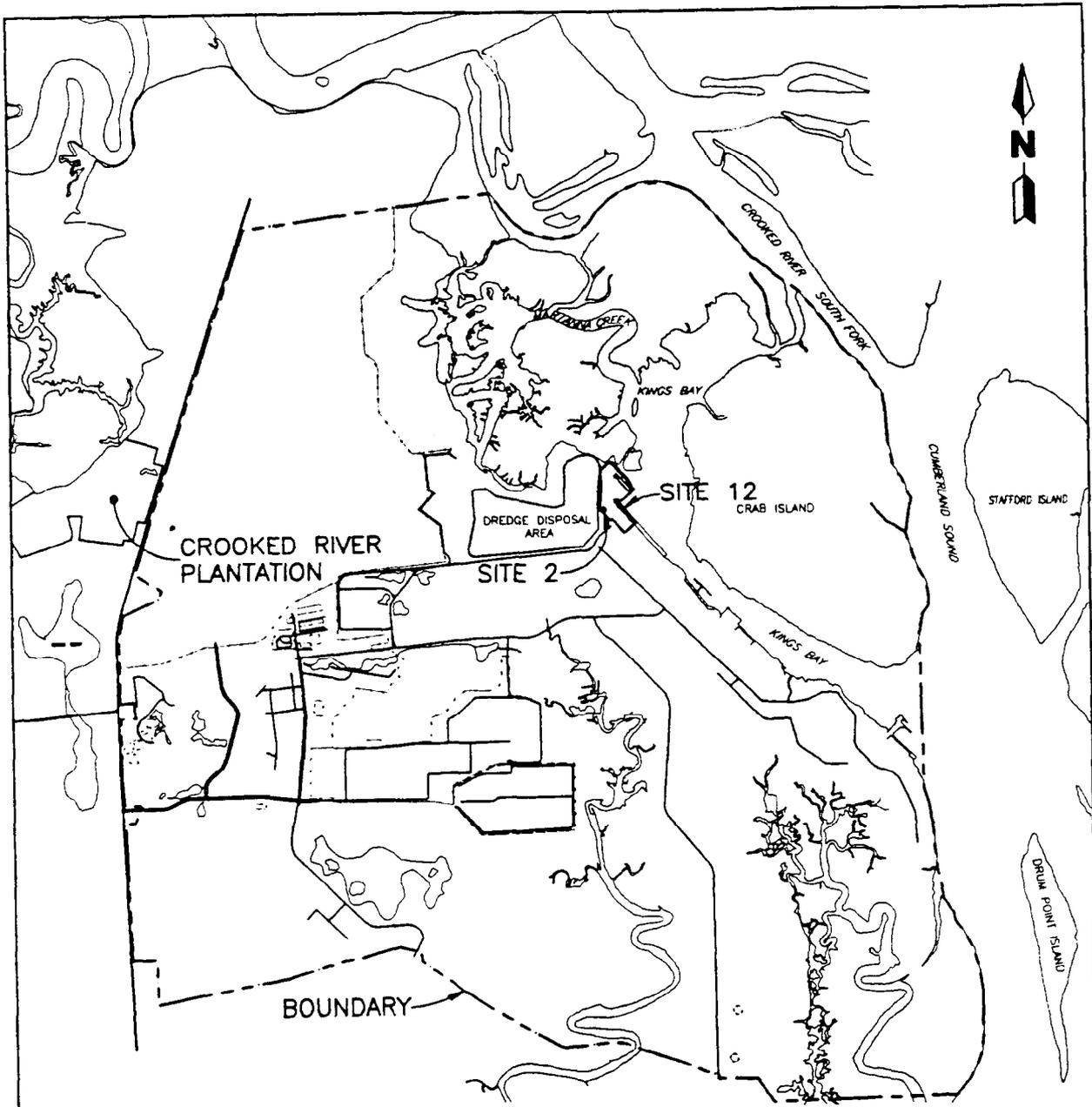


FIGURE 2-1
SITE LOCATION MAP



SCREENING INVESTIGATION
WORKPLAN FOR SITE 2

NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA

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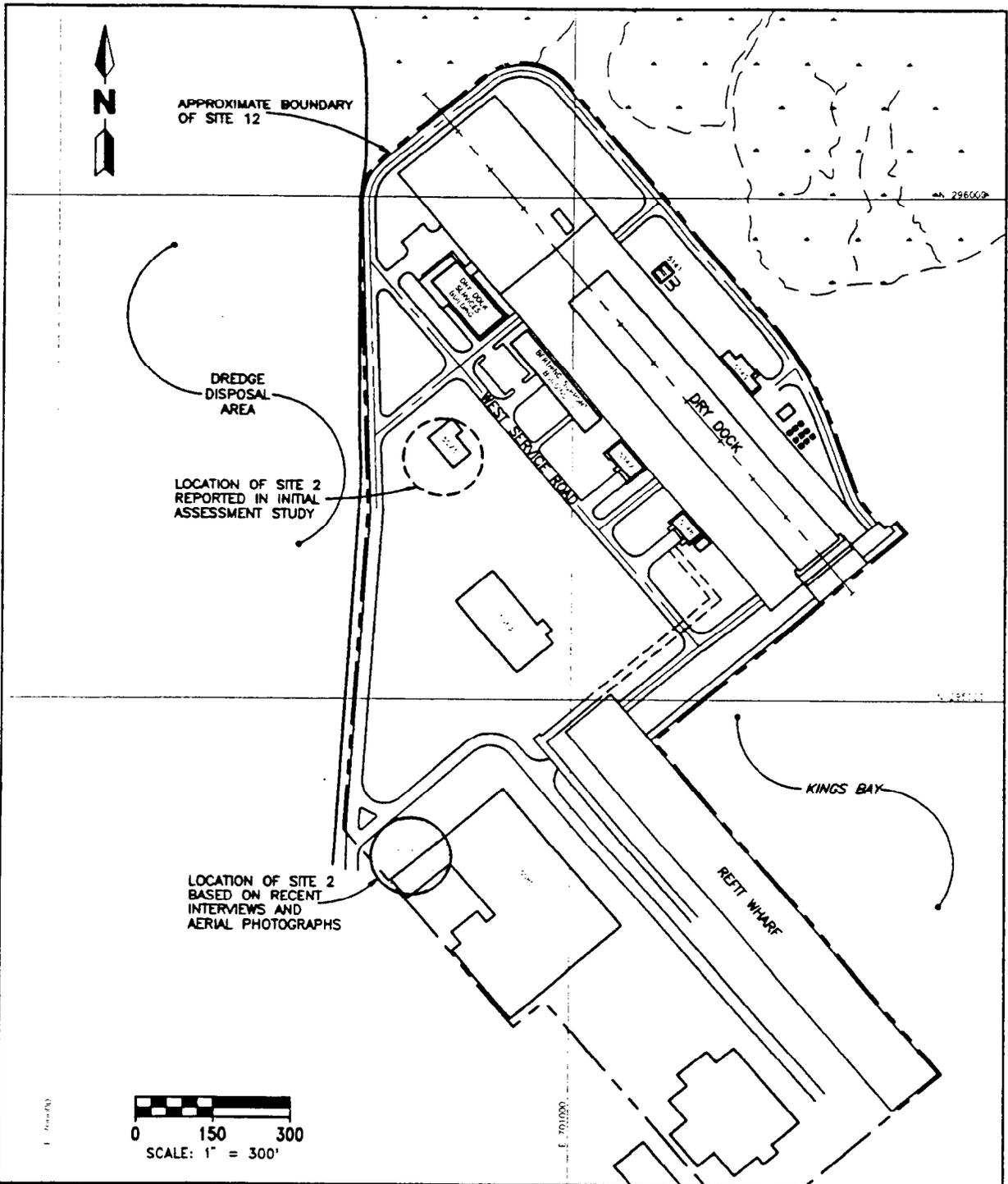


FIGURE 2-2
SITE LAYOUT



SCREENING INVESTIGATION
WORKPLAN FOR SITE 2

NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA

D:\DWG\ABB\08503-71\SITE_2\FIG_2-2\DMF\941020

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| Table 2-1 Extraction Procedure Toxicity Test Results | |
|--|---|
| <i>Screening Investigation Workplan for Site 2</i> Naval Submarine Base Kings Bay Kings Bay, Georgia | |
| Parameter | Test Result (milligrams per liter) |
| Arsenic | 0.017 |
| Barium | 0.2 |
| Cadmium | <0.002 |
| Chromium | 0.014 |
| Lead | 0.057 |
| Mercury | <0.0002 |
| Selenium | <0.01 |
| Silver | 0.005 |
| Endrin | <0.0005 |
| Lindane | <0.0005 |
| Methoxychlor | <0.001 |
| Toxaphene | <0.005 |
| 2,4-Dichlorophenoxyacetic acid | <0.05 |
| 2,4,5-Trichlorophenol (Silvex™) | <0.001 |

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3.0 PROJECT MANAGEMENT PLAN

3.1 PROJECT ORGANIZATION AND RESPONSIBILITIES. Key individuals in the project structure are highlighted below.

SOUTHNAVFACENGCOM. SOUTHNAVFACENGCOM is responsible for establishing policy and guidance for the CLEAN program. SOUTHNAVFACENGCOM awards contracts, approves funding, and has primary control of report release and interagency communication.

NSB Kings Bay Environmental Coordinator. The Environmental Coordinator will coordinate and monitor investigative activities at NSB Kings Bay. The Environmental Coordinator maintains a working relationship with local, State, and Federal regulatory agencies.

SOUTHNAVFACENGCOM Engineer-in-Charge. The SOUTHNAVFACENGCOM Engineer-in-Charge (EIC) is responsible for the technical and financial management of the screening investigation at NSB Kings Bay. The EIC prepares the project statement of work; develops the project Site Management Plan; manages project scope, schedule, and budget; and provides technical review and approval of all deliverables. The EIC will be responsible for changes in the scope of work determined during Project Managers' meetings.

Task Order Manager. The Task Order Manager (TOM) for the screening investigation is responsible for evaluating the appropriateness and adequacy of the technical and engineering services provided. The TOM is also responsible for resource management, for confirming that the project fulfills the requirements of the Contract Task Order, and for the daily conduct of work, including integration of input from supporting disciplines and subcontractors.

Technical Leader. The Technical Leader will be responsible for the quality and completeness of data gathered during the screening investigation, including overall management and coordination of fieldwork and supervision and scheduling of work. The Technical Leader will also be responsible for the development of the Screening Investigation Report.

Field Operations Leader. The Field Operations Leader (FOL) will be responsible for the day-to-day execution of the field program. These responsibilities include coordination of activities; record keeping; communication with the Base, Technical Leaders, and TOM; adherence to quality assurance and quality control requirements; subcontractor oversight; mobilization of equipment; local agency interaction; and preparation of sampling event reports. The FOL will also ensure that all field activities performed are consistent with the project workplan and supporting documents. These responsibilities include appropriate logging and documentation of investigative methods to confirm that pertinent testing information is obtained during the exploration program. Other responsibilities include oversight of sampling activities and site characterization studies.

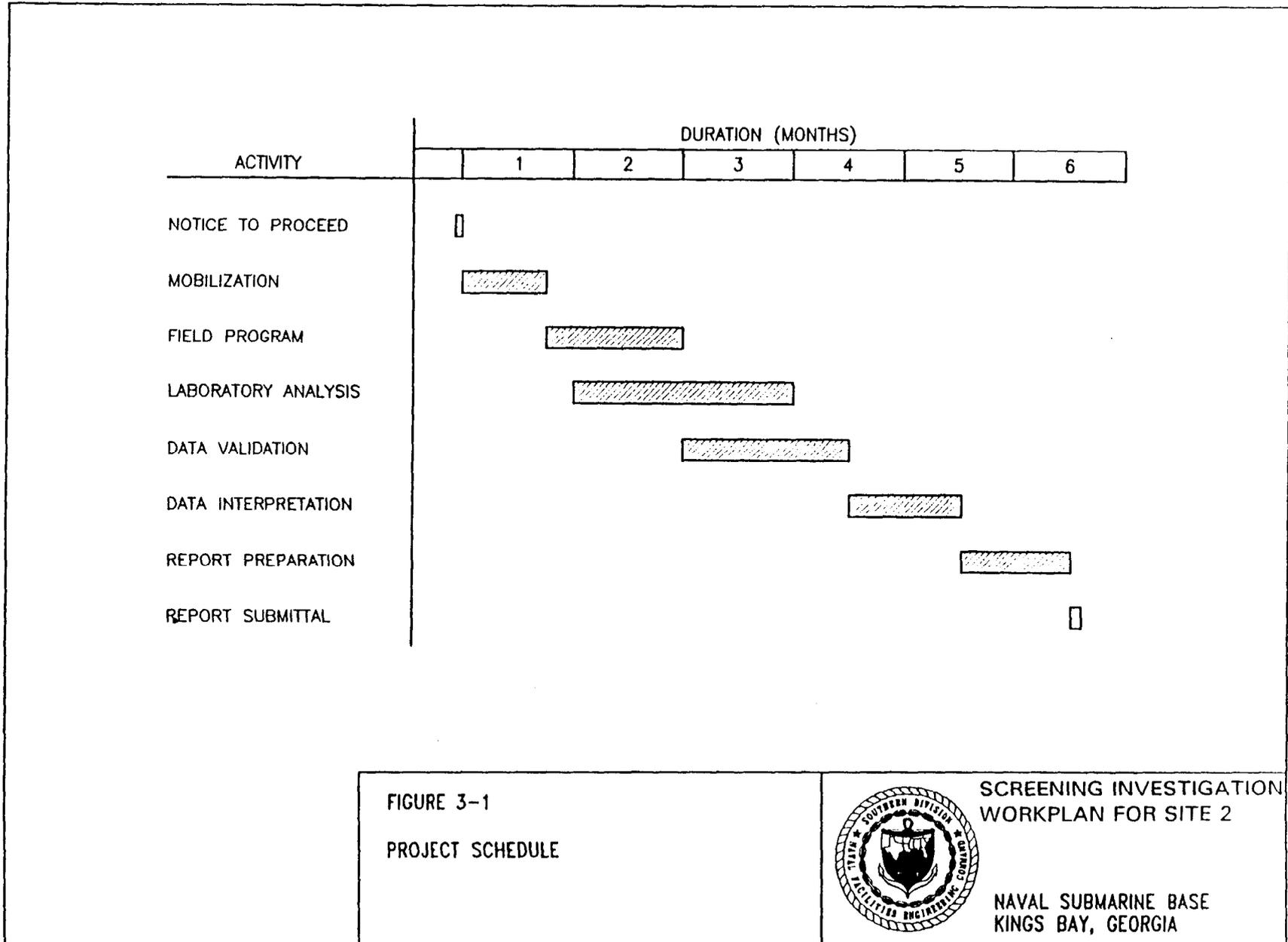
Technical Director. The Technical Director will be responsible for coordination of technical review of workplans and planning documents, interaction with the Technical Leaders, and guidance with regulatory and technical requirements.

RCRA Technical Expert. The RCRA Technical Expert will be responsible for providing expertise to the program at NSB Kings Bay. He will provide guidance and input

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to the direction of activities associated with the program. He will also provide review of documents created by the project team. He has close interaction with the Technical Leader.

3.2 SCHEDULE. Accurate schedule planning, tracking, and reporting are important for expeditious completion of the screening investigation at Site 2. For purposes of this workplan, the schedule is presented in Figure 3-1. The schedule will be updated to reflect actual progress during the project and will be forwarded to the SOUTHNAVFACENCOM EIC, NSB Kings Bay, and GEPA (if required). The schedule reflects durations and begins at notice to proceed. The schedule assumes ready access to the site.



4.0 SAMPLING AND ANALYSIS PLAN

4.1 SITE MANAGEMENT. The following subsections describe mobilization activities, site access and security clearances, and documentation requirements for the fieldwork.

4.1.1 Mobilization The following activities will be performed at NSB Kings Bay as part of mobilization:

- staking and utility clearance (i.e., drilling permits) for all exploration activities;
- field team orientation, including acquisition of personnel badges and security clearances for work in secure areas; and
- field team and subcontractor health and safety meetings (the Health and Safety Plan is included as Appendix B).

4.1.2 Site Access and Control NSB Kings Bay is an active Base with various levels of security clearance for different areas of the base. Work is planned in controlled access areas. Where necessary, security police will be notified of the locations of on-Base field activities. Badges will be obtained through Base security. The site is accessible from paved or dirt roads maintained by the Base.

4.1.3 Field Monitoring Instrumentation The following monitoring instruments may be used during field activities:

- photoionization (PID) meter,
- organic vapor analyzer (OVA),
- explosimeter,
- radiation meter,
- pH-temperature-specific conductance meter,
- electronic water level meter,
- metal detector,
- two-way radios or cellular telephones, and
- turbidity meter.

Instruments will be calibrated and inspected daily before field activities begin, as suggested by the manufacturers. Calibration information will be recorded in the field logbooks and on a field instrumentation quality assurance form. Monitoring equipment will be protected, as much as possible without hindering operation of the unit, from contamination during field exploration activities. Equipment maintenance will be performed according to manufacturers' specifications before field use or by rotating instruments into and out of the field on an instrument performance and maintenance schedule. As appropriate, routine periodic maintenance may be performed as a function of field calibration. Malfunctioning instruments will be repaired or replaced.

4.1.4 Control and Disposal of Investigation-Derived Waste (IDW) IDW associated with the screening investigation can include soil cuttings, groundwater, decontamination water and solutions, and expendable materials such as sample gloves, paper towels, and tin foil.

The IDW will be segregated by medium, liquids (groundwater, development water, etc.), and solids (soils, expendables, etc.). Liquid IDW will be derived from two sources: (1) groundwater, generated during development of piezometers, and (2) wastewater, generated from decontamination procedures. Solid IDW will be derived from three sources: (1) the advancement of soil borings, (2) the installation of piezometers, and (3) the disposable protective clothing, gloves, plastic sheeting, and other expendable materials.

Decontamination activities for large equipment such as the drilling rig will be conducted at the decontamination pad at Site 11, Old Camden County Landfill. The decontamination pad is constructed of concrete and drains to a sump on the pad. Decontamination fluids and solids will be collected in the sump. Fluids will be fed into the onsite treatment system at Site 11. Sediment in the sump will be transferred to new, 55-gallon, U.S. Department of Transportation (DOT) approved drums. Drums will be labeled indicating date and contents and the information will be recorded in an IDW logbook. These drums will be staged on wooden pallets at the decontamination area. The drums will be covered and temporary secondary containment will be constructed using bales of hay (or other suitable material) and plastic sheeting. Composite samples comprised of aliquots from no more than six drums will be collected and submitted for Toxicity Characteristic Leaching Procedure (TCLP) analyses. Disposal will be evaluated coincident with soil IDW generated during the field work and discussed in this subsection.

Groundwater IDW will be generated at the site during development of piezometers. The groundwater IDW will be contained in properly labeled DOT-approved drums or other appropriate containment devices. Proper methods of disposal of the groundwater IDW will be evaluated using data from TCLP analyses of representative samples from containers of IDW. It is anticipated that approximately 100 gallons of groundwater will be removed from each of the five piezometers. If the IDW is contained in drums, then the drums will be limited to containing groundwater from only one piezometer. In this case, it is estimated that two drums of IDW will be generated at each location. A composite sample will be prepared for each piezometer location by collecting equal portions of material from the entire water column in each of the drums. In the event that more than the expected volume of groundwater is removed from a piezometer during development, sampling for waste characterization will be conducted such that no more than six drums are included in a single composite sample. If a temporary storage container is used that has a capacity to contain the entire 500 gallons expected to be generated during piezometer development, then a composite sample will be collected from the container that is representative of the entire contents of the container.

Waste soil will be stored in new, properly labeled, 55-gallon, DOT-approved drums with removable lids or in plastic-lined, covered storage bins. If drums are used for the soil IDW, then the drums will be stored in a central area and staged on wooden pallets. The drums will be covered and temporary secondary containment will be constructed using bales of hay (or other suitable material) and plastic sheeting. A logbook will be kept, in which the sources of the contents in each container of IDW will be noted. The amount of solid waste from each point source will also be recorded as accurately as possible. The soil IDW will be characterized using TCLP analyses of composite samples representative of the material. It is anticipated that no more than six 55-gallon drums of soil would be generated for any one piezometer. To characterize soil IDW contained in drums, composite samples will be prepared for each piezometer location by collecting equal portions of material from each drum. When collecting material from a drum, the contents of the entire drum will be represented. If the soil IDW is contained in storage bins, then a composite sample will be prepared for

each storage bin. When preparing a composite sample from a storage bin, the bin will be divided into quadrants and equal portions of material will be collected from the top, middle, and bottom of each quadrant.

The soil cuttings, decontamination solids (sediment), and groundwater IDW will be handled as hazardous waste until TCLP results are obtained and reviewed. The criteria used to evaluate disposal of the IDW will be background concentrations and TCLP threshold values. If concentrations of analytes are equal to or less than background, the material may be spread onsite. If the concentrations are greater than background but less than TCLP threshold values, the material will be disposed in a Subtitle D landfill. If the analyte concentrations exceed TCLP threshold values, the material will be disposed as hazardous waste. The drums may be staged at the sites for up to 90 days, longer if TCLP analyses indicate concentrations below threshold values.

Expendables will be segregated from other solids. Under no circumstance will expendables be combined with soil. Expendables will be double-bagged in plastic bags and disposed in an NSB solid waste dumpster. Excessively soiled material will be washed at the decontamination pad to remove loose particles before disposal.

4.2 DATA COLLECTION AND SAMPLING PROCEDURES. The screening investigation program for Site 2 includes subsurface soil and groundwater sampling using direct push methodologies and the installation of piezometers.

Thirty-one exploration locations are planned for the investigation (Figure 4-1). A denser sampling grid is planned for two areas where fire-fighting activities may have occurred. A number of samples will be collected between the two areas to provide additional soil and groundwater chemical information. Sample grids consisting of nine samples will be concentrated in the two separate areas, and the additional samples will be spaced between these areas. The actual number of samples to be collected may increase or decrease during the site investigation due to site conditions or results from onsite analyses.

Soil Sampling. Soil samples will be collected from discrete intervals during advancement of soil borings. Soil borings will be advanced using direct push methodologies including TerraProbeSM, HydropunchTM, or cone penetrometer.

Soil will be collected continuously from every 2-foot interval (0 foot to 2 feet, 2 feet to 4 feet, etc.) until the water table is reached. After the water table is reached, the boring will continue into the saturated zone. Two soil samples will be collected from each boring: one from the 2-foot interval directly above the water table and the other from the 2-foot to 4-foot interval below the top of the water table. After the soil samples are collected and preliminary screening has been performed with a PID or OVA, the soil will be removed from the sampling instrument and placed into sampling containers for submission to the field laboratory. Stratigraphic information will be documented in the field logbook.

Table 4-1 outlines the sampling summary for the screening investigation at Site 2. The soil samples will be analyzed onsite using a field gas chromatograph (GC) for target VOCs and an infrared spectrometer for residual total petroleum hydrocarbon (TPH) analyses. Target VOCs are listed in Table 4-1. Ten percent of the soil samples will be sent to an offsite laboratory for confirmatory analyses for hydrazine, VOCs, semivolatile organic compounds (SVOCs), pesticides,

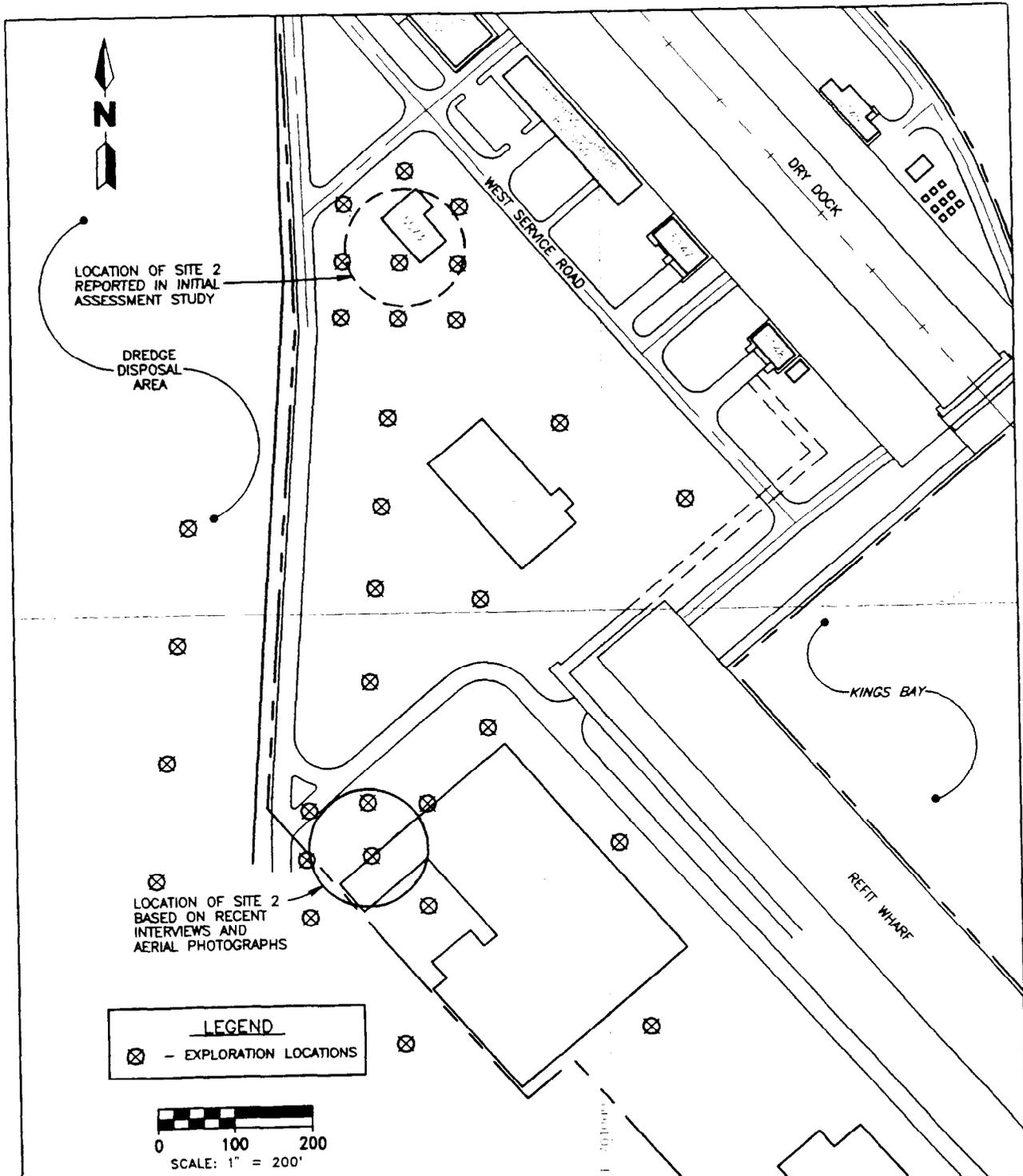


FIGURE 4-1

TENTATIVE EXPLORATION LOCATIONS
AT SITE 2



SCREENING INVESTIGATION
WORKPLAN FOR SITE 2

NAVAL SUBMARINE BASE
KINGS BAY, GEORGIA

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**Table 4-1
Sample Summary**

Screening Investigation Workplan for Site 2
Naval Submarine Base
Kings Bay, Georgia

| <u>Onsite Sampling Program</u> | | | | | | |
|--|-------------------------------|-----------------------------|--|-------------------------|---------------------|--------|
| Sample Media | No. of Locations ¹ | Samples Reg/QA ² | Field Analyses | Laboratory Confirmation | Laboratory Analysis | |
| Soil | 31 | 62/73 | 73 | ³ 8 | VOCs and TPH | |
| Groundwater | 31 | 93/108 | 108 | 10 | VOCs and TPH | |
| Total | 31 | 155/181 | 181 | 18 | VOCs and TPH | |
| <u>Offsite Sampling Program³</u> | | | | | | |
| Sample Media | No. of Samples | Duplicates | Trip Blanks | Field Blanks | Rinsates | MS/MSD |
| Soil | 8 ⁴ | 1 | - | - | - | 1 |
| Groundwater | 10 | 1 | 2 | 2 | 2 | 1 |
| Total | 18 | 2 | 2 | 2 | 2 | 2 |
| Total number of soil samples to be collected during field screening program (including QA/QC): 73 | | | | | | |
| Total number of groundwater samples to be collected during field screening program (including QA/QC): 108 | | | | | | |
| Target VOCs (field gas chromatograph) | | | | | | |
| Methyl ethyl ketone (MEK) | | | 1,2 - Dichloroethene | | | |
| Methylene chloride | | | 1,1 - Dichloroethane | | | |
| 2-Hexanone | | | 1,2 - Dichloroethane | | | |
| Trichloroethene (TCE) | | | benzene, ethylbenzene, toluene, xylenes (BTEX) | | | |
| Tetrachloroethene (PCE) | | | 4-methyl-2-pentanone (MIBK) | | | |
| ¹ Total number of samples is based on proposed number of exploration locations. Actual number of locations may vary. ² Shows number of regular (Reg) samples to be collected, and number of samples including all quality assurance (QA) and quality control (QA/QC) requirements. See Section 4.5 for discussion on QA/QC sample requirements. ³ Offsite analyses include hydrazine, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyl (PCBs), and inorganic compounds. ⁴ Six soil samples to be collected for grain-size and hydrometer analyses are not included here. | | | | | | |
| Notes: Reg/QA = regular and quality assurance. SVOCs = semivolatile organic compounds. VOCs = volatile organic compounds. PCBs = polychlorinated biphenyl compounds. TPH = total petroleum hydrocarbons. MS/MSD = matrix spike and matrix spike duplicate. QA/QC = quality assurance and quality control. | | | | | | |

polychlorinated biphenyl (PCB) compounds, and inorganic analytes. The offsite laboratory analyses will be performed using USEPA SW-846 analytical methods. If sufficient sample volume for offsite analyses cannot be obtained using direct push, then soil samples for offsite analyses will be collected during the drilling program for the piezometers. The locations for soil sampling will be selected within and outside of areas where field analytical data indicate soil contamination is present.

During the investigation, six samples will be collected and sent offsite for grain size and hydrometer analyses. The six samples will consist of two samples collected from three different borings. The sample depths will be within the anticipated screened interval of the piezometers and will represent the finest grained material in the interval. The results of these tests will be used to determine piezometer construction specifications (i.e., filter pack size and screen slot size).

Groundwater Sampling. The presence or absence of groundwater contamination at Site 2 will be evaluated by collecting three groundwater samples from each of the 31 borings advanced by direct push methodologies (see Figure 4-1). During drilling, borings will be advanced into the water table. After the water table is reached, the boring will continue at least 5 feet into the saturated zone for collection of a groundwater sample. A screened rod will be installed into the water table and time will be allowed for recharge if needed. Groundwater samples will be collected by inserting a small bailer into the screened interval. Care will be taken to collect non-turbid samples for VOC analyses. Ten percent of the groundwater samples will be sent to an offsite laboratory for analyses for hydrazine, VOCs, SVOCs, pesticides, PCBs, and inorganic analytes. Offsite analyses will be performed using USEPA SW-846 analytical methods. The sampling summary for groundwater collection is outlined in Table 4-1.

Piezometer Installation. Piezometers will be installed at five locations at Site 2 to: (1) evaluate groundwater flow direction and (2) determine the influence of tides on groundwater flow conditions. The five proposed locations for the piezometers are shown on Figure 4-2. The actual locations of the piezometers will be based upon site conditions, site access, and utility clearances in addition to analytical data.

Piezometers will be installed with a standard drilling rig using hollow stem auger methods. The piezometers will be constructed of 2-inch inside-diameter, Schedule 40, polyvinyl chloride (PVC) riser pipe and slotted well screen. The slot size for the screen and grain size distribution of the filter pack material will be specified using the approach described in American Society for Testing and Materials (ASTM) D 5092-90. Total depths of the piezometers are anticipated to be 15 to 20 feet below land surface (bls). Screened sections will be 10 feet in length and will be set to intercept the overburden and water table interface. The annulus surrounding the screen will be backfilled with a sand pack to approximately 2 feet above the screen. A 2-foot-thick bentonite seal will be placed above the sand pack. The remaining annulus above the seal will be grouted to the point of well vault installation.

Piezometers will be completed flush to the ground surface with 22-gauge steel, water-resistant, welded boxes with a minimum 3/4-inch locking cover plate. Each cover plate will be marked with a metal marker stamped by the Contractor. All materials used in piezometer construction will be inspected for compliance with

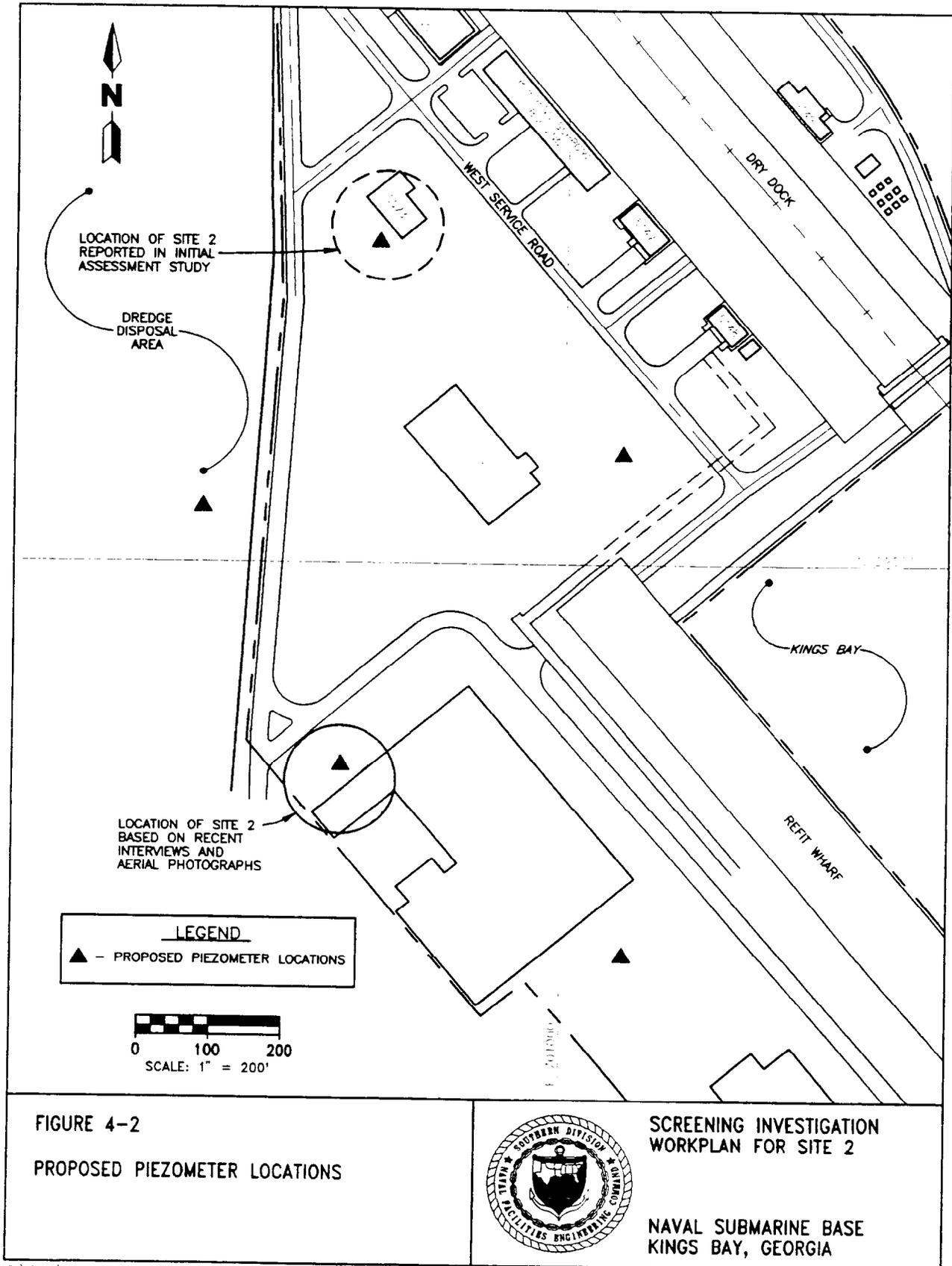


FIGURE 4-2
 PROPOSED PIEZOMETER LOCATIONS



SCREENING INVESTIGATION
 WORKPLAN FOR SITE 2

NAVAL SUBMARINE BASE
 KINGS BAY, GEORGIA

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specifications and pertinent information will be recorded in the field logbook. Recorded information may include supplier name and address, measurements, and grain size data for the filter pack material.

Each piezometer will be developed after a minimum of 24-hour grout set time to remove fines and improve the hydraulic connection with the natural soil. After installation and development is complete, the water level in each piezometer will be measured and recorded in the field logbook. Water levels will be recorded to the nearest 0.01 inch from the top of casing. Apparent groundwater flow direction will be interpreted from these measurements.

One piezometer will be used to evaluate the influence of tidal fluctuations on groundwater flow at the site. Water level readings in the piezometer will be collected continuously over a 24- to 48-hour period using an *in-situ* measuring device, such as a pressure transducer and data logger. After collection of water levels is complete, the data will be downloaded to a computer. Tidal influence will be evaluated by using barometric pressure data from the same time period. Barometric pressure data can be collected onsite using specific equipment, or can be obtained from the National Climatic Data Center for the Jacksonville, Florida, station located at the international airport (approximately 30 miles south of NSB).

Elevation Survey. An elevation and location survey will be performed by a Georgia-licensed surveyor to locate the exploration and piezometer locations, and other necessary control points. The north side of the inner casing (riser) for all piezometers will be surveyed for both horizontal and vertical control to a minimum degree of accuracy of 0.1 and 0.001 foot, respectively. Exploration and piezometer locations will be plotted on site-specific base maps. Identification of sampling locations will be given in terms of latitude and longitude coordinates and State Plan Coordinates in accordance with the Federal Interagency Coordinating Committee for Digital Cartography recommendations.

4.3 SAMPLE HANDLING PROCEDURES.

4.3.1 Sample Containers, Preservation, and Holding Times Sample containers will be obtained from a Naval Energy and Environmental Support Activity (NEESA)-approved subcontract laboratory. NEESA requires all subcontract laboratories to have a current and comprehensive Quality Assurance Plan (QAP) and sample container requirements that meet USEPA requirements.

Preservatives, controlled holding times, and selected container materials may be required to avoid sample degradation or alteration prior to laboratory analysis. Common preservation techniques include pH control, chemical complexation, and refrigeration or freezing. Holding times are controlled to minimize the time between sample collection and analysis, which in turn minimizes the reaction time for potential mechanisms of analyte loss or alteration. Selected container materials may be required to minimize sorption, leaching, or other interactions between the sample and the container. Sufficient sample volumes must be collected to accommodate specified analytical methods and to allow for the analyses of laboratory quality assurance and quality control samples, where required.

4.3.1.1 Sample Containers Sample containers will be provided by the contract laboratory. The containers will be consistent with laboratory quality assurance and quality control (QA/QC) procedures and the analytical methods being used for this project. Containers will be kept in the dark to minimize biological or

photoxidation and photolytic breakdown of constituents until they reach the analytical laboratory. Approximately 5 to 10 percent air space ("ullage") will be reserved in the sample container to allow for expansion or vaporization if the sample is heated during transport (1 liter of water at 4 degrees Celsius [$^{\circ}\text{C}$] expands by 15 milliliter [ml] if heated to 55 $^{\circ}\text{C}$). An important exception is VOC samples; headspace is not allowed in the VOC sample container. When sample containers are stored onsite, the containers will be kept sealed and away from solvents that are also being stored.

4.3.1.2 Preservation Techniques Reagents required for sample preservation will be added to the sample containers by the subcontract laboratory prior to shipment or preservatives may be added in the field. Preservation of samples will be consistent with the analytical methods and matrices sampled. Samples will be placed on ice in ice chests immediately after collection.

4.3.2 Sample Handling, Packaging, and Shipping Sample packaging and shipping procedures will protect the integrity of the samples and prevent detrimental effects from leakage or breakage. Regulations for packaging, marking, labeling, and shipping hazardous materials and wastes are promulgated by the DOT and described in the Code of Federal Regulations (CFR) (49 CFR 171 through 177; in particular 172.402h, Packages Containing Samples). In general, these regulations were not intended to hamper shipment of samples collected at controlled or uncontrolled hazardous waste sites or samples collected during emergency responses. However, the USEPA has agreed through a Memorandum of Agreement to package, mark, label, and ship samples observing DOT procedures.

Correct packaging, storing, and shipping of environmental samples will be followed to:

- ensure samples remain sealed in original containers,
- prevent breakage,
- prevent cross contamination of individual samples,
- ensure sample characteristics are preserved,
- prevent contamination to receiving personnel, and
- ensure samples are protected against tampering when not in the sampler's possession.

Prior to packaging, each sample container will be inspected to verify correct labeling. Labels will be secured to containers with clear tape. Each container will have a signed and dated custody seal over the cap. Samples will be shipped to the laboratory via commercial ground or air carrier within 24 hours of sample collection.

All breakable sample containers (glass) will be protected with packing. Bubble-pack bags or strips are acceptable. Sample containers may be placed in sealable plastic bags such as Zip-lock™ type bags.

Samples will be shipped in durable coolers packed with bubble-pack or vermiculite. Samples will be kept cool with double-bagged clean ice. Completed chain-of-custody (COC) forms will be placed in a plastic bag and taped to the inside lid of the shipping container. If COC forms refer to multiple containers, they may be placed in the lead container or each cooler may have a COC form for samples contained in the cooler. A signed and dated COC seal will be secured with clear tape over the front and back of the container lid. The container will be sealed by wrapping it in filament tape.

Until relinquished to the carrier, the shipping containers will remain with field personnel or remain in a locked vehicle so as not to be accessible to others. Upon shipping, the laboratory will be contacted and advised of the contents, scheduled arrival date and time, carrier, and number of containers.

4.4 DECONTAMINATION PROCEDURES. Equipment to be decontaminated during this project may include: (1) direct push equipment, (2) drilling rig, (3) tools, (4) monitoring equipment, (5) sample containers, and (6) truck or trailer.

All decontamination will be performed by personnel in protective gear appropriate for the level of decontamination, established by the Health and Safety Officer. The decontamination work tasks will be split or rotated among support and work crews.

4.4.1 Direct Push Equipment, Drilling Rig, and Tools All drilling rigs, drilling and sampling equipment, and all other associated equipment involved in the drilling and sampling activities will be cleaned and decontaminated before entering the designated site. All equipment will be inspected before entering the site to ensure that there are no fluids leaking and that all gaskets and seals are intact. All drilling and associated equipment entering a site will be cleaned of any contaminants that may have been transported from another site, thereby minimizing the potential for cross contamination. Before site drilling activities are initiated, all drilling equipment will be thoroughly cleaned and decontaminated at the designated cleaning and decontamination area at Site 11. Strict adherence to the requirements and procedures in the following paragraphs are required on all drilling activities.

Any part of the drilling rig that is over the borehole (kelly bar or mast, drilling platform, hoist or chain pulldowns, spindles, cathead, buckets, etc.) will be steam cleaned and wire brushed before being brought on the site to remove all rust, soil, and other material that may have come from other sites. The drilling rig and other equipment associated with the drilling and sampling activities will be inspected to ensure that all oil, grease, hydraulic fluid, etc., have been removed and all seals and gaskets are intact and there are no fluid leaks. No oils (except for vegetable oil) or grease will be used to lubricate drill stem threads or any other drilling equipment being used over the borehole or in the borehole. If drill stems have a tendency to tighten during drilling, Teflon™ string and/or vegetable oil can be used on the drill stem threads. The drilling rig(s) will be steam cleaned and wire brushed prior to drilling at each location. In addition, all downhole drilling, sampling, and associated equipment that will come into contact with the downhole equipment and sample medium will be cleaned and decontaminated by the following procedures.

1. Clean with tap water and laboratory grade, phosphate-free detergent, using a brush, if necessary, to remove particulate matter and surface films. Steam cleaning and/or high pressure hot water washing may be necessary to remove matter that is difficult to remove with the brush. Drill rods, Shelby tubes, split spoons, etc., that are hollow or have holes that transmit water or drilling fluids will be cleaned on the inside and on the outside. The steam cleaner and/or high pressure hot water washer will be capable of generating a pressure of at least 2,500 pounds per square inch (psi) and producing hot water and/or steam (200 degrees Fahrenheit [°F] or greater).

2. Rinse thoroughly with tap water (potable).

Note: Tap water (potable) may be applied with a pump sprayer. All other decontamination liquids (deionized water, organic-free water, and solvents), however, must be applied with non-interfering containers. These containers will be made of glass, Teflon™, or stainless steel. This aspect of the decontamination procedures used by the driller will be inspected by the site geologist and/or other responsible person prior to beginning operations.

3. Rinse thoroughly with deionized water.
4. Rinse with solvent (pesticide-grade isopropanol).
5. Rinse thoroughly with organic-free water and allow to air dry. Do not rinse with deionized or distilled water.

Note: Organic-free water can be processed onsite by purchasing or leasing a mobile deionization-organic filtration system.

Note: In some cases, when no organic-free water is available, it is permissible to omit the organic-free water rinse and allow the equipment to air dry before use.

6. Wrap with aluminum foil, if appropriate, to prevent contamination if equipment is going to be stored or transported. Clean plastic can be used to wrap drill stems, casings, etc., if they have been air dried.
7. Well casing, tremie tubing, etc., that are made of plastic (i.e., PVC) will not be solvent-rinsed during the cleaning and decontamination process. Used plastic materials that cannot be cleaned are not acceptable and will be discarded.

Cleaning and decontamination of all equipment will occur at the decontamination pad at Site 11. The pad is constructed of concrete and drains to a concrete sump. Washing of small equipment such as split-spoon samplers and direct push rods can be done at the drilling location.

Tap water (potable) brought on the site for drilling and cleaning purposes will be contained in a pre-cleaned tank of sufficient size so that drilling activities can proceed without having to stop and haul water. A stainless-steel water tank with a minimum capacity of 1,000 gallons is preferred.

4.4.2 Sample Containers Exterior surfaces of sample bottles will be decontaminated by wiping with a paper towel or cloth prior to packing for transportation to the analytical laboratory.

4.4.3 Monitoring Equipment Monitoring equipment will be protected as much as possible from contamination. The equipment will be brushed or wiped with a disposable paper wipe, wiped off with damp disposable wipes, and dried. The units will be checked, standardized, and recharged as necessary for the next day's operation.

4.5 QUALITY CONTROL SAMPLES. The number and types of QC samples to be collected for laboratory analyses during the screening investigation at Site 2 is included in Table 4-1. A brief description of QC samples is presented below. Selected definitions were obtained from USEPA Region IV Standard Operating Procedures and Quality Assurance Manual (SOPQAM) (USEPA, 1991a).

Duplicate Samples. Duplicate samples are two or more samples collected simultaneously into separate containers from the same source under identical conditions. One duplicate will be collected for every 10 samples of a single matrix except for Level V samples for which the frequency will be 1 duplicate for every 20 samples.

Trip Blanks. Trip blanks are prepared by the laboratory using ASTM Type II water prior to the sampling event, are kept with the investigative samples throughout the sampling event, and are packaged and shipped with the investigative samples. One trip blank will be included with each shipment of samples scheduled for VOC analysis. Trip blanks will be used to assess the potential of contamination during sampling or in transit.

Equipment Rinsate Blanks. Equipment rinsate blanks will be collected by running organic-free deionized water over and/or through sample collection equipment after it has been decontaminated. Equipment rinsate blanks will be collected at a frequency of one sample every other day that equipment is decontaminated. Rinsate samples will be collected from each type of sampling tool used. These blanks will be used to assess the adequacy of decontamination procedures and to trace potential cross contamination. Rinsate samples will be analyzed for the same parameters as the respective media samples.

Matrix Spike and Matrix Spike Duplicates. Matrix spike and matrix spike duplicate (MS/MSD) samples are additional samples collected in the field from a single sampling location. These samples are spiked in the laboratory with a known compound (or set of compounds) of known concentrations. The concentration detected after analysis provides an estimate of the amount of compound "lost" (e.g., sorbed to glassware, volatilized, or degraded) during the analytical procedure. A comparison of the original concentration to the final concentration provides data concerning analytical precision and accuracy. One set of MS/MSD samples will be collected per 20 or fewer samples per matrix or every 14 days.

Field Water Blanks. Field water blanks include a complete set of samples collected from each water source used in the investigation. One set of samples will be collected from each water source (potable, deionized, and organic free) used at the beginning of each field effort or every 14 days.

4.6 FIELD DOCUMENTATION PROGRAM. Records of all procedures performed during the screening investigation will be maintained as described below.

4.6.1 Field Logbooks Daily reports of investigative activities, including field data, will be kept in bound, weatherproof field logbooks. These logbooks will be maintained by the field team. Field personnel will be responsible for daily data entry in the field logbooks. The FOL will be responsible for reviewing the quality of the data entered in the logbooks and will maintain custody of the logbooks. Data entry into the logbooks, and any other onsite document (e.g., forms and notebooks), will be written in black ink and initialed by the author. Entry errors will be crossed out with a single line and initialed and dated by the author.

Field personnel will record in the field logbooks detailed documentation of daily events. Logbook entries can include such data as the names of onsite personnel, weather conditions, field sketches and maps, and unusual conditions (e.g., well tampering). Investigative and sampling activity entries can include sample designations and locations, sampling equipment used, field measurements, sample collection, sample handling, and shipping and decontamination events.

4.6.2 Plans A copy of the Screening Investigation Workplan for Site 2 will be kept onsite. As appropriate, copies will be provided to field team members.

4.7 SAMPLE ANALYSES.

4.7.1 Data Quality Objectives (DQOs) DQOs have been developed for the Screening Investigation at Site 2 to ensure that data collected will be of sufficient quality to support decision making for future response activities at the site. The principal objectives of the screening investigation and consequently the data generated from field activities are to characterize the site by determining the presence or absence of site-related contamination in the soil or groundwater. Site-specific questions such as how the data will be used and how much data are required were addressed during the development of the DQOs. In addition, the required data quality was addressed to indicate the magnitude of error that could be tolerated by the data user. The following subsections provide a brief description of DQO levels and identify the level associated with the screening tasks.

4.7.1.1 DQO Levels, General Description Five DQO levels have been defined by the USEPA: Level I, Field Screening; Level II, Field Analysis; Level III, Laboratory Analysis; Level IV, Contract Laboratory Program Routine Analytical Services (CLP-RAS); and Level V, Non-Conventional Parameter Analysis (USEPA, 1991a).

The NEESA has adopted three of these levels as quality assurance requirements, Levels C, D, and E, which correspond with USEPA Levels III, IV, and V, respectively (NEESA, 1988). For the purposes of this document, the USEPA nomenclature (Levels I through V) will be used.

The DQO level needed for a specific task is generally based on the intended use of the data and on the limitations of the analytical instrumentation. Many field screening and field analytical techniques are intended to provide a rapid turn-around time and qualitative data for decision making in the field. Field techniques necessarily involve rugged instrumentation with less sample preparation and rapid analysis. More precise and accurate analytical methods are used when both qualitative and quantitative data are needed, such as to support site characterization, confirmation, enforcement, treatability, and/or remedial action. The DQO level also specifies laboratory QC requirements and the deliverable package associated with the analyses. The five broad categories of data quality used are described below.

Level I, Field Screening. Field screening provides rapid real-time results that can be used to determine optimal placement of sampling locations and for health and safety support. Data generated provide information concerning the presence or absence of certain constituents or groups of constituents. The data are generally qualitative rather than quantitative.

Level I sampling requirements include the use of equipment and sampling containers that are clean (soap and tap water), visibly free of contamination, and free of analytes detectable by the screening method employed (USEPA, 1991a).

Level II, Field Analysis. Field analysis includes the use of more sophisticated analytical instruments in the field, including onsite GCs and mobile laboratories. The data generated may be both qualitative and quantitative, but the degree of QA/QC achievable may be more variable than with laboratory analysis.

Level II sampling and equipment requirements include the use of sampling equipment constructed of material that is compatible with the parameters being analyzed (e.g., PVC for inorganic parameter analyses, or chrome-plated material for organic parameter analyses) and field-cleaning procedures that include a potable water and soap scrub followed by a potable water rinse (or steam cleaning or high pressure washing).

The use of potable water is limited only by the parameters being analyzed and the minimum quantitation limits of the analytical method; water containing up to one-half the minimum quantitation limit of the parameters of concern may be used. A minimum of 10 percent of samples collected for DQO Level II analysis should be split for DQO Level III analysis. These samples must be representative of all samples analyzed in the field (USEPA, 1991a).

Level III, Laboratory Analysis. Laboratory analytical data are generated using USEPA-approved methods to achieve a level of confidence set by specified QA/QC protocols. Level III DQOs are appropriate for data collected for most activities including site characterization (i.e., qualitative and quantitative identification of contaminants and contaminant source[s] and extent of migration) and treatability studies.

Level III field methods, decontamination procedures, and sampling equipment construction materials are as specified in the USEPA Region IV SOPQAM (USEPA, 1991a). Cleaning of downhole drilling or excavation equipment must be performed, as with Level IV requirements, with the exclusion of the deionized water rinse, the double rinse with pesticide-grade isopropanol, and the rinse with organic-free water. All other cleaning and decontamination guidance must be followed.

When wells are constructed using materials that are not inert with respect to the contaminants being analyzed, data collected from those wells are DQO Level III or lower for those incompatible analytes, even if DQO Level IV analytical procedures are used.

Level III field QC sampling requirements include the following.

- One equipment rinsate blank will be collected for every other day equipment is field cleaned.
- One blank of each type of source water will be collected and analyzed during each sampling event. A sampling event is considered to be from the time sampling personnel arrive at the site until these people leave for more than 1 day (NEESA, 1988) or for each 14 days of continuous field work.
- One trip blank will accompany each cooler that is used for transporting samples to be analyzed for VOCs.

- Field duplicates will be collected at a frequency of 10 percent per sample matrix.

Level IV, Contract Laboratory Program. Level IV DQOs are the most stringent and are defined as data collected in accordance with USEPA Region IV SOPQAM (USEPA, 1991a) and analyzed in accordance with the USEPA CLP (USEPA, 1990a; 1991b). Level IV DQOs are not being used for the screening investigation at Site 2 because analyses are not to be performed using CLP protocol.

Level V, Nonconventional Parameter Analysis. Specific site investigations or remedial design characteristics may require the analyses of contaminants or conditions that are nonconventional. The Level V DQOs associated with these types of analysis must, by definition, be defined on an individual basis. The DQOs identified will depend on the specific collection method, decontamination procedures, and analysis to be used. These analyses are non-CLP, USEPA-accepted methods, or equivalent.

4.7.1.2 Task-Specific DQOs Tasks for the screening investigation at Site 2 will involve data collection with DQOs ranging from Level I through Level V. The following discusses the primary tasks for the investigation and the associated DQO Level.

- Soil Sample Screening, Level I. Samples collected from the soil borings advanced with direct push methods will be screened in the field with an OVA or PID, providing Level I qualitative data concerning the presence or absence of VOCs.
- Soil and Groundwater Analysis, Level II (quantitative data). Samples collected from the soil borings will be analyzed by the field GC and by infrared spectrometer, providing quantitative data regarding the presence or absence of VOCs and TPH.
- Characterization and Confirmatory Sampling, Levels III and V. Ten percent of the soil and groundwater samples collected during the investigation will be sent to an offsite laboratory and analyzed in accordance with Level III DQOs. These samples will be used for site chemical characterization and confirmation of GC data results. One subsurface soil sample will be collected and analyzed for grain size and hydrometer analysis in accordance with Level V DQOs.

The resulting data will be used, as applicable, for health and safety monitoring and site characterization.

4.7.2 Chain of Custody The control of a sample is accomplished through a COC record. The COC will be maintained through sample collection, shipment, storage, and analysis as a legal record of possession of the sample.

Possession will be traceable by means of a COC form, which will remain with the samples at all times and bear the name of the person responsible for the samples. Procedures for maintaining the appropriate sample custody information will be in accordance with USEPA Region IV SOPQAM (USEPA, 1991a).

Samples other than those collected for in situ analysis are identified by using a sample label that is attached to the sample container. The following information is included on the sample container label:

- project number;
- field identification or sample station number (a unique number identifying the sample);
- date and time of sample collection;
- type of sample (e.g., water, soil, or sediment) and, possibly, a brief description of the sampling location;
- the signature(s) of the sampler(s);
- whether the sample is preserved or unpreserved;
- the general types of analyses to be conducted; and
- any relevant comments regarding the sample.

A COC form is used to record the custody of all samples or other physical evidence collected and maintained by field personnel. The following information must be supplied in detail to complete the COC record:

- site name and address;
- project number;
- project name;
- signature of sampler in a designated signature blank;
- sampling station number, date, time of sample collection, and a brief description of the type of sample and the sampling location;
- sample bottle type (i.e., 40 ml glass) plus the intended analysis (i.e., VOC);
- for each sample the number of containers for each bottle type; and
- field investigator and subsequent transferee(s) signatures. (Both the person relinquishing the samples and the person receiving them must sign the form along with the date and time this occurred.)

When samples are relinquished to a shipping company for transport, the tracking number from the shipping bill or receipt will be recorded on the sample COC form. As necessary, carriers (e.g., United Parcel Service, Federal Express, or Greyhound) will be used to ship samples. In these cases the air bill becomes part of the COC.

All samples will be accompanied by the COC record. The original and at least one copy of the record will be shipped inside the shipping container if samples are shipped. One copy of the record will be retained by the field investigator. The original record will be transmitted to the field investigator after samples are accepted by the laboratory. This copy will become part of the project records. The COC record will be signed and dated upon receipt by the laboratory. Custody tracking will be maintained by the laboratory from sample receipt through

storage, analysis, and disposal in accordance with the individual laboratory's QAP.

Use of custody seals will be implemented during shipment of bottles and samples to document the integrity of the samples and bottles. Custody seals will be placed on the sample containers and on the shipping container so that it cannot be opened without breaking the seal. The seals will be signed and dated by the field investigator.

4.7.3 Sample Preparation Aqueous samples and soil samples will be properly prepared and extracted by the laboratory prior to analyses. Extraction methods are dependent upon analytical testing methods. Appropriate extraction methods as indicated by SW 846 (USEPA, 1986) will be followed.

4.7.4 Analytical Procedures Analytical procedures for the screening investigation at Site 2 are designed to confirm the presence or absence of soil and groundwater contamination. In the onsite laboratory, soil and groundwater samples will be analyzed for target VOCs and TPH according to the methods outlined in Table 4-2. Samples sent to the offsite laboratory will be analyzed for VOCs and TPH, and one sample will be analyzed for grain size and hydrometer as mentioned in Section 4.2.2. Methods for offsite laboratory analysis are also outlined in Table 4-2.

IDW generated during the subsurface soil sampling and piezometer installation will be containerized in 55-gallon drums and staged onsite. Soil samples from the drums will be collected and analyzed according to TCLP.

4.7.5 Offsite Laboratory Selection. The subcontract laboratory will be qualified to perform SW 846 (USEPA, 1986) analyses, will have an active QA/QC program, and will be NEESA approved. This laboratory will conduct all analyses requiring Level III and V DQOs.

4.7.6 Laboratory Quality Assurance and Quality Control The laboratory subcontractor is responsible for generation of a detailed laboratory QAP. This plan will also be approved during the NEESA certification program.

The laboratory will submit QC reports as specified in the laboratory QA program. ABB-ES will review the control charts periodically to ensure that the subcontract laboratory is performing analyses in compliance with SW 846 criteria (USEPA, 1986).

Onsite Laboratory. ABB-ES will provide an onsite field laboratory to analyze the screening samples collected from Site 2. Samples will be analyzed to detect VOCs using a Hewlett Packard™ 5890 electrolytic conductivity detector (ELCD)/PID GC or equivalent. This GC will be used in conjunction with an LSC 2000 purge-and-trap device to enable the GC to reach the required detection limits. A DB-624 75M column will be used to separate compounds of interest. The ELCD detector will be calibrated to detect a number of target VOCs (see Table 4-1). The PID detector will be calibrated to detect benzene, toluene, ethylbenzene, and xylenes (BTEX) constituents.

**Table 4-2
Analytical Program**

Screening Investigation Workplan for Site 2
Naval Submarine Base
Kings Bay, Georgia

| Analyte | USEPA Method | DQO Level |
|--|--|-----------|
| Onsite Analytical Program | | |
| Volatile Organic Compounds | | |
| Soil | GC (Modified 8010/8020) | II |
| Groundwater | GC (Modified 8010/8020) | II |
| Total Petroleum Hydrocarbons | | |
| Soil | IR spectroscopy (Modified 418.1) | II |
| Groundwater | IR spectroscopy (Modified 418.1) | II |
| Offsite Analytical Program | | |
| Hydrazine | | |
| Soil | ASTM D1385 | III |
| Groundwater | ASTM D1385 | III |
| Volatile Organic Compounds | | |
| Soil | 8010/8020 | III |
| Groundwater | 8010/8020 | III |
| Semivolatile Organic Compounds | | |
| Soil | 8270 | III |
| Groundwater | 8270 | III |
| Pesticides and PCBs | | |
| Soil | 8080 | III |
| Groundwater | 8080 | III |
| Inorganic Constituents | | |
| Soil | 6000/7000 series | III |
| Groundwater | 6000/7000 series | III |
| Grain size and hydrometer | | |
| Soil | ASTM D421/D422 | V |
| TCLP | | |
| IDW soil and groundwater | SW 1311 extraction and various SW analytical methods | V |
| <p>Notes: USEPA = U.S. Environmental Protection Agency. DQO = data quality objective. GC = gas chromatograph. IR = infrared. ASTM = American Society for Testing and Materials. PCBs = polychlorinated biphenyl compounds. TCLP = Toxicity Characteristic Leaching Procedure. IDW = investigation-derived waste. SW = solid waste.</p> | | |

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5.0 DATA MANAGEMENT PLAN

5.1 DATA RECORD. Three broad categories of data management are included in data recording: field data management, sample data management, and laboratory data management. Field data management consists of storing, retrieving, and reporting the results of measurements made from the field. Sample data management consists of tracking the origin, location, and status of a set of chemical data obtained from the analysis of an environmental sample. Laboratory data management consists of storing, retrieving, editing, validating, and reporting the results of the laboratory chemical analyses.

5.1.1 Field Data Management Field data management procedures vary depending on the type of data collected. Where appropriate, electronic field data also exist. The main objectives of the field data manager are to store the field data and to ensure the integrity of any reproductions of the field data.

5.1.2 Sample Data Management Sample management begins upon creation of the sample. The sample data manager tracks the life cycle of each sample, and uses milestones in the life cycle as reference points to judge the status of individual samples. Milestones include sample collection, sample receipt by the laboratory, invalidated sample data receipt, and validated sample receipt, as well as various steps in the process needed to ensure the quality of the electronic data. As each milestone is achieved, the sample data manager records the achievement in a sample data management database.

5.1.3 Laboratory Data Management Laboratory data management begins with receipt of invalidated data (hard copy and electronic copy) from the laboratory. The laboratory data manager later receives the validated data from the data validator. One hard copy of all of the chemical data is stored in-house to allow access to the raw data. Upon receipt of the validated data, the laboratory data manager uploads the electronic copy into a secure database. At the conclusion of the project, the laboratory data manager archives the electronic data.

5.2 DATA REPORTING. Data reporting of field measurement activities occurs after the site field activities have been approved by the field team leader. Data from the investigation will be arranged and presented in a clear and logical format using tabular, graphical, and other visual display methods.

The data provided by approved contract laboratories will be formatted into summary tables that are easily read and can be included in the final report. A complete listing of all validated data will be prepared and included in the final report also. Where appropriate, graphical displays will be developed to present data. Potentiometric maps developed from water-level elevation data and geologic cross sections are types of graphical presentations that might be expected in the final report.

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APPENDIX A

RESULTS OF AUGUST 1980 SAMPLING OF THE PIT

TECHNICAL SERVICES, INC.
ENVIRONMENTAL CONSULTANTS — INDUSTRIAL CHEMISTS
105 STOCKTON STREET — P.O. BOX 52329
JACKSONVILLE, FLORIDA 32201
(904) 353-5761

Laboratory No. 41658

August 20, 1981

Sample of Sludge

Date Received July 14, 1981

For Commanding Officer, Southern Division
Naval Facilities Engineering Command
Marks: P. O. Box 10068, Charleston, S.C. 29411

CERTIFICATE OF ANALYSIS OR TESTS

Naval Submarine Support Base, Kings Bay, Ga.
Taken at Firefighting Training Fir - 6 July 1981
Contract No. N62467-80-C-0464

E.P. EXTRACTION PROCEDURE TOXICITY TESTS

| | |
|----------------|---------|
| Arsenic, mg/l | 0.017 |
| Barium, mg/l | 0.2 |
| Cadmium, mg/l | <0.002 |
| Chromium, mg/l | 0.014 |
| Lead, mg/l | 0.057 |
| Mercury, mg/l | <0.0002 |
| Selenium, mg/l | <0.01 |
| Silver, mg/l | 0.005 |

| | |
|-----------------------|---------|
| Endrin, mg/l | <0.0005 |
| Lindane, mg/l | <0.0005 |
| Methoxychlor, mg/l | <0.001 |
| Toxaphene, mg/l | <0.005 |
| 2,4-D, mg/l | <0.05 |
| 2,4-5 TP Silvex, mg/l | <0.001 |

CC: Dept. of the Navy
Naval Support Base
Kings Bay, Ga 31547
ATTN: Code N5211

Respectfully submitted:

TECHNICAL SERVICES, INC.

Harvey C. Gray, Jr.
BY _____

APPENDIX B
HEALTH AND SAFETY PLAN

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**APPENDIX B: HEALTH AND SAFETY PLAN
SCREENING INVESTIGATION WORKPLAN FOR SITE 2
NAVAL SUBMARINE BASE KINGS BAY
KINGS BAY, GEORGIA**

Unit Identification Number: N42237

Contract Number: N62467-89-D-0317

Prepared by:

**ABB Environmental Services, Inc.
2590 Executive Center Circle, East
Tallahassee, Florida 32301**

Prepared for:

**Department of the Navy, Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29418**

Anthony Robinson, Code 18511, Engineer-in-Charge

October 1994

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GLOSSARY

| | |
|-------------------|---|
| CFR | Code of Federal Regulations |
| CPR | cardiopulmonary resuscitation |
| CRZ | contamination reduction zone |
| DOT | Department of Transportation (U.S.) |
| EP | Extraction Procedure |
| EZ | exclusion zone |
| FID | flammable ionization detector |
| GFCI | ground-fault current interrupters |
| HASP | Health and Safety Plan |
| HSM | Health and Safety Manager |
| HSO | Health and Safety Officer |
| HSS | Health and Safety Supervisor |
| IAS | Initial Site Assessment |
| IDLH | immediately dangerous to life or health |
| mg/m ³ | milligrams per cubic meter |
| MOTKI | Military Ocean Terminal, Kings Bay (U.S. Army) |
| NEESA | Naval Energy and Environmental Support Activity |
| NSB | Naval Submarine Base |
| OSHA | Occupational Safety and Health Administration |
| PEL/TLV | permissible exposure limit or threshold limit value |
| PID | photoionization detector |
| ppm | parts per million |
| SCBA | self-contained breathing apparatus |
| TOM | Task Order Manager |
| USEPA | U.S. Environmental Protection Agency |

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1.0 GENERAL

1.1 SCOPE AND PURPOSE. This Health and Safety Plan (HASP) has been prepared to meet the requirements of 29 Code of Federal Regulations (CFR) 1910.120. As such, the HASP addresses those activities associated with field operations for this project. Compliance with this HASP is required for all personnel entering the site.

1.2 PROJECT PERSONNEL.

1.2.1 Task Order Manager The Task Order Manager (TOM) is the individual with overall project management responsibilities. Those responsibilities as they relate to health and safety include provision for the development of this site-specific HASP, the necessary resources to meet requirements of this HASP, the coordination of staff assignments to ensure that personnel assigned to the project meet medical and training requirements, and the means and materials necessary to resolve any health and safety issues that are identified or that develop on the project.

1.2.2 Field Operations Leader The Field Operations Leader is either the TOM or the TOM's designee who is onsite and vested with the authority by the TOM to carry out day-to-day site operations, including interfacing with the site Health and Safety Officer (HSO).

1.2.3 Health and Safety Officer The HSO for this project has been designated by the TOM with concurrence of the Health and Safety Manager (HSM). The HSO will have at least an indirect line of reporting to the HSM for the duration of his/her assignment as project HSO. The HSO is responsible for developing and implementing this site-specific HASP in accordance with the Health and Safety Program. The HSO will investigate all accidents, illnesses, and incidents occurring onsite. The HSO will also conduct safety briefings and site-specific training for onsite personnel. As necessary, the HSO will accompany all U.S. Environmental Protection Agency (USEPA), Occupational Safety and Health Administration (OSHA), or other governmental agency personnel visiting the site in response to health and safety issues. The HSO, in consultation with the Health and Safety Supervisor (HSS) or HSM, is responsible for updating and modifying this HASP as site or environmental conditions change.

1.2.4 Other Functional Titles The following is a list of personnel who will be involved in this project. Responsibilities of these individuals are outlined in the workplan.

| <u>Position Title</u> | <u>Responsibilities</u> |
|-----------------------|-------------------------|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

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1.3 TRAINING. All personnel entering potentially contaminated areas of this site must meet the training requirements of 29 CFR 1910.120. The training requirements are: an initial 40-hour training course on hazardous waste site operations, an 8-hour annual refresher training course, and an 8-hour supervisory course for those personnel who will have supervisory responsibilities onsite. Personnel without the required training will not be permitted in any area with potential for exposure to toxic substances or harmful physical agents (i.e., downrange).

Also, personnel at the site must participate in the site-specific training presentation, which will cover major elements of this site-specific HASP, as well as health and safety procedures regarding an individual's specific job responsibilities and tasks. The site HSO or health and safety designee will provide this training before an individual is permitted to work in a downrange position.

Additional training will be provided as determined by the HSM and may include additional refreshers on personal protective equipment, instrumentation, cardiopulmonary resuscitation (CPR), first aid, U.S. Department of Transportation (DOT) confined space entry, blood-borne pathogen standard, or any other pertinent health- or safety-related subject.

1.4 MEDICAL SURVEILLANCE. All personnel entering potentially contaminated areas of this site will be medically qualified for site assignment through a medical surveillance program that meets the requirements of 1910.120. Personnel who have not received medical clearance will not be permitted in any area with potential for exposure to toxic substances or harmful physical agents (i.e., downrange).

The medical qualifications includes a health monitoring program that consists of an initial medical examination to establish the employee's general health profile. This profile provides important baseline laboratory data for later comparative study and annual examinations. Follow-up examinations are completed annually for all personnel enrolled in the health monitoring program, or more frequently if project assignments warrant testing following specific field activities.

Symptoms of exposure to hazardous materials will be reviewed for each site to indicate to personnel the recognized signs of possible exposure to those materials. This information will be supplemented with a discussion of the need for objectivity in the personal health assessment to account for normal reaction to stressful situations. The HSO will watch for outward evidence of changes in worker health. Symptoms may include skin irritations, skin discoloration, eye irritation, muscular soreness, fatigue, nervousness or irritability, intolerance to heat or cold, or loss of appetite. Employees will routinely be asked to assess their general state of health during the project. Special medical monitoring may be identified for certain sites.

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2.0 SITE CHARACTERIZATION AND ANALYSIS

2.1 SITE NAME, LOCATION, AND SIZE. Naval Submarine Base (NSB) Kings Bay is located in the southeast corner of Georgia, approximately 8 miles north of the Georgia-Florida border (see Figure 1-1 of the workplan). Kings Bay is an arm of Cumberland Sound, which is connected to the Atlantic Ocean via the St. Marys inlet. The NSB covers 16,168 acres and is located in Camden County. Refer to Figure 1-2 of the workplan for the Site Location Map for Site 2.

2.2 SITE HISTORY AND LAYOUT. The U.S. Army began operations at NSB Kings Bay in the early 1950's. The property originally was developed as a military ocean terminal. From inception until June 30, 1965, the terminal was known as the Kings Bay Army Terminal. The Kings Bay Army Terminal was constructed to meet the Department of the Army's requirements for East Coast port facilities capable of transporting ammunition and other explosives in the event of a national emergency. During this time, the Kings Bay Army Terminal was used for training purposes by the U.S. Army Reserve.

On April 1, 1965, as a result of a major reorganization, the terminal was placed under the jurisdiction of the newly organized Military Traffic Management and Terminal Service. On July 1, 1965, the terminal became known as the U.S. Army Military Ocean Terminal, Kings Bay (MOTKI). MOTKI was designed to store ammunition or explosives for about 3 months and was directly subordinate to the Military Ocean Terminal, Southport, North Carolina. Facilities constructed at MOTKI included a 2,000-foot wharf, administrative buildings, work shops, utility buildings, and 47 miles of railroad track for transporting explosives. The mission of MOTKI was to plan programs, make military repairs, and provide fire prevention and protection functions for the terminal. Because there was no immediate operational need for this installation, it was placed on inactive status from 1965 until July 1, 1978. MOTKI had no assigned military personnel and was maintained and operated by 19 U.S. Civil Service employees for reserve training operations and contingency purposes from 1965 to 1978.

In 1978, the Navy selected MOTKI as the East Coast location for its Fleet Ballistic Missile submarine support facility. On July 1, 1978, the site was established under a developmental status and was named the Naval Submarine Support Base. Construction of a refit facility for one submarine squadron (T-1) began in 1978 in anticipation of 10 Poseidon submarines. In 1979, the Navy moved Squadron 16 from Spain to Kings Bay, and the site's official name became the Naval Submarine Base, Kings Bay.

Currently, NSB Kings Bay supports TRIDENT submarines. New facilities completed in the early 1990's are for crew training, weapons handling and storage, submarine maintenance and repair, personnel support, and housing.

Site 2, Fire-Fighting Pit, is located within the boundaries of Site 12, Army Reserve Disposal Area at Kings Bay (see Figure 1-2 of the Workplan). As described in the Initial Site Assessment (IAS) performed in 1985 by C.C. Johnson and Associates, Inc., for the Naval Energy and Environmental Support Activity (NEESA), Site 2 was an unlined pit used for fire-fighting exercises from 1980 to 1981. The pit was approximately 30 feet by 30 feet by 2 feet deep. It was located in the waterfront area off Pelican Road near the intersection of Stimson Drive and

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USS James Monroe Avenue. Contaminated diesel fuel, paints, and paint thinners were poured into the bermed pit and burned once every 2 months by the fire department. Approximately 1,500 gallons of waste engine oil and small amounts of diesel fuel, paints, and paint thinners were reportedly burned between 1980 and 1981. In 1980, a one-time disposal of an unknown quantity of hydrazine was also burned at Site 2 (C.C. Johnson and Associates, 1985). It is unknown whether water or some type of chemical foam or powder was used to extinguish the fires (C.C. Johnson and Associates, 1985).

A soil core sample was collected from the pit in August 1980 and was tested for Extraction Procedure (EP) Toxicity. Laboratory results identified the sample contents as non-hazardous (see Appendix A of the workplan). In 1982, approximately 100 cubic yards of contaminated soil were excavated from the pit and disposed by a waste disposal contractor (C.C. Johnson and Associates, 1985).

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3.0 TASK ANALYSIS

3.1 SOIL BORING AND PIEZOMETER INSTALLATION AND GROUNDWATER AND SURFACE SOIL SAMPLING.

3.1.1 Hazardous Substances The materials identified are those suspected to be present onsite and are listed in Table 3-1.

**Table 3-1
Hazardous Substances**

Appendix B, Health and Safety Plan
Screening Investigation Workplan for Site 2
Naval Submarine Base Kings Bay
Kings Bay, Georgia

| Contaminants | PEL/TLV |
|---------------------|------------------------------|
| Methyl ethyl ketone | 200 ppm |
| Methylene chloride | 50 ppm |
| 2-Hexanone | 5 ppm |
| Hydrazine | 0.1 mg/m ³ (skin) |
| Diesel fuel | Not applicable |
| Trichloroethene | 50 ppm |
| Tetrachloroethene | 25 ppm |
| 1,2-Dichloroethene | 200 ppm |
| 1,1-Dichloroethane | 100 ppm |
| 1,2-Dichloroethane | 1 ppm |

Notes: PEL/TLV = permissible exposure limit or threshold limit value.
ppm = parts per million.
mg/m³ = milligrams per cubic meter.
skin = danger of cutaneous absorption.

3.1.2 Site Risks

3.1.2.1 Health Hazards Potential health hazards include exposure to hazardous compounds via dermal contact, inhalation, or ingestion.

3.1.2.2 Safety Hazards The potential safety hazards are: the operation of heavy machinery; sampling; temperature extremes; noise; fire and explosion; slips, trips, and falls; electrical hazards; and snake, tick, and spider bites. Confined space entry, excavation, and trenching are not expected to occur.

Heavy Equipment Operations. Only authorized employees are permitted to operate heavy equipment, i.e., backhoes, track hoes, dump trucks, etc. Unauthorized employees are not permitted to ride in cabs of heavy equipment. The operator and site personnel must be aware at all times of the location and pathway of the heavy equipment when in use. It is advisable for the operator to wear hearing protection.

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Temperature Extremes. Refer to Attachment E for further information on temperature extremes.

Noise. Protection from worker exposure to onsite noise shall comply with 29 CFR 1910.95. Site personnel working near heavy equipment operations are advised to wear hearing protection.

Fire and Explosion. All operations and activities involving the potential for fire and/or explosion hazard shall be conducted in a manner to minimize the risk. The following precautions should be taken to protect against the hazard: monitor the atmosphere for explosive atmospheres, oxygen deficient atmospheres, and flammable vapors; keep all potential ignition sources away; use non-sparking, explosion-proof, or intrinsically safe equipment; and follow safe practices when performing any task that might result in the agitation or release of chemicals.

Slip, Trip, and Fall. Holes, ditches, precariously positioned or sharp objects, slippery surfaces, steep grades, uneven terrain, and unstable surfaces may result in slip, trip, and fall hazards.

Electrical Equipment. Electrical equipment used onsite may pose a hazard to site personnel. Low voltage (12 volts) with ground-fault current interrupters (GFCI) and water tight, corrosion-resistant connecting cables should be used onsite to minimize electrical hazards. In addition, weather shall be monitored. All onsite work activities shall be suspended during electrical storms.

3.1.2.3 Conclusion and Risk Assessment Overall hazards at the site are anticipated to be low. Appropriate work practices and monitoring procedures will be implemented to minimize the risks.

3.1.3 Protective Measures

3.1.3.1 Engineering Controls If dusty conditions are encountered, use wet methods to suppress the dust to avoid exposure to potential dust-borne contaminants.

3.1.3.2 Levels of Protection The level of protection and action levels are based on the preliminary assessment. There have been no previous investigations at Site 2. This information about the site indicates there is a moderate health hazard to the workers who may perform intrusive activities at the site.

If the OVA or FID detects a steady measurable quantity of organic vapors greater than background at the source (e.g., borehole or sample), upgrade to modified Level D. If the OVA or FID reads steadily above background in the breathing zone, begin monitoring with benzene 0.5/c Draeger™ tubes. If benzene levels are greater than 0.5 ppm, upgrade to level C. Otherwise, continue to work at modified Level D until the OVA reads 5 ppm in the breathing zone, at which time upgrade to Level C. Upgrade to Level B if OVA or FID readings exceed 50 ppm.

The above action limits are summarized below.

Level B personal protective equipment (PPE) required if:

OVA or FID reads greater than 50 ppm.

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Level C PPE required if:

Benzene Draeger tube is greater than or equal to 0.5 ppm; and
OVA or FID reads greater than or equal to 5 ppm but less than 50 ppm.

Modified Level D PPE is required if:

Benzene Draeger™ tube is less than 0.5 ppm; and
OVA or FID reads greater than background at the source but less than 5 ppm in the
breathing zone.

Level D PPE is acceptable if:

OVA levels at the source are at background.

If dust is visible, stop operations and contact the HSM to determine if an
increase in the level of protection is needed due to potential exposure to dust-
borne contaminants.

3.1.4 Monitoring Monitoring of the work environment will be undertaken to ensure
that immediately dangerous to life or health (IDLH) or other dangerous conditions
are identified. At a minimum, this monitoring will include evaluations for
combustible atmospheres, oxygen-deficient environments, hazardous concentrations
of airborne contaminants, and radioactivity.

3.1.4.1 Air Sampling To the extent feasible, the presence of airborne
contaminants will be evaluated through the use of direct reading instrumentation.
Information gathered will be used to ensure the adequacy of the levels of
protection being used at the site and may be used as the basis for upgrading or
downgrading the levels of protection in conformance with action levels provided
in this HASP and at the direction of the site HSO.

The following sampling equipment will be used at the site. Refer to Attachment
A for information on the calibration and maintenance of the equipment.

1. Photoionization detector (PID) or flammable ionization detector (FID),
2. Combustible gas and oxygen meter, and
3. Draeger tubes.

3.1.4.2 Personal Monitoring Personal monitoring is undertaken to characterize
the personal exposure of high risk employees to the hazardous substances they may
encounter onsite. Personal monitoring is conducted on a representative basis.
It is not anticipated personal monitoring will be conducted at the site.

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4.0 MATERIAL SAFETY DATA SHEETS

Material safety data sheets for potential contaminants at Site 2 are included in the following pages of this chapter.

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1,1-DICHLOROETHANE

DCH

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|---|--|---|
| <p>Common Synonyms Ethylene chloride Ethylene dichloride Chlorinated hydrocarbon ether</p> | | <p>City liquid Colorless Chloroform like etheral</p> |
| <p>Wear goggles, self-contained breathing apparatus, and rubber overclothing. Stop discharge if possible. Keep people away. Shut off ignition sources and call fire department. Avoid contact with liquid. Isolate and remove discharged material. Notify local health and pollution control agencies.</p> | | <p>Sinks and mixes with water.</p> |
| <p>Fire</p> | | <p>Flammable. POISONOUS GAS MAY BE PRODUCED IN FIRE OR WHEN HEATED. Containers may explode in fire. Wear goggles and self-contained breathing apparatus. Extinguish with alcohol foam, carbon dioxide, or dry chemical. Water may be ineffective on fire.</p> |
| <p>Exposure</p> | | <p>CALL FOR MEDICAL AID. LIQUID If swallowed may cause nausea, vomiting and dizziness. Irritating to skin and eyes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS have victim drink water or milk and induce vomiting.</p> |
| <p>Water Pollution</p> | | <p>Dangerous to aquatic life in high concentrations. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p> |
| <p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability. Restrict access. Chemical and physical treatment.</p> | | <p>2. LABEL 2.1 Category: None 2.2 Class: Not pertinent</p> |
| <p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Hydrogenated hydrocarbon 3.2 Formula: C₂H₂Cl₂ 3.3 HSC/WH Designation: Not listed 3.4 DOT ID No.: 2342 3.5 CAS Registry No.: 75-34-3</p> | | <p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): City liquid 4.2 Color: Colorless 4.3 Odor: Chloroform</p> |
| <p>5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: In areas of poor ventilation or high concentration, a self-contained breathing apparatus with full face mask should be worn. Chemical workers goggles, rubber gloves, and protective clothing should be worn.</p> <p>5.2 Symptoms Following Exposure: INHALATION: Irritation of respiratory tract. Soreness, sneezing, coughing, dizziness, nausea, and vomiting. EYES: Irritation, lacrimation, and redness of conjunctiva. SKIN: Irritation. Prolonged or repeated skin contact can produce a slight burn. INGESTION: Ingestion incidental to industrial handling is not considered to be a problem. Swallowing of substantial amounts could cause nausea, vomiting, lethargy, drowsiness, cyanosis, and emusatory failure.</p> <p>5.3 Treatment of Exposure: Call a doctor. INHALATION: Remove from contaminated area; keep warm and quiet. If breathing has stopped, give artificial respiration. Administer oxygen. EYES: Flush with large amounts of water or weak bicarbonate or soda solution. SKIN: Wash with large amounts of water. Remove contaminated clothing. INGESTION: Attempt to empty stomach, induce by administering fluids (tap water, soapy water, salt water, or milk).</p> <p>5.4 Threshold Limit Value: 200 ppm. 5.5 Short Term Inhalation Limit: 250 ppm. 5.6 Toxicity by Ingestion: Grade 2, LD₅₀ = 0.5 to 5 g/kg (rat). 5.7 Late Toxicity: Chronic exposure may cause liver damage and dermatitis. Animal experimentation has shown this compound to be slightly embryo-toxic and to retard fetal development. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smearing and reddening of skin. 5.10 Odor Threshold: Data not available. 5.11 IDLH Value: 4,000 ppm.</p> | | |

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|---|--|--|
| <p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: 57°F O.C. = 22°F C.C. 6.2 Flammable Limits in Air: 5.5% to 11.4% 6.3 Fire Extinguishing Agents: Alcohol foam, water, foam, CO₂, dry chemical, carbon tetrachloride 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective 6.5 Special Hazards of Combustion Products: When heated to decomposition emits highly toxic fumes of phosphorus. 6.6 Behavior in Fire: Explosive hazard 6.7 Ignition Temperature: 866°F 6.8 Electrical Hazard: Data not available 6.9 Burning Rate: Data not available 6.10 Autobaric Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p> | | <p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-P-O-R-S</p> |
| <p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: Data not available 7.3 Stability During Transport: Data not available 7.4 Neutralizing Agents for Acids and Caustics: Data not available 7.5 Polymerization: Data not available 7.6 Inhibitor of Polymerization: Inhibitor Data not available 7.7 Motor Fuel (Propellant to Product): Data not available 7.8 Reactivity Group: 30</p> | | <p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Not listed 11.2 NIOSH Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Category Classification Health Hazard (Blue) _____ 2 Flammability (Red) _____ 3 Reactivity (Yellow) _____ 0</p> |
| <p>8. WATER POLLUTION</p> <p>8.1 Aqueous Toxicity: TL₀₄ (Marine invertebrate) 250 to 275 mg/l 24-hour TL₀₄ Brine shrimp: 220 mg/l 24-hour TL₀₄ Perch: 180 mg/l 8.2 Waterborne Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Percent: 0.05 g/g for 10 days Percent: 0.002 g/g for 5 days 8.4 Food Chain Concentration Potential: Data not available</p> | | <p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 98.97 12.3 Boiling Point at 1 atm: 126.14°F = 57.3°C = 330.5°K 12.4 Freezing Point: -143.52°F = -87.4°C = 175.75°K 12.5 Critical Temperature: 502.77° = 261.3°C = 534.65°K 12.6 Critical Pressure: 734.8 psia = 50 atm = 5,066 MN/m² 12.7 Specific Gravity: 1.174 at 20°C 12.8 Liquid Surface Tension: 24.75 dynes/cm = 0.02475 N/m at 20°C 12.9 Liquid Water Intertial Tension: Data not available 12.10 Vapor (Gas) Specific Gravity: 3.42 12.11 Ratio of Specific Heats of Vapor (Gas): 1.126 at 20°C (86°F) 12.12 Latent Heat of Vaporization: 131.6 Btu/lb = 73.1 cal/g = 3.06 X 10⁵ J/kg 12.13 Heat of Combustion: -4,774 Btu/lb = -2,662 cal/g = -111 X 10³ J/kg 12.14 Heat of Decomposition: Data not available 12.15 Heat of Solution: Data not available 12.16 Heat of Polymerization: Data not available 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 7.35 psia</p> |
| <p>9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Data not available 9.2 Storage Temperature: Cool 9.3 Inert Atmosphere: Data not available 9.4 Venting: Data not available</p> | | <p>NOTES</p> |

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|-----|-----------------------|
| DCH | DICHLOROETHANE |
|-----|-----------------------|

| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|-----------------------------------|--------------------------|-------------------------------|-------------------------------------|--------------------------------------|---|----------------------------|------------|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour- square foot-F | Temperature (degrees F) | Centipoise |
| 35 | 75.198 | | D | 35 | .804 | 35 | .617 |
| 40 | 74.929 | | A | 40 | .799 | 40 | .595 |
| 45 | 74.660 | | T | 45 | .795 | 45 | .574 |
| 50 | 74.389 | | A | 50 | .791 | 50 | .555 |
| 55 | 74.120 | | | 55 | .786 | 55 | .537 |
| 60 | 73.851 | | N | 60 | .782 | 60 | .520 |
| 65 | 73.580 | | O | 65 | .778 | 65 | .504 |
| 70 | 73.311 | | T | 70 | .773 | 70 | .489 |
| 75 | 73.042 | | | 75 | .769 | 75 | .475 |
| 80 | 72.771 | | A | 80 | .765 | 80 | .462 |
| 85 | 72.502 | | V | 85 | .760 | 85 | .449 |
| | | | A | 90 | .756 | 90 | .437 |
| | | | I | 95 | .752 | 95 | .426 |
| | | | L | 100 | .747 | 100 | .415 |
| | | | A | 105 | .743 | 105 | .405 |
| | | | B | 110 | .739 | 110 | .395 |
| | | | L | | | 115 | .386 |
| | | | E | | | 120 | .377 |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|------------------------------|-----------------------------------|-----------------------------------|---------------------------|----------------------------------|--------------------------|----------------------------------|-----------------------------------|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal ur per pound-F |
| 68 | .500 | -70 | -1.334 | -100 | .07407 | | D |
| | | -60 | -1.944 | -80 | .05000 | | A |
| | | -50 | -.555 | -60 | .02594 | | T |
| | | -40 | .835 | -40 | .00187 | | A |
| | | -30 | .225 | -20 | .02219 | | |
| | | -20 | .386 | 0 | .04626 | | N |
| | | -10 | .996 | 20 | .07032 | | O |
| | | 0 | 1.607 | 40 | .09439 | | T |
| | | 10 | 2.217 | 60 | .11845 | | |
| | | 20 | 2.827 | 80 | .14252 | | A |
| | | 30 | 3.438 | 100 | .16658 | | V |
| | | 40 | 4.048 | 120 | .19065 | | A |
| | | 50 | 4.658 | 140 | .21471 | | I |
| | | 60 | 5.269 | 160 | .23878 | | L |
| | | 70 | 5.879 | | | | A |
| | | 80 | 6.489 | | | | B |
| | | 90 | 7.100 | | | | L |
| | | 100 | 7.710 | | | | L |
| | | 110 | 8.321 | | | | E |
| | | 120 | 8.931 | | | | |
| | | 130 | 9.541 | | | | |

1,2-DICHLOROETHYLENE

DEL

| | | |
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| <p>Common Synonyms Dichloroethane 1,2-dichloroethane DCE ca-1, 2-dichloroethylene trans-1, 2-dichloroethylene</p> | | <p>Liquid Colorless Sweet pleasant odor</p> |
| <p>Sinks in water. Flammable, irritating vapor is produced.</p> | | |
| <p>Wear goggles and self-contained breathing apparatus. Shut off ignition sources. Call fire department. Stop discharge if possible. Keep people away. Isolate and remove discharged material. Notify local health and pollution control agencies.</p> | | |
| <p>Fire</p> | <p>FLAMMABLE. POISONOUS GASES MAY BE PRODUCED IN FIRE. Containers may explode in fire. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Extinguish with dry chemicals, foam or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p> | |
| <p>Exposure</p> | <p>CALL FOR MEDICAL AID. VAPOR If inhaled will cause dizziness, nausea, vomiting, or difficult breathing. Move victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIVID Harmful if swallowed. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.</p> | |
| <p>Water Pollution</p> | <p>Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and welfare officials. Notify operators of nearby water intakes.</p> | |
| <p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Restrict access Evacuate area Should be removed Chemical and physical treatment</p> | <p>2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3</p> | |
| <p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: C₂H₄Cl₂ 3.3 IMO/IUN Designation: 2.2/1150 3.4 DOT ID No.: 1150 3.5 CAS Registry No.: 540-84-0</p> | <p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Ethereal, slightly acid, pleasant, chloroform-like</p> | |
| <p>5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Rubber gloves, safety goggles or safety mask or self-contained breathing apparatus. 5.2 Symptoms Following Exposure: Irritation causes nausea, vomiting, weakness, tremor, epigastric cramps, general nervous depression. Contact with liquid causes irritation of eyes and (on prolonged contact) skin. Irritation causes slight depression to deep necrosis. 5.3 Treatment of Exposure: INHALATION: remove from further exposure; if breathing is difficult, give oxygen, if victim is not breathing, give artificial respiration, preferably mouth-to-mouth, give oxygen when breathing is resumed, call a physician. EYES: flush with water for at least 15 min. SKIN: wash well with soap and water. INGESTION: give gastric lavage and astringents. 5.4 Threshold Limit Value: 200 ppm 5.5 Short Term Inhalation Limit: Data not available 5.6 Toxicity by Ingestion: Grade 2, oral LD₅₀ = 770 mg/kg (rat) 5.7 Late Toxicity: Produces liver and kidney injury in experimental animals 5.8 Vapor (Gas) Irritant Characteristics: Data not available 5.9 Liquid or Solid Irritant Characteristics: Data not available 5.10 Odor Threshold: Data not available 5.11 IDLH Value: 4,000 ppm</p> | | |

6. FIRE HAZARDS

6.1 Flash Point: 37°F C.C.
 6.2 Flammable Limits in Air: 8.7%-12.8%
 6.3 Fire Extinguishing Agents: Dry chemical, foam, carbon dioxide
 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective.
 6.5 Special Hazards of Combustion: Products: Phosgene and hydrogen cyanide fumes may form in fire.
 6.6 Behavior in Fire: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back.
 6.7 Ignition Temperature: 860°F
 6.8 Electrical Hazards: Data not available
 6.9 Burning Rate: 2.6 mm/min.
 6.10 Auto-oxidation Temperature: Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
 7.2 Reactivity with Common Materials: No reaction
 7.3 Stability During Transport: Stable
 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
 7.5 Polymerization: Will not occur under ordinary conditions of shipment. The reaction is not vigorous.
 7.6 Inhibitor of Polymerization: None used
 7.7 Motor Ratio (Reactant to Product): Data not available
 7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity: Data not available
 8.2 Waterfowl Toxicity: Data not available
 8.3 Biological Oxygen Demand (BOD): Data not available
 8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Commercial
 9.2 Storage Temperature: Ambient
 9.3 Inert Atmosphere: No requirement
 9.4 Venting: Pressure-vacuum

6. FIRE HAZARDS (Continued)

6.11 Stoichiometric Air to Fuel Ratio: Data not available
 6.12 Flame Temperature: Data not available

10. HAZARD ASSESSMENT CODE
 (See Hazard Assessment Handbook)
 A-X-Y

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
 11.2 NFPA Hazard Rating for Bulk Water Transportation: Not listed
 11.3 NFPA Hazard Classification:

| Category | Classification |
|----------------------|----------------|
| Health Hazard (Blue) | 2 |
| Flammability (Red) | 2 |
| Reactivity (Yellow) | 2 |

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
 12.2 Molecular Weight: 97.0
 12.3 Boiling Point at 1 atm:
 66°C = 140°F = 80°C = 333°K
 12.4 Freezing Point:
 -114°F = -81°C = 182°K
 -68°F = -50°C = 223°K
 12.5 Critical Temperature: Not pertinent
 12.6 Critical Pressure: Not pertinent
 12.7 Specific Gravity:
 1.27 at 25°C (liquid)
 12.8 Liquid Surface Tension:
 24 dynes/cm = 0.024 N/m at 20°C
 12.9 Liquid Water Interfacial Tension:
 (mL)
 30 dynes/cm = 0.030 N/m at 20°C
 12.10 Vapor (Gas) Specific Gravity: 3.34
 12.11 Ratio of Specific Heats of Vapor (Gas): 1.1468
 12.12 Latent Heat of Vaporization:
 130 Btu/lb = 72 cal/g = 3.0 X 10⁵ J/kg
 12.13 Heat of Combustion: -4,847.2 Btu/lb = -2,862.9 cal/g = -112.67 X 10³ J/kg
 12.14 Heat of Decomposition: Not pertinent
 12.15 Heat of Solution: Not pertinent
 12.16 Heat of Polymerization: Not pertinent
 12.17 Heat of Fusion: Data not available
 12.18 Limiting Value: Data not available
 12.19 Reid Vapor Pressure: Data not available

| | |
|-----|-----------------------------|
| DEL | 1,2-DICHLOROETHYLENE |
|-----|-----------------------------|

| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|-----------------------------------|--------------------------|-------------------------------|-------------------------------------|--------------------------------------|---|----------------------------|------------|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour- square foot-F | Temperature (degrees F) | Centipoise |
| 35 | 81.020 | 35 | .183 | 65 | .907 | 40 | .478 |
| 40 | 80.820 | 40 | .196 | 70 | .894 | 50 | .454 |
| 45 | 80.610 | 45 | .198 | 75 | .882 | 60 | .432 |
| 50 | 80.400 | 50 | .200 | 80 | .869 | 70 | .411 |
| 55 | 80.190 | 55 | .202 | 85 | .857 | 80 | .393 |
| 60 | 79.980 | 60 | .204 | 90 | .844 | 90 | .376 |
| 65 | 79.780 | 65 | .207 | 95 | .832 | 100 | .360 |
| 70 | 79.570 | 70 | .209 | 100 | .819 | 110 | .345 |
| 75 | 79.360 | 75 | .211 | 105 | .807 | 120 | .331 |
| 80 | 79.150 | 80 | .213 | 110 | .794 | 130 | .319 |
| 85 | 78.940 | 85 | .216 | 115 | .782 | 140 | .307 |
| 90 | 78.740 | 90 | .218 | 120 | .769 | 150 | .296 |
| 95 | 78.530 | 95 | .220 | 125 | .757 | 160 | .286 |
| 100 | 78.320 | 100 | .222 | 130 | .744 | 170 | .276 |
| 105 | 78.110 | 105 | .224 | | | 180 | .267 |
| 110 | 77.900 | 110 | .227 | | | 190 | .259 |
| 115 | 77.690 | 115 | .229 | | | 200 | .251 |
| 120 | 77.490 | 120 | .231 | | | 210 | .244 |
| 125 | 77.280 | 125 | .233 | | | | |
| 130 | 77.070 | 130 | .236 | | | | |
| 135 | 76.860 | 135 | .238 | | | | |
| 140 | 76.650 | 140 | .240 | | | | |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|------------------------------|-----------------------------------|-----------------------------------|---------------------------|----------------------------------|--------------------------|----------------------------------|-------------------------------------|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| 68 | .630 | 55 | 3.009 | 55 | .05284 | 0 | .150 |
| | | 60 | 3.396 | 60 | .05906 | 20 | .153 |
| | | 65 | 3.824 | 65 | .06587 | 40 | .156 |
| | | 70 | 4.297 | 70 | .07330 | 60 | .159 |
| | | 75 | 4.817 | 75 | .08141 | 80 | .162 |
| | | 80 | 5.389 | 80 | .09023 | 100 | .165 |
| | | 85 | 6.016 | 85 | .09980 | 120 | .167 |
| | | 90 | 6.702 | 90 | .11020 | 140 | .170 |
| | | 95 | 7.453 | 95 | .12140 | 160 | .173 |
| | | 100 | 8.272 | 100 | .13360 | 180 | .176 |
| | | 105 | 9.164 | 105 | .14660 | 200 | .179 |
| | | 110 | 10.130 | 110 | .16070 | 220 | .182 |
| | | 115 | 11.190 | 115 | .17590 | 240 | .185 |
| | | 120 | 12.330 | 120 | .19220 | 260 | .188 |
| | | 125 | 13.560 | 125 | .20960 | 280 | .191 |
| | | 130 | 14.900 | 130 | .22830 | 300 | .194 |
| | | 135 | 16.340 | 135 | .24820 | 320 | .197 |
| | | 140 | 17.890 | 140 | .26960 | 340 | .200 |
| | | | | | | 360 | .203 |
| | | | | | | 380 | .205 |
| | | | | | | 400 | .208 |
| | | | | | | 420 | .211 |
| | | | | | | 440 | .214 |

DICHLOROMETHANE

DCM

| | | |
|--|---|---|
| <p>Common Synonyms Methylene chloride Methylene dichloride</p> | | <p>Watery liquid Colorless Sweet, pleasant odor</p> |
| <p>Berks in water. Irritating vapor is produced.</p> | | |
| <p>Stop discharge if possible. Avoid contact with liquid and vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p> | | |
| <p>Fire</p> | <p>Not flammable. POISONOUS GASES ARE PRODUCED WHEN HEATED. Wear goggles and self-contained breathing apparatus. Cool exposed containers with water.</p> | |
| <p>Exposure</p> | <p>CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause nausea and dizziness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.</p> | |
| <p>Water Pollution</p> | <p>Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and pollution control offices. Notify operators of nearby water intakes.</p> | |
| <p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Dispense and flush</p> | <p>2. LABEL 2.1 Category: None 2.2 Class: Not pertinent</p> | |
| <p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Inorganic hydrocarbon 3.2 Formula: CH₂Cl₂ 3.3 IMD/UN Designation: 9.0/1593 3.4 DOT ID No.: 1593 3.5 CAS Registry No.: 75-09-2</p> | <p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Pleasant, aromatic; like chloroform; sweet, ethereal</p> | |
| <p>5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Organic vapor respirator mask, safety glasses, protective clothing 5.2 Symptoms Following Exposure: INHALATION: anesthetic effects, nausea and drunkenness. CONTACT WITH SKIN AND EYES: skin irritation, irritation of eyes and nose. 5.3 Treatment of Exposure: INHALATION: remove from exposure. Give oxygen if needed. INGESTION: no specific antidote. CONTACT WITH SKIN AND EYES: remove contaminated clothing, wash skin or eyes if affected. 5.4 Threshold Limit Value: 100 ppm 5.5 Short Term Inhalation Limit: 500 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 2, LD₅₀ = 0.5 to 5 g/kg 5.7 Lethal Toxicity: None 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smearing and reddening of the skin. 5.10 Odor Threshold: 205-307 ppm 5.11 IDLH Value: 5,000 ppm</p> | | |

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| <p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: Not flammable under conditions likely to be encountered. 6.2 Flammable Limits in Air: 12%-18% 6.3 Fire Extinguishing Agents: Not pertinent 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Decomposition products generated in a fire may be irritating or toxic. 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: 1164°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not pertinent 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Plasma Temperature: Data not available</p> | <p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity With Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 36</p> |
| <p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: Not pertinent 8.2 Waterway Toxicity: Not pertinent 8.3 Biological Oxygen Demand (BOD): Not pertinent 8.4 Food Chain Concentration Potential: None</p> | <p>9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Aerial grade; technical grade 9.2 Storage Temperature: Data not available 9.3 Inert Atmosphere: varied 9.4 Venting: Data not available</p> |
| <p>NOTES</p> | |

| <p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-P-X</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|----------------|--------|------|---|--------|--|----------------|---|--------------------------|---|---------|---|-----------------|--|----------------|---|------------------|---|-------------------|---|------------|--|-----------------|---|-------|---|---------------|---|----------|----------------|----------------------|---|--------------------|---|---------------------|---|
| <p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: OSHA 11.2 NAB Hazard Rating for Bulk Water Transportation:</p> <table border="1"> <thead> <tr> <th>Category</th> <th>Rating</th> </tr> </thead> <tbody> <tr> <td>Fire</td> <td>1</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor Irritant</td> <td>2</td> </tr> <tr> <td>Liquid or Solid Irritant</td> <td>1</td> </tr> <tr> <td>Poisons</td> <td>2</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity</td> <td>2</td> </tr> <tr> <td>Aquatic Toxicity</td> <td>1</td> </tr> <tr> <td>Anesthetic Effect</td> <td>2</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td>Other Chemicals</td> <td>2</td> </tr> <tr> <td>Water</td> <td>1</td> </tr> <tr> <td>Self Reaction</td> <td>0</td> </tr> </tbody> </table> <p>11.3 NFPA Hazard Classification:</p> <table border="1"> <thead> <tr> <th>Category</th> <th>Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td> <td>2</td> </tr> <tr> <td>Flammability (Red)</td> <td>0</td> </tr> <tr> <td>Reactivity (Yellow)</td> <td>1</td> </tr> </tbody> </table> | Category | Rating | Fire | 1 | Health | | Vapor Irritant | 2 | Liquid or Solid Irritant | 1 | Poisons | 2 | Water Pollution | | Human Toxicity | 2 | Aquatic Toxicity | 1 | Anesthetic Effect | 2 | Reactivity | | Other Chemicals | 2 | Water | 1 | Self Reaction | 0 | Category | Classification | Health Hazard (Blue) | 2 | Flammability (Red) | 0 | Reactivity (Yellow) | 1 |
| Category | Rating | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fire | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Health | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Vapor Irritant | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Liquid or Solid Irritant | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poisons | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Pollution | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Human Toxicity | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aquatic Toxicity | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Anesthetic Effect | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reactivity | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Other Chemicals | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Self Reaction | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category | Classification | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Health Hazard (Blue) | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Flammability (Red) | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reactivity (Yellow) | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 84.93 12.3 Boiling Point at 1 atm: 101°F = 38.3°C = 313.0°K 12.4 Freezing Point: -142°F = -86.7°C = 176.5°K 12.5 Critical Temperature: 473°F = 245°C = 518°K 12.6 Critical Pressure: 895 psia = 60.9 atm = 6.17 MPa/10⁶ 12.7 Specific Gravity: 1.322 at 20°C (liquid) 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Water Interfacial Tension: Not pertinent 12.10 Vapor (Gas) Specific Gravity: 2.9 12.11 Ratio of Specific Heats of Vapor (Gas): 1.199 12.12 Latent Heat of Vaporization: 142 Btu/lb = 79.7 cal/g = 3.30 x 10⁴ J/kg 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.26 Heat of Fusion: 16.89 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 13.9 psia</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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| DCM | DICHLOROMETHANE |
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| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|-----------------------------------|--------------------------|-------------------------------|-------------------------------------|--------------------------------------|---|----------------------------|------------|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour- square foot-F | Temperature (degrees F) | Centipoise |
| -70 | 91.320 | 35 | .274 | -110 | 1.205 | | N |
| -60 | 90.700 | 40 | .275 | -100 | 1.182 | | O |
| -50 | 90.080 | 45 | .276 | -90 | 1.179 | | T |
| -40 | 89.450 | 50 | .277 | -80 | 1.166 | | |
| -30 | 88.830 | 55 | .278 | -70 | 1.154 | | P |
| -20 | 88.200 | 60 | .279 | -60 | 1.141 | | E |
| -10 | 87.580 | 65 | .279 | -50 | 1.128 | | R |
| 0 | 86.959 | 70 | .280 | -40 | 1.115 | | T |
| 10 | 86.330 | 75 | .281 | -30 | 1.102 | | I |
| 20 | 85.709 | 80 | .282 | -20 | 1.090 | | N |
| 30 | 85.080 | 85 | .283 | -10 | 1.077 | | E |
| 40 | 84.459 | 90 | .284 | 0 | 1.064 | | N |
| 50 | 83.830 | 95 | .284 | 10 | 1.051 | | T |
| 60 | 83.209 | 100 | .285 | 20 | 1.038 | | |
| 70 | 82.589 | | | 30 | 1.025 | | |
| 80 | 81.959 | | | 40 | 1.013 | | |
| 90 | 81.341 | | | 50 | 1.000 | | |
| 100 | 80.709 | | | 60 | .987 | | |
| | | | | 70 | .974 | | |
| | | | | 80 | .961 | | |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|------------------------------|-----------------------------------|-----------------------------------|---------------------------|----------------------------------|--------------------------|----------------------------------|-------------------------------------|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| 68.02 | 1.380 | -10 | .866 | -10 | .01525 | 0 | .126 |
| | | -5 | 1.013 | -5 | .01763 | 10 | .129 |
| | | 0 | 1.180 | 0 | .02031 | 20 | .131 |
| | | 5 | 1.370 | 5 | .02333 | 30 | .133 |
| | | 10 | 1.586 | 10 | .02671 | 40 | .135 |
| | | 15 | 1.830 | 15 | .03050 | 50 | .137 |
| | | 20 | 2.105 | 20 | .03472 | 60 | .139 |
| | | 25 | 2.414 | 25 | .03941 | 70 | .142 |
| | | 30 | 2.762 | 30 | .04462 | 80 | .144 |
| | | 35 | 3.151 | 35 | .05039 | 90 | .145 |
| | | 40 | 3.585 | 40 | .05676 | 100 | .147 |
| | | 45 | 4.068 | 45 | .06378 | 110 | .149 |
| | | 50 | 4.606 | 50 | .07149 | 120 | .151 |
| | | 55 | 5.201 | 55 | .07996 | 130 | .153 |
| | | 60 | 5.860 | 60 | .08922 | 140 | .155 |
| | | 65 | 6.588 | 65 | .09934 | 150 | .156 |
| | | 70 | 7.389 | 70 | .11040 | 160 | .158 |
| | | 75 | 8.270 | 75 | .12240 | 170 | .159 |
| | | 80 | 9.237 | 80 | .13540 | 180 | .161 |
| | | 85 | 10.300 | 85 | .14960 | 190 | .163 |
| | | | | | | 200 | .164 |
| | | | | | | 210 | .165 |
| | | | | | | 220 | .167 |
| | | | | | | 230 | .168 |
| | | | | | | 240 | .169 |
| | | | | | | 250 | .171 |

METHYL n-BUTYL KETONE

MBK

| | |
|--|---|
| <p>Common Synonyms 2-Hexanone n-Butyl methyl ketone</p> | <p>Liquid Clear Disagreeable Odor</p> <p>Flammable and mixes with water.</p> |
| <p>Shut off ignition sources. Call fire department. Avoid contact with liquid and vapor. Keep people away. Stop discharge if possible. Stay upwind. Use water spray to "knock down" vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p> | |
| <p>Fire</p> | <p>FLAMMABLE. Containers may explode on fire. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Extinguish with dry chemical, alcohol foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p> |
| <p>Exposure</p> | <p>CALL FOR MEDICAL AID.</p> <p>VAPOR Irritating to eyes, nose and throat. Harmful if inhaled. If in eyes, hold eyes open and flush with plenty of water. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.</p> <p>LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyes open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water if milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.</p> |
| <p>Water Pollution</p> | <p>Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and waste officials. Notify operators of nearby water intakes.</p> |
| <p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning of contaminants, water contamination, high flammability Restrict access Mechanical containment Should be removed Chemical and physical treatment</p> | <p>2. LABEL 2.1 Category: None 2.2 Class: Not pertinent</p> |
| <p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: $C_6H_{12}O$ 3.3 HM/UN Designation: Not listed 3.4 DOT ID No.: Data not available 3.5 CAS Registry No.: 98-178-6</p> | <p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Clear 4.3 Odor: Characteristic, strong, disagreeable odor resembling acetone</p> |
| <p>5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Protective gloves, goggles or face shield, approved respirator (for major spills)</p> <p>5.2 Symptoms Following Exposure: Inhalation of high concentrations of vapor may result in narcosis, peripheral neuropathy may develop. Ingestion of large amounts may cause some systemic injury. Contact with eyes causes mild to moderate irritation. Liquid irritates skin; prolonged or repeated contact may cause defatting of the skin with resultant dermatitis.</p> <p>5.3 Treatment of Exposure: INHALATION: move to uncontaminated atmosphere and treat symptomatically; alert physician to possible development of peripheral neuropathy. INGESTION: give large amount of water and induce vomiting. EYES: irrigate immediately and thoroughly with water for 15 min. and get medical attention. SKIN: flush exposed areas thoroughly with water.</p> <p>5.4 Threshold Limit Value: 6 ppm 5.5 Short Term Inhalation Limit: Data not available 5.6 Toxicity by Ingestion: Grade 2; oral LD₅₀ = 2,580 mg/kg (rat) 5.7 Late Toxicity: Peripheral neuropathy in experimental animals and man (lesions of motor and/or sensory nerves) 5.8 Vapor (Gas) Irritant Characteristics: Data not available 5.9 Liquid or Solid Irritant Characteristics: Data not available 5.10 Odor Threshold: Data not available 5.11 IDLH Value: Data not available</p> | |

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| <p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: 63°F O.C.; 77°F C.C. 6.2 Flammable Limits in Air: 1.3%-6.0% 6.3 Fire Extinguishing Agents: Dry chemical, "alcohol" foam, carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective. 6.5 Special Hazards of Combustion Products: Data not available 6.6 Behavior in Fire: Data not available 6.7 Ignition Temperature: 785°F 6.8 Electrical Hazard: Data not available 6.9 Burning Rate: 4.8 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Self-Heating: Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p> | <p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-P-Q-T-U</p> |
| <p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: Data not available 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Corrosives: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Moisture (Resistant to Product): Data not available 7.8 Reactivity Group: Data not available</p> | <p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Not listed 11.2 NAB Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Class/Reaction Category Classification Health Hazard (Blue) _____ 2 Flammability (Red) _____ 3 Reactivity (Yellow) _____ 0</p> |
| <p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: Data not available 8.2 Waterway Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Fecal Chain Concentration Potential: None</p> | <p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 16°C and 1 atm: Liquid 12.2 Molecular Weight: 100.16 12.3 Boiling Point at 1 atm: 261°F = 127°C = 400°K 12.4 Freezing Point: -70.4°F = -56.9°C = 216.3°K 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 0.812 at 20°C (liquid) 12.8 Liquid Surface Tension: 25.48 dynes/cm = 0.02548 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 9.79 dynes/cm = 0.00979 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: 3.5 12.11 Rate of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: 148 Btu/lb = 82 cal/g = 3.4 X 10⁴ J/kg 12.13 Heat of Combustion: -16,100 Btu/lb = -9,040 cal/g = -374 X 10⁴ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available</p> |
| <p>9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Commercial, 95%; Pure, 99% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester)</p> | <p>NOTES</p> |

| | |
|-----|------------------------------|
| MBK | METHYL n-BUTYL KETONE |
|-----|------------------------------|

| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|-----------------------------------|--------------------------|-------------------------------|-------------------------------------|--------------------------------------|---|----------------------------|------------|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour- square foot-F | Temperature (degrees F) | Centipoise |
| 40 | 51.470 | 35 | .550 | 30 | 1.038 | 52 | .711 |
| 45 | 51.320 | 40 | .550 | 40 | 1.029 | 54 | .699 |
| 50 | 51.170 | 45 | .550 | 50 | 1.019 | 56 | .688 |
| 55 | 51.030 | 50 | .550 | 60 | 1.010 | 58 | .677 |
| 60 | 50.880 | 55 | .550 | 70 | 1.001 | 60 | .666 |
| 65 | 50.730 | 60 | .550 | 80 | .992 | 62 | .655 |
| 70 | 50.580 | 65 | .550 | 90 | .982 | 64 | .645 |
| 75 | 50.430 | 70 | .550 | 100 | .973 | 66 | .635 |
| 80 | 50.280 | 75 | .550 | 110 | .964 | 68 | .625 |
| 85 | 50.120 | 80 | .550 | 120 | .955 | 70 | .615 |
| 90 | 49.970 | 85 | .550 | 130 | .945 | 72 | .606 |
| 95 | 49.820 | 90 | .550 | 140 | .936 | 74 | .596 |
| 100 | 49.660 | 95 | .550 | 150 | .927 | 76 | .587 |
| 105 | 49.510 | 100 | .550 | 160 | .918 | 78 | .578 |
| 110 | 49.350 | | | 170 | .908 | 80 | .570 |
| 115 | 49.190 | | | 180 | .899 | 82 | .561 |
| 120 | 49.030 | | | 190 | .890 | 84 | .553 |
| 125 | 48.870 | | | 200 | .881 | 86 | .545 |
| 130 | 48.710 | | | 210 | .871 | | |
| | | | | 220 | .862 | | |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|------------------------------|-----------------------------------|-----------------------------------|---------------------------|----------------------------------|--------------------------|----------------------------------|--|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| 68 | 1.400 | 60 | .231 | 60 | .00415 | | N O T P E R T I N E N T |
| | | 70 | .306 | 70 | .00540 | | |
| | | 80 | .402 | 80 | .00695 | | |
| | | 90 | .522 | 90 | .00885 | | |
| | | 100 | .671 | 100 | .01119 | | |
| | | 110 | .856 | 110 | .01401 | | |
| | | 120 | 1.082 | 120 | .01741 | | |
| | | 130 | 1.357 | 130 | .02147 | | |
| | | 140 | 1.689 | 140 | .02628 | | |
| | | 150 | 2.088 | 150 | .03195 | | |
| | | 160 | 2.563 | 160 | .03859 | | |
| | | 170 | 3.125 | 170 | .04631 | | |
| | | 180 | 3.788 | 180 | .05525 | | |
| | | 190 | 4.564 | 190 | .06555 | | |
| | | 200 | 5.468 | 200 | .07734 | | |
| | | 210 | 6.516 | 210 | .09078 | | |
| | | 220 | 7.724 | 220 | .10600 | | |
| | | 230 | 9.112 | 230 | .12330 | | |
| | | 240 | 10.700 | 240 | .14270 | | |
| | | 250 | 12.500 | 250 | .16440 | | |
| | | 260 | 14.550 | 260 | .18860 | | |

METHYL ETHYL KETONE

MEK

| | | | |
|--|--|--|--|
| <p>Common Synonyms</p> <p>MEK 2-Butanone Ethyl methyl ketone</p> | | <p>Liquid</p> <p>Colorless</p> <p>Sweet odor</p> | <p>Reacts and mixes with water. Flammable, irritating vapor is produced.</p> |
| <p>Stop discharge if possible. Keep people away. Shut off ignition sources and call fire department. Stay upwind and use water spray to "break down" vapor. Avoid contact with liquid and vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p> | | | |
| <p>Fire</p> | | <p>FLAMMABLE. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Extinguish with dry chemical, alcohol foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p> | |
| <p>Exposure</p> | | <p>CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause weakness, vomiting, headache, dizziness, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LQUID We burn eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES: hold eyes open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.</p> | |
| <p>Water Pollution</p> | | <p>Dangerous to aquatic life in high concentrations. May be dangerous if it enters sewer systems. Notify local health and waste officials. Notify operators of nearby water intakes.</p> | |
| <p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability. Disperse and flush.</p> | | <p>2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3</p> | |
| <p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Ketone 3.2 Formula: CH₃COCH₂CH₃ 3.3 IMO/IUN Designation: 3.2/1180 3.4 DOT ID No.: 1180 3.5 CAS Registry No.: 78-93-3</p> | | <p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Like acetone; pleasant; pungent</p> | |
| <p>5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Organic carrier or air pack; plastic gloves; goggles or face shield. 5.2 Symptoms Following Exposure: Liquid causes eye burn. Vapor irritates eyes, nose, and throat; can cause headache, dizziness, nausea, weakness, and loss of consciousness. 5.3 Treatment of Exposure: INHALATION: remove victim to fresh air; if breathing is irregular or has stopped, start resuscitation and administer oxygen. EYES: wash with plenty of water for at least 15 min. and call physician. 5.4 Threshold Limit Value: 200 ppm 5.5 Short Term Inhalation Limit: 250 mg/m³ for 60 min. 5.6 Toxicity by Ingestion: Grade 2; LD₅₀ = 0.5 to 0.6 g/kg (bw) 5.7 Lethal Toxicity: None 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Moderate irritant. If spilled on clothing and allowed to remain, may cause stinging and reddening of the skin. 5.10 Odor Threshold: 10 ppm 5.11 IDLH Value: Data not available</p> | | | |

| <p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: 20°F C.C.; 27°F D.C. 6.2 Flammable Limits in Air: 1.2%-11.5% 6.3 Fire Extinguishing Agents: Alcohol foam, dry chemical, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: 967°F 6.8 Electrical Hazard: Class I, Group D 6.9 Burning Rate: 4.1 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Self-Heating Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p> | | <p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-P-O-R-S</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|----------------|--|--|----------|--------|------|---|--------|--|----------------|---|--------------------------|---|---------|---|-----------------|--|----------------|---|------------------|---|------------------|---|------------|--|-----------------|---|-------|---|---------------|---|----------|----------------|----------------------|---|--------------------|---|---------------------|---|
| <p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity With Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Corrosives: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Oxidation States (Relevant to Product): Data not available 7.8 Reactivity Group: 16</p> | | <p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Flammable liquid 11.2 NFPA Hazard Rating for Bulk Water Transportation: <table border="1"> <thead> <tr> <th>Category</th> <th>Rating</th> </tr> </thead> <tbody> <tr> <td>Fire</td> <td>3</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor irritant</td> <td>1</td> </tr> <tr> <td>Liquid or Solid Irritant</td> <td>1</td> </tr> <tr> <td>Poisons</td> <td>2</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity</td> <td>2</td> </tr> <tr> <td>Aquatic Toxicity</td> <td>1</td> </tr> <tr> <td>Aesthetic Effect</td> <td>1</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td>Other Chemicals</td> <td>2</td> </tr> <tr> <td>Water</td> <td>0</td> </tr> <tr> <td>Self Reaction</td> <td>0</td> </tr> </tbody> </table> </p> <p>11.3 NFPA Hazard Classification: <table border="1"> <thead> <tr> <th>Category</th> <th>Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td> <td>1</td> </tr> <tr> <td>Flammability (Red)</td> <td>3</td> </tr> <tr> <td>Reactivity (Yellow)</td> <td>0</td> </tr> </tbody> </table> </p> | | Category | Rating | Fire | 3 | Health | | Vapor irritant | 1 | Liquid or Solid Irritant | 1 | Poisons | 2 | Water Pollution | | Human Toxicity | 2 | Aquatic Toxicity | 1 | Aesthetic Effect | 1 | Reactivity | | Other Chemicals | 2 | Water | 0 | Self Reaction | 0 | Category | Classification | Health Hazard (Blue) | 1 | Flammability (Red) | 3 | Reactivity (Yellow) | 0 |
| Category | Rating | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fire | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Health | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Vapor irritant | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Liquid or Solid Irritant | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poisons | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Pollution | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Human Toxicity | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aquatic Toxicity | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aesthetic Effect | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reactivity | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Other Chemicals | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Self Reaction | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Category | Classification | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Health Hazard (Blue) | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Flammability (Red) | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reactivity (Yellow) | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 8640 mg/l/48 hr (bunch)/TL₅₀/fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 214%, 5 days 8.4 Food Chain Concentration Potential: None</p> | | <p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 72.11 12.3 Boiling Point at 1 atm: 175.3°F = 79.6°C = 362.8°K 12.4 Freezing Point: -123.3°F = -85.5°C = 188.9°K 12.5 Critical Temperature: 504.9°F = 262.5°C = 536.7°K 12.6 Critical Pressure: 803 psia = 41.0 atm = 4.18 MPa/m² 12.7 Specific Gravity: 0.808 at 20°C (liquid) 12.8 Liquid Surface Tension: Not pertinent 12.9 Liquid Water Interfacial Tension: Not pertinent 12.10 Vapor (Gas) Specific Gravity: 2.5 12.11 Ratio of Specific Heats of Vapor (Gas): 1.075 12.12 Latent Heat of Vaporization: 101 Btu/lb = 106 cal/g = 4.44 X 10⁴ J/kg 12.13 Heat of Combustion: -13,480 Btu/lb = -7491 cal/g = -313.8 X 10⁴ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution (sol.) -9 Btu/lb = -5 cal/g = -0.2 X 10⁴ J/kg 12.16 Heat of Polymerization: Not pertinent 12.17 Heat of Fusion: Data not available 12.18 Limiting Value: Data not available 12.19 Reid Vapor Pressure: 2.5 psia</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>9. SHIPPING INFORMATION</p> <p>9.1 Grade of Purity: 99.5+ % 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester) or pressure-vacuum</p> | | <p>NOTES</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| | |
|-----|----------------------------|
| MEK | METHYL ETHYL KETONE |
|-----|----------------------------|

| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|-----------------------------------|--------------------------|-------------------------------|-------------------------------------|--------------------------------------|---|----------------------------|--|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour- square foot-F | Temperature (degrees F) | Centipoise |
| 35 | 51.460 | -35 | .501 | 10 | 1.073 | | N O T P E R T I N E N T |
| 40 | 51.280 | -30 | .502 | 15 | 1.068 | | |
| 45 | 51.110 | -25 | .503 | 20 | 1.063 | | |
| 50 | 50.940 | -20 | .504 | 25 | 1.058 | | |
| 55 | 50.760 | -15 | .505 | 30 | 1.053 | | |
| 60 | 50.590 | -10 | .507 | 35 | 1.048 | | |
| 65 | 50.420 | -5 | .508 | 40 | 1.043 | | |
| 70 | 50.240 | 0 | .509 | 45 | 1.038 | | |
| 75 | 50.070 | 5 | .510 | 50 | 1.033 | | |
| 80 | 49.900 | 10 | .511 | 55 | 1.028 | | |
| 85 | 49.720 | 15 | .512 | 60 | 1.023 | | |
| 90 | 49.550 | 20 | .513 | 65 | 1.018 | | |
| 95 | 49.380 | 25 | .514 | 70 | 1.013 | | |
| 100 | 49.200 | 30 | .516 | 75 | 1.008 | | |
| 105 | 49.030 | 35 | .517 | 80 | 1.003 | | |
| 110 | 48.860 | 40 | .518 | 85 | .998 | | |
| 115 | 48.680 | 45 | .519 | 90 | .993 | | |
| 120 | 48.510 | 50 | .520 | 95 | .988 | | |
| | | 55 | .521 | 100 | .983 | | |
| | | 60 | .522 | 105 | .978 | | |
| | | 65 | .523 | | | | |
| | | 70 | .524 | | | | |
| | | 75 | .526 | | | | |
| | | 80 | .527 | | | | |
| | | 85 | .528 | | | | |
| | | 90 | .529 | | | | |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|------------------------------|-----------------------------------|-----------------------------------|---------------------------|----------------------------------|--------------------------|----------------------------------|-------------------------------------|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| 68.02 | 27.000 | 0 | .148 | 0 | .00216 | 0 | .352 |
| | | 10 | .216 | 10 | .00310 | 25 | .368 |
| | | 20 | .310 | 20 | .00435 | 50 | .384 |
| | | 30 | .437 | 30 | .00599 | 75 | .399 |
| | | 40 | .604 | 40 | .00812 | 100 | .414 |
| | | 50 | .823 | 50 | .01085 | 125 | .429 |
| | | 60 | 1.104 | 60 | .01427 | 150 | .444 |
| | | 70 | 1.461 | 70 | .01853 | 175 | .458 |
| | | 80 | 1.909 | 80 | .02376 | 200 | .472 |
| | | 90 | 2.465 | 90 | .03012 | 225 | .486 |
| | | 100 | 3.147 | 100 | .03778 | 250 | .500 |
| | | 110 | 3.977 | 110 | .04690 | 275 | .513 |
| | | 120 | 4.977 | 120 | .05768 | 300 | .526 |
| | | 130 | 6.171 | 130 | .07030 | 325 | .538 |
| | | 140 | 7.586 | 140 | .08498 | 350 | .551 |
| | | 150 | 9.250 | 150 | .10190 | 375 | .563 |
| | | 160 | 11.190 | 160 | .12130 | 400 | .575 |
| | | 170 | 13.450 | 170 | .14350 | 425 | .586 |
| | | 180 | 16.050 | 180 | .16850 | 450 | .598 |
| | | 190 | 19.030 | 190 | .19670 | 475 | .609 |
| | | 200 | 22.420 | 200 | .22830 | 500 | .620 |
| | | 210 | 26.270 | 210 | .26350 | 525 | .630 |
| | | 220 | 30.610 | 220 | .30250 | 550 | .640 |
| | | 230 | 35.480 | 230 | .34560 | 575 | .650 |
| | | 240 | 40.930 | 240 | .39290 | 600 | .660 |

OILS: DIESEL

ODS

| | | |
|--|---|---|
| <p>Common Synonyms Fuel oil 1-D Fuel oil 2-D</p> | <p>City Liquid Yellow-brown Lube or fuel oil odor</p> | <p>Flammable Flammable on water.</p> |
| <p>Shut discharge if possible. Call fire department. Avoid contact with liquid. Isolate and remove discharged material. Notify local health and pollution control agencies.</p> | | |
| Fire | <p>Combustible. Extinguish with dry chemical, foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.</p> | |
| Exposure | <p>CALL FOR MEDICAL AID. LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Push grease away from party of water. IF IN EYES: hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.</p> | |
| Water Pollution | <p>Dangerous to aquatic life in high concentrations. Polluting to streams. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p> | |
| <p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Mechanical containment Should be removed Chemical and physical treatment</p> | <p>2. LABEL 2.1 Category: None 2.2 Class: Not pertinent</p> | |
| <p>3. CHEMICAL DESIGNATIONS 3.1 CO Compatibility Class: Miscellaneous Hydrocarbon Mixtures 3.2 Formula: Not applicable 3.3 IMO/UN Designation: 3.1/1270 3.4 DOT ID No.: 1270 3.5 CAS Registry No.: Data not available</p> | <p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Light brown 4.3 Odor: Like fuel oil</p> | |
| <p>5. HEALTH HAZARDS</p> | | |
| <p>5.1 Personal Protective Equipment: Goggles or face shield. 5.2 Symptoms Following Exposure: If liquid is ingested, an increased frequency of bowel movements will occur. 5.3 Treatment of Exposure: INGESTION: do NOT induce vomiting. SIGHT sign off, wash with soap and water. EYES: wash with copious amounts of water for at least 15 min. 5.4 Threshold Limit Value: No single TLV applicable. 5.5 Short Term Inhalation Limits: Data not available 5.6 Toxicity by Ingestion: Grade 1; LD₅₀ = 8 to 15 g/kg 5.7 Lethal Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, they cause stinging and reddening of the skin. 5.10 Odor Threshold: Data not available 5.11 IDLH Value: Data not available</p> | | |

| | | | | | | | | | |
|---|--|----------|----------------|----------------------|---|--------------------|---|---------------------|---|
| <p>6. FIRE HAZARDS</p> <p>6.1 Flash Point (1-D) 109°F C.C.; (2-D) 125°F C.C. 6.2 Flammable Limits in Air: 1.5-6.0 vol. % 6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature (1-D) 260-625°F (2-D) 490-645°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: 4 cm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p> <p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 2</p> <p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 204 mg/l/24 hr./acute American shad/TL₁₀₀/fish water 8.2 Waterfowl Toxicity: > 50 ml/kg /LD₅₀/mature 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: None</p> <p>9. SHIPPING INFORMATION</p> <p>9.1 Grade or Purity: Diesel Fuel 1-D (ASTM); Diesel Fuel 2-D (ASTM) 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (Nerve smother)</p> | <p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U</p> <p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: Combustible Liquid 11.2 NFPA Hazard Rating for Bulk Water Transporters: Not listed 11.3 NFPA Hazard Classifications</p> <table style="width: 100%; border: none;"> <tr> <td style="text-align: right;">Category</td> <td style="text-align: right;">Classification</td> </tr> <tr> <td style="text-align: right;">Health Hazard (Blue)</td> <td style="text-align: right;">0</td> </tr> <tr> <td style="text-align: right;">Flammability (Red)</td> <td style="text-align: right;">2</td> </tr> <tr> <td style="text-align: right;">Reactivity (Yellow)</td> <td style="text-align: right;">0</td> </tr> </table> <p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: Not pertinent 12.3 Boiling Point at 1 atm: 260-240°F = 290-235°C = 561-512°K 12.4 Freezing Point: -30 to 0°F = -34 to -18°C = 239 to 255°K 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 0.841 at 15°C (liquid) 12.8 Liquid Surface Tension (mN): 25 dynes/cm = 0.025 N/m at 20°C 12.9 Liquid Water Interfacial Tension (mN): 60 dynes/cm = 0.06 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Not pertinent 12.13 Heat of Combustion: -16,400 Btu/lb = -16,200 cal/g = 429 X 10⁴ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.17 Heat of Fusion: Data not available 12.18 Limiting Value: Data not available 12.19 Reid Vapor Pressure: Varies</p> | Category | Classification | Health Hazard (Blue) | 0 | Flammability (Red) | 2 | Reactivity (Yellow) | 0 |
| Category | Classification | | | | | | | | |
| Health Hazard (Blue) | 0 | | | | | | | | |
| Flammability (Red) | 2 | | | | | | | | |
| Reactivity (Yellow) | 0 | | | | | | | | |
| <p>NOTES</p> | | | | | | | | | |

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| ODS | OILS: DIESEL |
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| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|-----------------------------------|-------------------------------------|-------------------------------|-------------------------------------|--------------------------------------|---|----------------------------|------------|
| Temperature (degrees F) | Pounds per cubic foot (estimate) | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour- square foot-F | Temperature (degrees F) | Centipoise |
| 50 | 52.430 | 10 | .429 | 30 | .968 | 100.42 | 11.950 |
| 52 | 52.430 | 15 | .431 | 35 | .966 | | |
| 54 | 52.430 | 20 | .434 | 40 | .965 | | |
| 56 | 52.430 | 25 | .436 | 45 | .963 | | |
| 58 | 52.430 | 30 | .439 | 50 | .962 | | |
| 60 | 52.430 | 35 | .441 | 55 | .961 | | |
| 62 | 52.430 | 40 | .444 | 60 | .959 | | |
| 64 | 52.430 | 45 | .446 | 65 | .958 | | |
| 66 | 52.430 | 50 | .448 | 70 | .957 | | |
| 68 | 52.430 | 55 | .451 | 75 | .955 | | |
| 70 | 52.430 | 60 | .453 | 80 | .954 | | |
| 72 | 52.430 | 65 | .456 | 85 | .952 | | |
| 74 | 52.430 | 70 | .458 | 90 | .951 | | |
| 76 | 52.430 | 75 | .461 | 95 | .950 | | |
| 78 | 52.430 | 80 | .463 | 100 | .948 | | |
| 80 | 52.430 | 85 | .466 | 105 | .947 | | |
| 82 | 52.430 | 90 | .468 | 110 | .946 | | |
| 84 | 52.430 | 95 | .471 | 115 | .944 | | |
| | | 100 | .473 | 120 | .943 | | |
| | | 105 | .475 | 125 | .941 | | |
| | | | | 130 | .940 | | |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|------------------------------|--|-----------------------------------|--------------------------------------|----------------------------------|--------------------------|----------------------------------|-------------------------------------|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch (estimate) | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| | I N S O L U B I L I T Y | 70 | .042 | | N O T | | N O T |
| | | 75 | .049 | | | | |
| | | 80 | .057 | | | | |
| | | 85 | .065 | | | | |
| | | 90 | .076 | | | | |
| | | 95 | .087 | | | | |
| | | 100 | .100 | | | | |
| | | 105 | .114 | | | | |
| | | 110 | .131 | | | | |
| | | 115 | .149 | | | | |
| | | 120 | .170 | | | | |
| | | 125 | .193 | | | | |
| | | 130 | .218 | | | | |
| | | 135 | .247 | | | | |
| | | 140 | .279 | | | | |
| | | 145 | .314 | | | | |
| | | 150 | .352 | | | | |
| | | 155 | .395 | | | | |
| | | 160 | .443 | | | | |
| | | 165 | .495 | | | | |
| | | 170 | .552 | | | | |
| | | 175 | .615 | | | | |
| | | 180 | .683 | | | | |
| | | 185 | .758 | | | | |
| | | 190 | .841 | | | | |
| | | 195 | .930 | | | | |

TETRACHLOROETHYLENE

TTE

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|---|--|--|--|
| <p>Common Synonyms Tetracop Perchloro Pentachloroethylene Perk</p> | | <p>Physical State Heavy liquid Colorless Sweet odor</p> | |
| <p>Boils in water, irritating vapor is produced.</p> | | | |
| <p>Stop discharge if possible. Avoid contact with liquid and vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.</p> | | | |
| <p>Fire</p> | | <p>Not flammable. Poisonous gases are produced when heated.</p> | |
| <p>Exposure</p> | | <p>CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.</p> | |
| <p>Water Pollution</p> | | <p>Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water streams. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p> | |
| <p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Should be removed Chemical and physical treatment</p> | | <p>2. LABEL 2.1 Category: None 2.2 Class: Not pertinent</p> | |
| <p>3. CHEMICAL DESIGNATIONS 3.1 CO Compatibility Class: Not listed 3.2 Formula: C₂Cl₄ 3.3 BCG/UN Designation: 9.0/1887 3.4 DOT ID No.: 1887 3.5 CAS Registry No.: 127-18-4</p> | | <p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Ethereal; like chloroform; mildly sweet</p> | |
| <p>5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: For high vapor concentrations use approved respirator or air-supplied mask; chemical goggles or face shield; plastic gloves.</p> <p>5.2 Symptoms Following Exposure: Vapor can affect central nervous system and cause anesthesia. Liquid may irritate skin after prolonged contact. May irritate eyes but causes no injury.</p> <p>5.3 Treatment of Exposure: INHALATION: If illness occurs, remove person to fresh air, keep him warm and quiet, and get medical attention. INGESTION: Induce vomiting only on physician's recommendation. EYES AND SKIN: flush with plenty of water and get medical attention if irritation or injury occurs.</p> <p>5.4 Threshold Limit Value: 50 ppm</p> <p>5.5 Short Term Inhalation Limit: 100 ppm for 60 min.</p> <p>5.6 Toxicity by Ingestion: Grade 2; LD₅₀ = 0.5 to 5 g/kg</p> <p>5.7 Lethal Toxicity: None</p> <p>5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or throat if present in high concentrations. The effect is temporary.</p> <p>5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause stinging and reddening of the skin.</p> <p>5.10 Odor Threshold: 5 ppm</p> <p>5.11 IDLH Value: 500 ppm</p> | | | |
| <p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: Not flammable 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Not pertinent 6.4 Fire Extinguishing Agents best to be used: Not pertinent 6.5 Special Hazards of Combustion Products: Toxic, irritating gases may be generated in fire. 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: Not flammable 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not flammable 6.10 Autoxidative Flame Temperature: Data not available 6.11 Self-Heats to Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p> | | | |
| <p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Bases: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Initiator of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available</p> | | | |
| <p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: Data not available 8.2 Waterway Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): None 8.4 Food Chain Concentration Potential: None</p> | | | |
| <p>9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Dry cleaning and industrial grades: 95-98% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Pressure-vacuum</p> | | | |
| <p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-X</p> | | | |
| <p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: OSHA 11.2 NAB Hazard Rating for Bulk Water Transportation: Category: _____ Rating: _____ Health: _____ 0 Vapor Inert: _____ 1 Liquid or Solid Inert: _____ 1 Poisons: _____ 2 Water Pollution: Human Toxicity: _____ 1 Aquatic Toxicity: _____ 3 Acute Effect: _____ 2 Reactivity: Other Chemicals: _____ 1 Water: _____ 0 Self Reaction: _____ 1 11.3 NFPA Hazard Classification: Not listed</p> | | | |
| <p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 186.83 12.3 Boiling Point at 1 atm: 200°F = 121°C = 394°K 12.4 Freezing Point: -6.5°F = -21.4°C = 250.8°K 12.5 Critical Temperature: 677°F = 347°C = 620°K 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.89 at 20°C (liquid) 12.8 Liquid Surface Tension: 31.3 dynes/cm = 0.0313 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 44.4 dynes/cm = 0.0444 N/m at 25°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.116 12.12 Latent Heat of Vaporization: 80.2 Btu/lb = 80.1 cal/g = 2.10 x 10⁴ J/kg 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.17 Heat of Fusion: Data not available 12.18 Limiting Value: Data not available 12.19 Reid Vapor Pressure: Data not available</p> | | | |
| <p>NOTES</p> | | | |

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| TTE | TETRACHLOROETHYLENE |
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| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|-----------------------------------|--------------------------|-------------------------------|-------------------------------------|--------------------------------------|---|----------------------------|------------|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour- square foot-F | Temperature (degrees F) | Centipoise |
| 35 | 103.400 | 0 | .198 | | N | 55 | .958 |
| 40 | 103.099 | 10 | .200 | | O | 60 | .929 |
| 45 | 102.900 | 20 | .201 | | T | 65 | .900 |
| 50 | 102.599 | 30 | .202 | | | 70 | .873 |
| 55 | 102.299 | 40 | .203 | | P | 75 | .848 |
| 60 | 102.000 | 50 | .204 | | E | 80 | .823 |
| 65 | 101.700 | 60 | .205 | | R | 85 | .800 |
| 70 | 101.400 | 70 | .206 | | T | 90 | .777 |
| 75 | 101.099 | 80 | .207 | | I | 95 | .756 |
| 80 | 100.799 | 90 | .208 | | N | 100 | .736 |
| 85 | 100.500 | 100 | .210 | | E | 105 | .716 |
| 90 | 100.200 | 110 | .211 | | N | 110 | .698 |
| 95 | 99.910 | 120 | .212 | | T | 115 | .680 |
| 100 | 99.610 | 130 | .213 | | | 120 | .663 |
| 105 | 99.320 | 140 | .214 | | | 125 | .647 |
| 110 | 99.020 | 150 | .215 | | | 130 | .631 |
| 115 | 98.730 | 160 | .216 | | | 135 | .616 |
| 120 | 98.429 | 170 | .217 | | | 140 | .601 |
| 125 | 98.139 | 180 | .218 | | | 145 | .588 |
| 130 | 97.839 | 190 | .220 | | | 150 | .574 |
| 135 | 97.549 | 200 | .221 | | | 155 | .561 |
| 140 | 97.250 | 210 | .222 | | | 160 | .549 |
| 145 | 96.959 | | | | | 165 | .537 |
| 150 | 96.669 | | | | | 170 | .526 |
| 155 | 96.370 | | | | | 175 | .515 |
| 160 | 96.080 | | | | | | |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|------------------------------|-----------------------------------|-----------------------------------|---------------------------|----------------------------------|--------------------------|----------------------------------|-------------------------------------|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| 68.02 | .016 | 60 | .236 | 60 | .00702 | 0 | .108 |
| | | 70 | .318 | 70 | .00929 | 25 | .110 |
| | | 80 | .425 | 80 | .01216 | 50 | .113 |
| | | 90 | .561 | 90 | .01575 | 75 | .116 |
| | | 100 | .732 | 100 | .02022 | 100 | .118 |
| | | 110 | .948 | 110 | .02571 | 125 | .120 |
| | | 120 | 1.217 | 120 | .03242 | 150 | .122 |
| | | 130 | 1.548 | 130 | .04055 | 175 | .125 |
| | | 140 | 1.953 | 140 | .05032 | 200 | .127 |
| | | 150 | 2.446 | 150 | .06199 | 225 | .129 |
| | | 160 | 3.042 | 160 | .07563 | 250 | .131 |
| | | 170 | 3.756 | 170 | .09215 | 275 | .132 |
| | | 180 | 4.607 | 180 | .11130 | 300 | .134 |
| | | 190 | 5.616 | 190 | .13360 | 325 | .136 |
| | | 200 | 6.805 | 200 | .15940 | 350 | .138 |
| | | 210 | 8.199 | 210 | .18910 | 375 | .139 |
| | | 220 | 9.824 | 220 | .22330 | 400 | .141 |
| | | 230 | 11.710 | 230 | .26230 | 425 | .142 |
| | | 240 | 13.890 | 240 | .30660 | 450 | .143 |
| | | 250 | 16.390 | 250 | .35680 | 475 | .144 |
| | | 260 | 19.260 | 260 | .41330 | 500 | .146 |
| | | 270 | 22.520 | 270 | .47680 | 525 | .147 |
| | | 280 | 26.230 | 280 | .54790 | 550 | .148 |
| | | | | | | 575 | .148 |
| | | | | | | 600 | .149 |

TRICHLOROETHYLENE

TCL

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|--|---|---|-------------------------|--------------------------|
| <p>Common Synonyms Trichloroethylene Triglyme; Alglym Chloroyan Germolepene Treshylene Trichloron; Tribene</p> | | <p>Water Solub Soluble in water, irritating vapor is produced.</p> | <p>Colorless</p> | <p>Sweet odor</p> |
| <p>Stop discharge if possible. Keep people away. Avoid contact with liquid and vapor. Call fire department. Isolate and remove discharged material. Notify local health and pollution control agencies.</p> | | | | |
| <p>Fire</p> | <p>Combustible. POISONOUS GASES ARE PRODUCED IN FIRE. Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, carbon dioxide, or foam.</p> | | | |
| <p>Exposure</p> | <p>CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause nausea, vomiting, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. If swallowed, will cause nausea, vomiting, difficult breathing, or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyes open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk, and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.</p> | | | |
| <p>Water Pollution</p> | <p>Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water masses. Notify local health and wildlife officials. Notify operators of nearby water intakes.</p> | | | |
| <p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Should be removed Chemical and physical treatment</p> | | <p>2. LABEL 2.1 Category: None 2.2 Class: Not pertinent</p> | | |
| <p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Halogenated hydrocarbon 3.2 Formula: C₂HCl₃ 3.3 MSD/WH Designator: 9.2/1710 3.4 DOT ID No.: 1710 3.5 CAS Registry No.: 78-01-6</p> | | <p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Chloroform-like, etheral</p> | | |
| <p>5. HEALTH HAZARDS</p> <p>5.1 Personal Protective Equipment: Organic vapor-proof gas canister, self-contained breathing apparatus for emergencies, neoprene or vinyl gloves, chemical safety goggles, face shield, respirator safety shoes, respirator suit or apron for splash protection.</p> <p>5.2 Symptoms Following Exposure: INHALATION: symptoms range from irritation of the nose and throat to nausea, an attitude of irresponsibility, blurred vision, and finally disturbance of central nervous system resulting in cardiac failure. Chronic exposure may cause organic injury. INGESTION: symptoms similar to irritation. SKIN: detaching action can cause dermatitis. EYES: slightly irritating sensation and lachrymation.</p> <p>5.3 Treatment of Exposure: Do NOT administer adrenaline or epinephrine; get medical attention for all cases of overexposure. INHALATION: remove victim to fresh air; if necessary, apply artificial respiration and/or administer oxygen. INGESTION: have victim drink water and induce vomiting; repeat three times; then give 1 tablespoon epsom salts in water. EYES: flush thoroughly with water. SKIN: wash thoroughly with soap and warm water.</p> <p>5.4 Threshold Limit Value: 80 ppm 5.5 Short Term Inhalation Limit: 300 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 2; LD₅₀ = 50 to 500 mg/kg 5.7 Lethal Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If applied on clothing and allowed to remain, may cause smarting and reddening of the skin. 5.10 Odor Threshold: 50 ppm 5.11 IDLH Value: 1,000 ppm</p> | | | | |

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| <p>6. FIRE HAZARDS</p> <p>6.1 Flash Point: 80°F G.C.; practically nonflammable 6.2 Flammable Limits in Air: 8.0%-10.5% 6.3 Fire Extinguishing Agents: Water fog 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion: Products: Toxic and irritating gases are produced in fire situations. 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: 770°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not pertinent 6.10 Autoheats Plastic Temperature: Data not available 6.11 Self-Heats Air to Fuel Ratio: Data not available 6.12 Plasma Temperature: Data not available</p> | <p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-X-Y</p> |
| <p>7. CHEMICAL REACTIVITY</p> <p>7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Motor Fuels (Resistant to Product): Data not available 7.8 Reactivity Group: 20</p> | <p>11. HAZARD CLASSIFICATIONS</p> <p>11.1 Code of Federal Regulations: OSHA 11.2 NAB Hazard Rating for Bulk Water Transportation: Category Rating Fire _____ 1 Health _____ Vapor Irritant _____ 1 Liquid or Solid Irritant _____ 1 Poisons _____ 2 Water Pollution Human Toxicity _____ 1 Aquatic Toxicity _____ 2 Aesthetic Effect _____ 2 Reactivity Oxizer Oxidant _____ 1 Water _____ 0 Self Reaction _____ 1</p> <p>11.3 NFPA Hazard Classification: Category Classification Health Hazard (Blue) _____ 2 Flammability (Red) _____ 1 Reactivity (Yellow) _____ 0</p> |
| <p>8. WATER POLLUTION</p> <p>8.1 Aquatic Toxicity: 980 mg/L/40 hr (Aphasia/fish/fresh water) 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: None</p> | <p>12. PHYSICAL AND CHEMICAL PROPERTIES</p> <p>12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 131.39 12.3 Boiling Point at 1 atm: 187°F = 87°C = 360°K 12.4 Freezing Point: -125.5°F = -86.4°C = 186.9°K 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.46 at 20°C (Liquid) 12.8 Liquid Surface Tension: 29.3 dynes/cm = 0.2293 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 34.5 dynes/cm = 0.2245 N/m at 24°C 12.10 Vapor (Gas) Specific Gravity: 4.5 12.11 Ratio of Specific Heats of Vapor (Gas): 1.119 12.12 Latent Heat of Vaporization: 100 Btu/lb = 67.2 cal/g = 2.4 x 10⁴ J/kg 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.17 Heat of Fusion: Data not available 12.18 Limiting Value: Data not available 12.19 Reid Vapor Pressure: 2.5 psia</p> |
| <p>9. SHIPPING INFORMATION</p> <p>9.1 Grades of Purity: Technical; dry cleaning; degreasing; extraction 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Pressure-vacuum</p> | <p>NOTES</p> |

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| TCL | TRICHLOROETHYLENE |
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| 12.17 SATURATED LIQUID DENSITY | | 12.18 LIQUID HEAT CAPACITY | | 12.19 LIQUID THERMAL CONDUCTIVITY | | 12.20 LIQUID VISCOSITY | |
|-----------------------------------|--------------------------|-------------------------------|-------------------------------------|--------------------------------------|--|----------------------------|------------|
| Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F | Temperature (degrees F) | British thermal unit-inch per hour- square foot-F | Temperature (degrees F) | Centipoise |
| 0 | 94.669 | 0 | .220 | | N O T P E R T I N E N T | 15 | .800 |
| 5 | 94.410 | 10 | .221 | | | 20 | .775 |
| 10 | 94.150 | 20 | .223 | | | 25 | .750 |
| 15 | 93.889 | 30 | .225 | | | 30 | .727 |
| 20 | 93.629 | 40 | .226 | | | 35 | .705 |
| 25 | 93.370 | 50 | .228 | | | 40 | .684 |
| 30 | 93.110 | 60 | .230 | | | 45 | .664 |
| 35 | 92.849 | 70 | .231 | | | 50 | .645 |
| 40 | 92.589 | 80 | .233 | | | 55 | .627 |
| 45 | 92.330 | 90 | .235 | | | 60 | .610 |
| 50 | 92.070 | 100 | .236 | | | 65 | .593 |
| 55 | 91.809 | 110 | .238 | | | 70 | .577 |
| 60 | 91.549 | 120 | .240 | | | 75 | .562 |
| 65 | 91.290 | 130 | .241 | | | 80 | .548 |
| 70 | 91.030 | 140 | .243 | | | 85 | .534 |
| 75 | 90.770 | 150 | .245 | | | 90 | .521 |
| 80 | 90.509 | 160 | .246 | | | 95 | .508 |
| 85 | 90.250 | 170 | .248 | | 100 | .496 | |
| 90 | 89.990 | | | | 105 | .485 | |
| 95 | 89.730 | | | | 110 | .474 | |
| 100 | 89.469 | | | | 115 | .463 | |
| 105 | 89.209 | | | | 120 | .453 | |
| 110 | 88.950 | | | | | | |
| 115 | 88.690 | | | | | | |
| 120 | 88.429 | | | | | | |
| 125 | 88.169 | | | | | | |

| 12.21 SOLUBILITY IN WATER | | 12.22 SATURATED VAPOR PRESSURE | | 12.23 SATURATED VAPOR DENSITY | | 12.24 IDEAL GAS HEAT CAPACITY | |
|------------------------------|-----------------------------------|-----------------------------------|---------------------------|----------------------------------|--------------------------|----------------------------------|-------------------------------------|
| Temperature (degrees F) | Pounds per 100 pounds of water | Temperature (degrees F) | Pounds per square inch | Temperature (degrees F) | Pounds per cubic foot | Temperature (degrees F) | British thermal unit per pound-F |
| 77.02 | .110 | 40 | .508 | 40 | .01245 | 0 | .136 |
| | | 50 | .678 | 50 | .01628 | 25 | .139 |
| | | 60 | .894 | 60 | .02105 | 50 | .143 |
| | | 70 | 1.166 | 70 | .02695 | 75 | .146 |
| | | 80 | 1.507 | 80 | .03416 | 100 | .149 |
| | | 90 | 1.929 | 90 | .04296 | 125 | .152 |
| | | 100 | 2.448 | 100 | .05354 | 150 | .155 |
| | | 110 | 3.081 | 110 | .06619 | 175 | .157 |
| | | 120 | 3.846 | 120 | .08120 | 200 | .160 |
| | | 130 | 4.765 | 130 | .09891 | 225 | .162 |
| | | 140 | 5.862 | 140 | .11960 | 250 | .165 |
| | | 150 | 7.163 | 150 | .14380 | 275 | .167 |
| | | 160 | 8.695 | 160 | .17180 | 300 | .169 |
| | | 170 | 10.490 | 170 | .20390 | 325 | .172 |
| | | 180 | 12.580 | 180 | .24080 | 350 | .174 |
| | | 190 | 15.010 | 190 | .28280 | 375 | .176 |
| | | 200 | 17.810 | 200 | .33040 | 400 | .177 |
| | | 210 | 21.020 | 210 | .38420 | 425 | .179 |
| | | | | | | 450 | .181 |
| | | | | | | 475 | .182 |
| | | | | | | 500 | .184 |
| | | | | | | 525 | .185 |
| | | | | | | 550 | .186 |
| | | | | | | 575 | .187 |
| | | | | | | 600 | .188 |

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5.0 SITE CONTROL

5.1 ZONATION. The general zonation protocols that should be employed at hazardous waste sites are described in Attachment C. The site-specific zonation that will be used for this project is described as follows. The immediate work area will be considered the exclusion zone (EZ) with the appropriate demarcation, an area for decontamination will be considered the contamination reduction zone (CRZ), and all other areas will be considered the support zone. All personnel will be required to sign in before entering the site.

5.2 COMMUNICATIONS. When radio communication is not used, the following air horn signals will be employed in the following manner:

| | | |
|------------|-----------------------------------|-------------|
| HELP | three short blasts | (. . .) |
| EVACUATION | three long blasts | (_ _ _) |
| ALL CLEAR | alternating long and short blasts | (_ . _ .) |

5.3 WORK PRACTICES. General work practices to be used during field operations are described in Attachment D.

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6.0 DECONTAMINATION AND DISPOSAL

All personnel and/or equipment leaving contaminated areas of the site will be subject to decontamination, which will take place in the contamination reduction zone.

6.1 PERSONNEL DECONTAMINATION. The decontamination procedures described below will be followed by all personnel leaving the site. Under no circumstances (except emergency evacuation) will personnel be allowed to leave the site prior to decontamination.

Disposable items (i.e., Tyvek™ coveralls, inner gloves, and latex overboots) will be changed on a daily basis unless there is reason to change sooner (e.g., if leaving the exclusion zone). If Level C protection is required, respirator cartridges will be changed daily, unless more frequent changes are deemed appropriate.

If used, respirators will be decontaminated daily and taken from the drop area, the masks will be disassembled, the cartridges discarded, and all other parts placed in a cleansing solution. After an appropriate time in the solution, the parts will be removed and rinsed with tap water. Old cartridges will be discarded in the contaminated trash container for disposal. In the morning, respirators will be reassembled and new cartridges installed.

Generalized procedures for removal of protective clothing are as follows.

1. Drop tools, monitors, samples, and trash at designated drop stations.
2. Remove gross contamination from outer boots and gloves with decontamination solution and water and rinse with water.
3. Remove tape from outer boots and remove boots, discard tape and boots in disposal container (if disposable outer boots are used).
4. Remove tape from outer gloves and remove gloves, discard tape and gloves in disposal container.
5. If the worker has left the exclusion zone to change the air tank on the self-contained breathing apparatus (SCBA) or the canister on the air-purifying respirator, this will be the last step in the decontamination procedure. The tank or cartridge should be exchanged, new outer gloves and boot covers donned (if disposable overboots are being used), and the joints taped. The worker then returns to duty.
6. Remove outer garments and discard in disposal container.
7. Remove respirator, if used, and place or hang in the designated area.
8. Remove inner gloves and discard in disposal container.

Disposable materials such as gloves, Tyvek™, and latex overboots will be placed in plastic bags and disposed in the appropriate manner.

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6.1.1 Small Equipment Decontamination Small equipment will be protected from contamination as much as possible by draping, masking, or otherwise covering the instruments with plastic (to the extent feasible, without hindering operation of the unit). For example, the PID can be placed in a clear plastic bag to allow for reading the scale and operating the knobs. The PID can be partially wrapped, keeping the sensor tip and discharge port clear.

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

6.1.2 Heavy Equipment Decontamination Drilling rigs and direct push equipment may become contaminated during investigative activities. They will be cleaned with high-pressure water or steam, followed by a soap and water wash and rinse. Loose material will be removed with a brush. The person performing this activity will usually be dressed at least at the level of protection used during the personnel and monitoring equipment decontamination.

6.2 COLLECTION AND DISPOSAL OF DECONTAMINATED PRODUCTS. Refer to Section 4.6 in the workplan for procedures related to control and disposal of decontamination products.

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7.0 EMERGENCY AND CONTINGENCY PLAN

This chapter identifies emergency and contingency planning that has been undertaken for operations at this site. Most sections of the HASP provide information that would be used under emergency conditions. General emergency planning information is addressed in Attachment F. The following sections present site-specific emergency and contingency planning information.

7.1 PERSONNEL ROLES, LINES OF AUTHORITY, AND COMMUNICATION. The site HSO or the health and safety designee is the primary authority for directing operations at the site under emergency conditions. All communications both on and off the site will be directed through the HSO or designee.

7.2 EVACUATION. In the event site evacuation is deemed necessary, all personnel will evacuate the site in an upwind direction if a clear roadway is available. Otherwise, the site will be evacuated by the nearest clear roadway.

7.3 EMERGENCY MEDICAL TREATMENT AND FIRST AID. Any personnel injured onsite will be rendered first aid as appropriate and transported to competent medical facilities for further examination and/or treatment. The preferred method of transport would be through professional emergency transportation means; however, when this is not readily available or would result in excessive delay, other transport will be authorized. Under no circumstances will injured persons transport themselves to a medical facility for emergency treatment.

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8.2 HEALTH AND SAFETY PLAN APPROVALS. By their signatures, the undersigned certify that this HASP will be used for the protection of the health and safety of all persons entering this site.

Health and Safety Officer

Date

Task Order Manager

Date

Health and Safety Manager

Date

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8.4 MEDICAL DATA SHEET. This Medical Data Sheet will be completed by all onsite personnel and will be kept in the support zone during site operations. It is not a substitute for the Medical Surveillance Program requirements consistent with CFR 1910.120. This data sheet will accompany any personnel when medical assistance or transport to hospital facilities is required.

Project: _____

Name: _____

Address: _____

Home Telephone: Area Code () _____

Age: _____ Height: _____ Weight: _____

In case of emergency, contact: _____

Address: _____

Telephone: Area Code () _____

Do you wear contact lenses? Yes () No ()

Allergies: _____

List medication(s) taken regularly: _____

Particular sensitivities: _____

Previous/current medical conditions or exposures to hazardous chemicals: _____

Name of Personal Physician: _____

Telephone: Area Code () _____

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8.5 EMERGENCY TELEPHONE NUMBERS.

Base Security (912) 673-4444
Rescue Service (912) 673-3333
Primary Hospital (Gillman Hospital) (912) 882-4227
Alternate Hospital (Brunswick Hospital) (912) 264-7000
Base Fire Department (912) 673-3333
Offsite Emergency Services (912) 673-3333
Poison Control Center (800) 962-1253
National Response Center (800) 424-8802
Regional USEPA Emergency Response (800) 414-8802
Site HSO: _____
Field Operations Leader: _____
Task Order Manager: _____
Contractor HSM: _____
Environmental Coordinator: Mike Anderson (912) 673-4620

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8.6 ROUTES TO EMERGENCY MEDICAL FACILITIES. The primary source of medical assistance for the site is:

Gillman Hospital
805 Dillworth Street
St. Marys, Georgia 31558

DIRECTIONS TO PRIMARY:

From Jackson Gate, Stimson Gate, or Franklin Gate (all on Spur 40), travel south to intersection with Highway 40 (also known as Osborne Street). Turn left (south) on Highway 40, travel about 3 miles on Highway 40, take a right (west) on Dillworth Street, travel two blocks, to your right is the hospital.

The alternate source of medical assistance for the site is:

Brunswick Hospital
3100 Kemble Avenue
Parkwood, Georgia 31520

DIRECTIONS TO ALTERNATE:

Exit NSB via Stimson Gate, Franklin Gate, or Jackson Gate. Turn left (south) on Spur 40, travel about 5 miles on Spur 40, take a right on Highway 40 west, continue on Highway 40 west for another 5 miles. Take interstate 95 north, travel about 30 miles, exit on Highway 17, continue north, take a left on Parkwood Drive, travel 10 blocks on Parkwood Drive.

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REFERENCES

29 Code of Federal Regulations (CFR) 1910.120

C.C. Johnson and Associates, Inc., 1985, Initial Assessment Study, Naval Energy & Environmental Support Activity, Naval Submarine Base, Kings Bay, Georgia: Contract No. N62474-84-C-3384, September.

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ATTACHMENT A
PERSONAL PROTECTIVE EQUIPMENT

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A.1 PERSONAL PROTECTION LEVEL DETERMINATION. The level of personal protective equipment required will be determined by the type and levels of waste or spill material present at the site where project personnel may be exposed. In situations where the types of waste or spill material onsite are unknown, the hazards are not clearly established, or the situation changes during onsite activities, the HSO must make a reasonable determination of the level of protection that will ensure the safety of investigators and response personnel until potential hazards have been determined through monitoring, sampling, informational assessment, laboratory analyses, or other reliable methods. Once the hazards have been determined, protective levels commensurate with the hazards will be used. Protection requirements will be evaluated on a continuous basis to reflect new information as it is acquired.

A.2 LEVELS OF PROTECTION. The following subsections describe the basic composition of the generally recognized protective ensembles to be used for site operations. Specific components for any level of protection will be selected based on hazard assessment; additional elements will be added as necessary. Disposable protective clothing, gloves, and other equipment, exclusive of respirators, should be used when feasible to minimize risks during decontamination and possible cross-contamination during sample handling.

A.2.1 Level A Level A protection provides the highest level of protection for skin, eyes, and the respiratory system. It is appropriate for conditions where there are potential or actual high concentrations of atmospheric vapors, gases, or particulates. Level A should be used if site operations or work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to the skin or capable of being absorbed through the intact skin. Level A is used primarily for emergency situations or when the following conditions exist: (1) vapors or mists of strong acids, (2) known or probable immediately dangerous to life and health (IDLH) atmospheres with dermally active compounds, (3) high atmospheric concentrations of compounds that can be absorbed through the skin, and (4) operations that must be conducted in a confined, poorly ventilated area, where conditions requiring Level A have not yet been eliminated. The fully encapsulating suit and the pressure-demand SCBA or hoseline respirator are the key elements in Level A personal protective equipment.

Level A equipment includes the following items:

- SCBA (pressure demand) or supplied air respirator (pressure demand with escape mask);
- total encapsulating suit;
- coveralls (optional);
- long underwear;
- gloves (outer, chemical-resistant);
- gloves (inner, chemical-resistant);
- boots (chemical-resistant, steel-toed, steel shank);

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- hard hat (optional);
- disposable protective suit, gloves, and boots (to be worn over or under encapsulating suit); and
- two-way radios.

A.2.2 Level B Level B protection should be used when the type and atmospheric concentration of substances have been identified and require a high level of respiratory protection; however, the atmospheric contaminant, splashing liquid, or other direct contact will not adversely affect or be absorbed through any exposed skin. This includes atmospheres with IDLH concentrations of specific substances that do not (1) represent a severe skin hazard or (2) meet the criteria for use of air-purifying respirators. Level B has the same respiratory protection criteria as Level A; however, dermal exposure is not as severe.

Level B equipment includes the following items:

- SCBA (pressure demand) or supplied air respirator (pressure demand with escape SCBA),
- hooded chemical-resistant clothing (coated Tyvek),
- coveralls (optional),
- gloves (outer, chemical-resistant),
- gloves (inner, chemical-resistant),
- boots (chemical-resistant, steel-toed, steel shank),
- boot covers (chemical-resistant) (optional),
- hard hat (optional),
- two-way radio (to be worn under outside protective clothing), and
- face shield (optional).

A.2.3 Level C Level C protection should be used when the atmospheric contaminant, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin. In addition, the types of air contaminants must have been identified, concentration measured, and an air-purifying respirator must be available that can remove the contaminants. An air-purifying respirator can only be used if the oxygen content in the air is at least 19.5 percent, the contaminant has adequate warning properties (e.g., odor, taste, and irritating effect thresholds within two times the Threshold Limit Value), the concentration of the contaminant does not exceed the IDLH, and the worker has been fit-tested. Level C has the same splash protection as Level B; however, cartridge respirators are used instead of SCBAs.

Level C equipment includes the following items:

- full-face respirator (cartridge),

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- hooded chemical-resistant clothing (coated Tyvek),
- coveralls (optional),
- gloves (inner, chemical-resistant),
- gloves (outer, chemical-resistant),
- boots (chemical-resistant, steel-toed, steel shank),
- boot covers (chemical-resistant) (optional),
- hard hat (optional),
- escape mask (optional),
- two-way radios (worn under outside protective clothing), and
- face shield (optional).

A.2.4 Level D Level D is a work uniform affording minimal protection and is used for nuisance contaminants only. Level D protection should only be used when the atmosphere contains no known hazard, when all potential airborne contaminants can be monitored for, and when work functions preclude splash, immersion, or the potential for unexpected inhalation or contact with hazardous levels of any chemical.

Level D equipment includes the following items:

- coveralls,
- gloves (optional),
- boots (chemical-resistant, steel-toed, steel shank),
- boot covers (chemical-resistant) (optional),
- safety glasses or chemical splash goggles (optional),
- hard hat (optional),
- escape mask (optional), and
- face shield (optional).

Note: Modified Level D is Level D with chemical protective clothing, i.e., Tyvek.

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**ATTACHMENT B
MONITORING EQUIPMENT**

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The work environment will be monitored to ensure that IDLH or other dangerous conditions are identified. At a minimum, monitoring will include evaluations for combustible atmospheres, oxygen-deficient environments, hazardous concentrations of airborne contaminants, and radioactivity.

B.1 AIR SAMPLING: EQUIPMENT, CALIBRATION, AND MAINTENANCE. To the extent feasible, the presence of airborne contaminants will be evaluated through the use of direct-reading instrumentation. Information gathered will be used to ensure the adequacy of the levels of protection being used at the site, and may be used as the basis for upgrading or downgrading levels of protection at the discretion of the site HSO.

B.1.1 Combustible Gas and Oxygen Meter This meter monitors for combustible gases and oxygen. It can be used to determine (1) if an area contains concentrations of combustible gases with readings in percentage of the lower explosive limit (LEL); and (2) the percentage of oxygen. This equipment will be calibrated in accordance with the manufacturer's instructions.

This instrument also is calibrated to methane and monitors combustible gases in the percentage of the lower explosive limit. It will be calibrated in accordance with the manufacturer's instructions.

B.1.2 Photovac Organic Vapor Analyzer 10S50 The organic vapor analyzer (OVA) is a total organic vapor analyzer capable of detecting volatile organic compounds (VOCs) that can be ionized by ultraviolet (UV) light. Model 10S50 is commonly used onsite to estimate the presence of VOCs for purposes of crew protection, well screen placement, and selection of samples for further analyses. The principle of operation is twofold: (1) the ambient temperature gas chromatograph, which breaks down mixtures of VOCs into individual components identified by retention time; and (2) detection accomplished by ionization in UV light. The charged component then moves to an electrode which, in turn, results in a meter deflection proportional to the concentration of the contaminant. This instrument does not read out directly in ppm unless calibrated against the material being measured; therefore, results must be interpreted conservatively and with care. Calibration and maintenance will be performed in accordance with the manufacturer's instructions.

B.1.3 HNU IS101 and Photovac TIP Photoionization Detector Like the OVA, the photoionization detector (PID) operates on the basis of ionization of the contaminant, which results in a meter deflection proportional to the concentration of the contaminant. In the PID, ionization is caused by a UV light source. The strength of the UV, measured in electron volts (eV), determines which contaminants can be ionized. The HNU can use three different-strength UV sources, including 9.6, 10.2, and 11.7 eV; only the 10.2- and 11.7-eV probes are currently available for field use. The TIP operates using a UV light source of 10.6 eV. Calibration and maintenance will be performed in accordance with the manufacturer's instructions.

B.1.4 Detector Tubes (MSA and Draeger) A colorimetric detector tube is a direct-reading instrument consisting of a glass tube impregnated with an indicating chemical, which is connected to a piston cylinder or bellows-type pump. A known volume of air is drawn through the glass tube. The contaminant in the air reacts with the indicator chemical, producing a stain the length of which is proportional

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to the contaminant's concentration. Care must be taken when using the detector tubes because reliability of the results depends on the proper pump calibration, the degree of stability of the reacting chemical, and the ambient temperature. Interfering gases or vapors can also positively or negatively affect measured results. Calibration and maintenance will be performed in accordance with the manufacturer's instructions.

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ATTACHMENT C
ZONATION

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The site itself will normally be divided into three zones: (1) the majority of the work area, considered the exclusion zone; (2) limited areas serving as the support zone; and (3) an area for decontamination called the contamination reduction zone (CRZ).

C.1 EXCLUSION ZONE. The exclusion zone isolates the area of contaminant generation and restricts (to the extent possible) the spread of contamination from active areas of the site to support areas and offsite locations. The exclusion zone is demarcated by the "hot line" (i.e., a tape line or physical barrier). Personnel entering the exclusion zone must (1) enter through the CRZ, (2) wear the prescribed level of protection, and (3) be otherwise authorized to enter the exclusion zone. Any personnel, equipment, or materials exiting the exclusion zone will be considered contaminated. Personnel will be subject to decontamination. Equipment and materials will either be subject to decontamination or containerized in uncontaminated devices.

Within the exclusion zone, specific locations or restricted areas (clearly marked or identified) will be established (as necessary) for particular locations or around specific site operations. In the case of well drilling or excavation operations, a restricted area will be established that includes a minimum 30-foot-radius from the drill rig or excavation operation. Other restricted areas may include drum areas, active site areas, sources of combustible gases or air contaminants, or other dangerous areas as they are identified. Access for emergency services to areas of specific site operations will be established.

C.2 CONTAMINATION REDUCTION ZONE. Moving out from the exclusion zone, starting at the hot line and continuing to the contamination control line, is the CRZ. The CRZ is a transition zone between contaminated and uncontaminated areas of the site. When "hot" or contaminated personnel, equipment, or materials cross the hot line, they are assumed to be as hot or contaminated as they are going to be from site operations. Being subjected to the decontamination process, they become less contaminated; when they reach the contamination control line, they are cleaned and can exit the CRZ without spreading contamination.

Within the CRZ is the contamination reduction corridor, where materials necessary for full personnel and portable equipment decontamination are kept. A separate facility will be established for heavy equipment decontamination. In addition, certain safety equipment (e.g., emergency eye wash, fire extinguisher, stretcher, and first aid kit) are staged in this zone.

C.3 SUPPORT ZONE. The support zone is the outermost zone of the site, separated from the CRZ by the contamination control line. It is considered a clean area. Movement of personnel and materials from the support zone into the CRZ is generally unrestricted, except as required through access points controlled for administrative purposes. However, only uncontaminated and/or decontaminated personnel or materials may enter the support zone from the CRZ.

The support zone contains the necessary support facilities (including personal hygiene facilities) for site operations. It also serves as the communications center and source of emergency assistance for operations in the exclusion zone and CRZ. A log of all persons entering the site will be maintained by the HSO, the field operations leader, or the site designee.

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**ATTACHMENT D
WORK PRACTICES**

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D.1 GENERAL. Workers will be expected to adhere to the established safe work practices for their respective specialties (e.g., drilling, laboratory analysis, and construction). The need to exercise caution in the performance of specific work tasks is made more acute due to (1) weather conditions, (2) restricted mobility and reduced peripheral vision caused by the protective gear itself, (3) need for maintaining integrity of the protective gear, and (4) increased difficulty in communicating caused by respirators. Work at the site will be conducted according to established protocol and guidelines for the safety and health of all involved. Among the most important of these principles for working at a hazardous waste site are the following.

- In any unknown situation, always assume the worst conditions and plan responses accordingly.
- Use the buddy system. Under no conditions will any person be permitted to enter the exclusion zone alone. Establish and maintain communications. In addition to radio communications, it is advisable to develop a set of hand signals because conditions may greatly impair verbal communications.
- Because no personal protective equipment is 100 percent effective, all personnel must minimize contact with excavated or contaminated materials. Plan work areas, decontamination areas, and procedures accordingly. Do not place equipment or drums on the ground. Do not sit on drums or other materials. Do not sit or kneel on the ground in the exclusion zone or CRZ. Avoid standing in or walking through puddles or stained soil.
- Disposable items will be used, when possible, to minimize risks during decontamination and possible cross-contamination during sample-handling.
- Smoking, eating, or drinking in the work area and before decontamination will not be allowed. Oral ingestion of contaminants is a likely means of introducing toxic substances into the body.
- Avoid heat and other work stresses related to wearing protective gear. Work breaks should be planned to prevent stress-related accidents or fatigue.
- Maintain monitoring systems. Conditions can change quickly if subsurface areas of contamination are penetrated.
- Conflicting situations that may arise concerning safety requirements and working conditions must be addressed and resolved rapidly by the HSO to avoid any motivation or pressure to circumvent established safety policy.
- To the extent feasible, handling of contaminated materials should be done in a remote area, particularly when drummed or other containerized hazardous waste materials are found onsite. Every effort should be made to identify the contents of containers found onsite before they are subject to material-handling applications.

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- Personnel must be observant of not only their own immediate surroundings but also that of others. Everyone will be working under constraints; therefore, a team effort is needed to notice and warn of impending dangerous situations. Extra precautions are necessary when working near heavy equipment while using personnel protective gear because vision, hearing, and communication can be restricted.
- Contact lenses are not allowed to be worn onsite; if corrosive or lachrymose substances enter the eyes, proper flushing is impeded.
- All facial hair that interferes with the face piece fit must be removed before donning a respirator at all sites requiring Level C or Level B protection.
- Rigorous contingency planning and dissemination of plans to all personnel minimizes the impact of rapidly changing safety protocols in response to changing site conditions.
- Personnel must be aware that chemical contaminants may mimic or enhance symptoms of other illnesses or intoxication. Avoid excess use of alcohol or working while ill during field investigation assignments.
- The site leader, HSO, and sampling personnel will maintain project records in a bound notebook (e.g., daily activities, meetings, incidents, and data). Notebooks will remain onsite for the project duration so that replacement personnel may add information, thereby maintaining continuity. The notebooks and daily records will become part of the permanent project file.

D.2 SITE ENTRY PROCEDURES. In most cases, field teams are not the first onsite investigators. Considerable knowledge of site history and current status allows preparation of a HASP with reasonable assurance that personnel are adequately protected. In the event that sufficient site information is not available to perform a summary risk assessment and assign the appropriate level of personal protective equipment, the following procedures should be followed. It must be understood that verification of the level of contamination (even with background information) will always require some of the following steps.

1. Recognize that presence onsite implies a perceived contamination potential by the client.
2. Assume that the site is contaminated and conduct a site safety reconnaissance, consisting of the following activities:
 - Establish a CRZ (decontamination area).
 - Survey the site at the highest level of protection practicable, beginning with a perimeter survey and gradually covering all areas of proposed activity with the following (as appropriate):
 - HNU PID or equivalent,
 - OVA,

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- radiation survey meter,
 - personal air sampling pumps,
 - chemically reactive indicator tubes,
 - oxygen-deficiency meter, and
 - explosive mixture meter.
- Establish a "hot zone."
 - Review data, assess risk, and select the appropriate level of protection.
3. Prepare a summary site HASP and document all data acquired.

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ATTACHMENT E
TEMPERATURE EXTREMES

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E.1 HEAT STRESS. Due to the increase in ambient air temperatures and the effects of protective outer wear decreasing body ventilation, there is increased potential for injury, specifically heat casualties. Site personnel will be instructed in the identification of a heat stress victim, the first-aid treatment procedures for the victim, and the prevention of heat stress casualties.

E.1.1 Identification and Treatment

E.1.1.1 Heat Exhaustion

Symptoms. Heat exhaustion usually begins with muscular weakness, dizziness, nausea, and a staggering gait. Vomiting is frequent. The bowels may move involuntarily. The victim is very pale, the skin is clammy, and he or she may perspire profusely. The pulse is weak and fast; breathing is shallow. The victim may faint unless he or she lies down. This may pass; however, sometimes it persists and, while heat exhaustion is generally not considered life threatening, death could occur.

First Aid. Immediately remove the victim to the CRZ in a shady or cool area with good air circulation. Remove all protective outer wear. Call a physician. Treat the victim for shock (i.e., have the victim lie down, raise the feet 6 to 12 inches, and maintain body temperature but loosen all clothing). If the victim is conscious, it may be helpful to give sips of water. Transport the victim to a medical facility.

E.1.1.2 Heat Stroke

Symptoms. This is the most serious of heat casualties because the body excessively overheats. Body temperatures often are between 107 and 110 degrees Fahrenheit (°F). The victim will have a red face and will not be sweating. First there is often pain in the head, dizziness, nausea, oppression, and dryness of the skin and mouth. Unconsciousness follows quickly and death is imminent if exposure continues. The attack will usually occur suddenly. Heat stroke is always serious.

First Aid. Immediately evacuate the victim to a cool and shady area in the CRZ. Remove all protective outer wear and all personal clothing. Lay the victim on his or her back with the head and shoulders slightly elevated. It is imperative that the body temperature be lowered immediately. This can be accomplished by applying cold wet towels or ice bags to the head and groin. Sponge off the bare skin with cool water or rubbing alcohol, if available, or even place the victim in a tub of cool water. The main objective is to cool without chilling. Do not give stimulants. Transport the victim to a medical facility as soon as possible.

E.1.2 Prevention of Heat Stress One of the major causes of heat casualties is the depletion of body fluids and salts through sweating. Fluids should be maintained in the support zone. Salts can be replaced by either a 0.1 percent salt solution, more heavily salted foods, or commercial mixes such as Gatorade™. The commercial mixes are advised for personnel on low-sodium diets.

During warm weather, a work schedule will be established that allows most work to be conducted during the morning hours, before ambient air temperature levels reach highs.

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A work/rest schedule will be implemented for personnel required to wear Level B or C protection (i.e., an impervious outer garment) with sufficient time allowed for personnel to "cool down" (this may require working in shifts). Two hours is the maximum time between breaks at Level B or C, regardless of temperature. At elevated temperatures, breaks should be scheduled as follows:

| Ambient Temperatures (degrees Fahrenheit) | Maximum Time Between Cool Down Breaks (hours) |
|--|---|
| Above 90 | $\frac{1}{2}$ |
| 85 to 90 | $\frac{1}{2}$ |
| 80 to 85 | 1 |
| 70 to 80 | 1 $\frac{1}{2}$ |

E.1.3 Heat Stress Monitoring Monitoring of personnel wearing impervious clothing should commence when the ambient temperature reaches 70 °F, with increased frequency if ambient temperature increases or as slow recovery rates are indicated. When temperatures exceed 85 °F, workers should be monitored for heat stress after every work period. As a screening mechanism of the body's recuperative ability to excess heat, one or more of the following techniques should be used.

1. Measure the heart rate (HR) for 30 seconds by radial pulse, as early in the resting period as possible. At the beginning of the rest period, the HR should not exceed 110 beats per minute. If the HR is higher, the next work period should be shortened by 10 minutes (or 33 percent), with the length of the rest period staying the same. If the pulse rate is still above 110 beats per minute at the beginning of the next rest period, the following work cycle should again be shortened by 33 percent.
2. Measure oral body temperature with a clinical thermometer, as early as possible in the resting period. At the beginning of the rest period, oral temperature (OT) should not exceed 99 °F. If OT exceeds 99 °F, the next work period should be shortened by 10 minutes (or 33 percent), with the length of the rest period staying the same. If the OT again exceeds 99 °F at the beginning of the next period, the following work cycle should be further shortened by 33 percent. OT should also be measured at the end of the rest period to ensure that it has dropped below 99 °F.
3. Maintain good hygienic standards by changing clothes frequently, showering daily, and allowing clothing to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.

E.2 COLD STRESS. Cold weather may often cause problems for personnel working outside, even at temperatures above freezing. As temperatures drop below freezing, the potential for cold weather injuries increases dramatically, as does the potential for equipment failure. Because of the considerable danger to personnel, outdoor work should be suspended if the ambient temperature drops below 0 °F (-18 degrees Celsius [°C]) or if the windchill factor drops below -29 °F (-34

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°C). These levels represent guidelines that should be used as an action level unless the HSO determines and documents otherwise. Table E-1, which shows equivalent temperatures (i.e., windchill) for a range of ambient conditions, should also be referred.

Snow and ice increase the risks to personnel and operations through reduced visibility, increased potential for falling injuries, reduced onsite mobility, and the increased time required to access the site (or offsite support services).

In view of these factors, it is critical that the HSO establish site-specific safety and operating protocols and that all onsite personnel be made aware of the risks.

E.2.1 Local Cold Injuries Local cold injuries affect specific areas of the body (e.g., fingers, ears, or toes), including the more commonly recognized injuries described in the following subsections.

E.2.1.1 Chilblains Chilblains is a chronic condition affecting the skin and peripheral capillary circulation resulting from prolonged exposure of the bare skin (primarily in the extremities) to temperatures at or below 60 °F. The best method of preventing and treating chilblains is to cover and protect the skin, thereby avoiding prolonged exposure to the cold.

E.2.1.2 Frostbite Frostbite is freezing of the hands, feet, ears, and exposed parts of the face as a result of exposure to very low temperatures. Frostbite occurs when ice crystals form in the fluid in cells of the skin and tissue. As long as blood circulation remains good, frostbite will not occur.

There are three stages of frostbite: incipient frost bite (frostnip), superficial frostbite, and deep frostbite. The classification depends on severity and can range from incipient frostbite (frostnip) which affects the skin, to superficial frostbite which involves the skin and the tissues immediately beneath it, and to deep frostbite which is much more serious with damage that may affect deeper tissue and even bone.

Symptoms. Symptoms for each of the three stages of frostbite are described as follows.

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Table E-1
Cooling Power of Wind on Exposed Flesh Expressed as an Equivalent Temperature
(under Calm Conditions)

Appendix B, Health and Safety Plan
 Screening Investigation Workplan for Site 2
 Naval Submarine Base Kings Bay
 Kings Bay, Georgia

| Estimated Wind Speed (mph) | Actual Temperature Reading (°F) | | | | | | | | | | | |
|---|---|----|----|---|-----|-----|-----|---|------|------|------|------|
| | 50 | 40 | 30 | 20 | 10 | 0 | -10 | -20 | -30 | -40 | -50 | -60 |
| | Equivalent Chill Temperature (°F) | | | | | | | | | | | |
| Calm | 50 | 40 | 30 | 20 | 10 | 0 | -10 | -20 | -30 | -40 | -50 | -60 |
| 5 | 48 | 37 | 27 | 16 | 6 | -5 | -15 | -26 | -36 | -47 | -57 | -68 |
| 10 | 40 | 28 | 16 | 4 | -9 | -24 | -33 | -46 | -58 | -70 | -83 | -95 |
| 15 | 36 | 22 | 9 | -5 | -18 | -32 | -45 | -58 | -72 | -85 | -99 | -112 |
| 20 | 32 | 18 | 4 | -10 | -25 | -39 | -53 | -67 | -82 | -96 | -110 | -121 |
| 25 | 30 | 16 | 0 | -15 | -29 | -44 | -59 | -74 | -88 | -104 | -118 | -133 |
| 30 | 28 | 13 | -2 | -18 | -33 | -48 | -63 | -79 | -94 | -109 | -125 | -140 |
| 35 | 27 | 11 | -4 | -20 | -35 | -51 | -67 | -82 | -98 | -113 | -129 | -145 |
| 40 | 26 | 10 | -6 | -21 | -37 | -53 | -69 | -85 | -100 | -116 | -132 | -148 |
| (Wind speeds greater than 40 mph have little additional effect.) | LITTLE DANGER In less than an hour with dry skin. Maximum danger of false sense of security. | | | INCREASING DANGER Danger from freezing of exposed flesh within 1 minute. | | | | GREATER DANGER Flesh may freeze within 30 seconds. | | | | |
| Trenchfoot and immersion foot may occur at any point on this chart. | | | | | | | | | | | | |
| Source: Developed by U.S. Army Research Institute of Environmental Medicine, Natick, Massachusetts. | | | | | | | | | | | | |
| Notes: mph = miles per hour. °F = degrees Fahrenheit. | | | | | | | | | | | | |

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- Frostnip. Skin first turns red and then later becomes pale or waxy white. There may be tingling, stinging, aching, an uncomfortable sensation of coldness or numbness, or no noticeable symptoms.
- Superficial Frostbite. The skin turns white or gray-white and is waxy in appearance. It is firm to touch (i.e., does not move easily) and the tissue beneath the skin is soft and resilient. There is a lack of sensation in the area.
- Deep Frostbite. The tissue is pale, cold, and solid with possible blisters and swelling. The hands and feet are especially susceptible to deep frostbite.

Emergency Treatment of Frostbite. Frostnip is easily treated in the field by the application of body heat, which should be applied before the affected area becomes numb. If frostnip affects your fingers and hands, place them against the skin of your chest or in your armpits. To warm your face, hold a mitten or scarf over the lower part of your face and breathe into it. Thaw frozen spots immediately. Do not rub affected areas.

Superficial frostbite usually responds to the application of body heat, as described previously. If the skin does not respond to body heat or if it resembles the early stages of deep frostbite, follow the emergency treatments listed in the following paragraphs. DO NOT rub affected areas.

For deep frostbite, if possible, the injured person should be taken to a heated shelter to avoid further frostbite. If it can be done without the danger of further frostbite, remove all constricting items (e.g., boots, gloves, and socks) from the injured area. RAPID REWARMING WILL MINIMIZE TISSUE LOSS. If possible, warm the extremities in a carefully controlled water bath (104 to 106 °F) until tips of the fingers or toes turn pink and feeling is restored. If a water bath is not available, either apply wet packs (100 to 112 °F) to the person's body, or gently wrap frostbitten area in blankets or some other warm material.

DO NOT attempt to thaw the affected parts by exercising them or heating them in front of an open fire, heat lamp, radiator, or stove. The person could receive a heat injury as a result of sensation loss.

DO NOT use snow to thaw frostbite. DO NOT rub, massage, or use pressure on the affected areas. Keep the frostbitten parts elevated if possible. Watch to see if CPR is necessary. Give the victim warm drinks such as tea, coffee, or soup. DO NOT GIVE ALCOHOLIC BEVERAGES. Have the victim exercise fingers or toes as soon as possible, but only after they are warmed. DO NOT allow a person with frostbitten feet to walk; walking may cause additional damage.

Medical Treatment of Frostbite.

- Frostnip. Usually does not require medical care.
- Superficial Frostbite. Blisters may require medical care.
- Deep Frostbite. EARLY MEDICAL TREATMENT IS URGENT! Transport the victim to medical care facilities at once.

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Prevention of Frostbite. It is far easier to prevent or stop frostbite in earlier stages than to thaw and take care of badly frozen flesh. To protect the body against frostbite, the following precautions should be taken.

- Wear enough clothing to protect against the cold and wind.
- Wear warm gloves and boots.
- Pull a scarf or jacket flap over the lower part of the face or pull a hood tightly around the face.
- Occasionally exercise the face, fingers, and toes to keep them warm and to detect any areas that may have become numb.
- Crew members should watch each other closely, especially the face, for signs of frostbite.

E.2.1.3 Immersion Foot Immersion foot (formerly called trenchfoot) is a cold injury resulting from prolonged exposure to near-freezing temperatures when standing or walking on wet or swampy ground.

Symptoms. In the early stages, the feet and toes are pale, cold, numb, and stiff and walking is difficult. If preventive action is not taken, the feet will swell and ache; in extreme cases, this may result in irreversible damage to the tissues of the foot or leg.

Emergency Treatment of Immersion Foot. Handle feet very gently. DO NOT rub or massage. If necessary, clean feet carefully with soap and warm water then dry, elevate, and expose to warm but not hot air.

Prevention of Immersion Foot. Because the early stages of immersion foot are not painful, crew members must be constantly on the alert and check feet often when working in cold, wet conditions. Keep feet dry by wearing waterproof footgear and changing socks frequently because perspiration, trapped inside waterproof boots or heavy footgear, can contribute to immersion foot symptoms. Avoid standing in wet areas. If feet get wet, dry them as soon as possible, warm them with your hands, use foot powder, and change to dry socks. If you cannot change wet boots and socks, exercise your feet frequently by wiggling your toes and moving your ankles. Never wear tight boots.

E.2.2 Systemic Cold Injuries Systemic injuries are those that affect the entire body system. Severe body cooling, known as systemic hypothermia, can occur at temperatures well above freezing. Hypothermia, which can be fatal, is the progressive lowering of body temperature accompanied by rapid, progressive mental and physical collapse. A large percentage of wilderness deaths are the result of hypothermia.

Hypothermia is caused by exposure to cold and is aggravated by moisture, cold winds, fatigue, hunger, inadequate clothing or shelter, and excessive perspiration from strenuous exercise followed by too rapid cooling.

Hypothermia often occurs between temperatures of 30 to 50 °F, which most people believe are not dangerous. Crew members should be alert for symptoms of

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hypothermia, especially when temperatures are dropping rapidly or when they must work in rain, snow, or ice.

Hypothermia may occur on land or following submersion in even moderately cold water (i.e., 65 °F or lower). On land, hypothermia may take a full day or more of exposure to develop; however, if the conditions are extremely severe, death may occur within a few hours of initial symptoms.

In cold water, death may seem to be from drowning; in reality, it is usually the result of hypothermia. In water, skin and nearby tissues chill very fast (in 10 to 15 minutes) and the temperature of the heart and brain may drop. When the core (i.e., internal body) temperature reaches 90 °F, unconsciousness may occur; when body temperature drops to 80 °F, heart failure is possible.

E.2.2.1 Symptoms In the early stages of hypothermia, the body begins to lose heat faster than it can be produced, making an effort to stay warm by shivering. When the body can no longer generate enough heat to overcome heat loss and the energy reserves of the body become exhausted, body temperature begins to drop. This affects the ability of the brain to make judgements and also results in loss of muscular control. As the body temperature drops, hypothermia symptoms become increasingly severe, as shown in the following table.

| Symptoms Of Hypothermia | Approximate Core Temperature (°F) |
|---|---|
| Person is conscious, alert with increased respiration. Shivering may become uncontrollable as core temperature nears 95 °F. | Above 95 |
| Person is conscious but disoriented and apathetic. Shivering is present but diminishes as temperature drops. Below 92 °F, respiratory rate gradually diminishes and pupils begin to dilate. | 95 to 90 |
| Person is semiconscious. Shivering is replaced by muscular rigidity. Pupils are fully dilated at about 86 °F. | 90 to 86 |
| Unconscious; diminished respiration. | Below 86 |
| Barely detectable or nondetectable respiration. | Below 80 |

Note: °F = degrees Fahrenheit.

E.2.2.2 Emergency Treatment of Hypothermia Move hypothermia victim to shelter and warmth as rapidly as possible. In very mild cases, dry clothing and shelter may be all that is needed. Gently remove all of the victim's wet clothing (so energy is not expended by warming and drying wet clothing) and replace it with a dry set. Give the person something warm to drink. **DO NOT GIVE ALCOHOLIC BEVERAGES.**

ALL OTHER HYPOTHERMIA CASES SHOULD BE CONSIDERED MEDICAL EMERGENCIES. PROVIDE EXTERNAL HEAT IN ANY WAY POSSIBLE! A warm bath (with the water kept between 105 and 110 °F) is the most effective way of warming a victim of hypothermia. NEVER put an UNCONSCIOUS VICTIM in a bathtub.

If it is not possible to give the person a warm bath, use one of the following.

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ALTERNATE METHODS:

- Wrap warm moist towels (or other fabric) around the victim's head, neck, sides, and groin. As the packs cool, rewarm them by adding warm water (approximately 105 °F). Check the temperature of the water with your elbow or the inside of your arm; it should be warm but not hot.
- If you are at a remote outdoor location and cannot use the other method, make a "human sandwich" by placing the unclothed victim in a sleeping bag (or between blankets) with two other undressed persons to provide body-to-body heat transfer. THIS WILL SAVE LIVES. Additional sleeping bags or blankets can be placed over and under the victim.

DO NOT wrap a hypothermia victim in a blanket without an auxiliary source of heat unless it is to protect against any further heat loss before treatment can begin, or you need to go for help and there is no other alternative.

Continue treatment once the victim has stabilized. Give warm liquids and nourishing food if the person is conscious. Check the person for symptoms of frostbite and if necessary, give treatment.

Handle the patient gently and do not allow him or her to walk. Exertion can circulate cold stagnant blood from extremities to the central body and cause "after-drop," in which the patient's core temperature drops below the level that will sustain life. ALCOHOL CONTRIBUTES TO AFTER-DROP.

E.2.2.3 Medical Care for Hypothermia HYPOTHERMIA IS A SEVERE EMERGENCY. GET MEDICAL TREATMENT AS SOON AS POSSIBLE. Even persons with mild hypothermia should see a doctor.

E.2.2.4 Prevention of Hypothermia In cold weather, never go into the field without wearing adequate clothing. Take a complete change of warm clothes and one or two extra pairs of socks (in plastic bags). Wear or carry a windproof, water-resistant outer jacket and, in rain or snow, wear adequate rain gear.

Stay dry. If your clothing becomes wet from perspiration, rain, snow, or immersion in water, change it as soon as possible. If you start to shiver in a prolonged and/or violent way, seek shelter at once. Shivering may produce heat but it also uses up energy. Violent shivering may be an early sign of hypothermia.

Avoid accidental immersion in water. Practice boat safety and learn cold water survival techniques. If you fall into water and you are not very close to shore, remain quiet. Keep your head out of water, climb onto the boat, or hold or climb onto any other object that will support you and keep you up out of the water.

E.2.3 Safety and First Aid Equipment In view of the causes, results, and appropriate treatment of cold weather injuries discussed previously, as a minimum, the following safety equipment should be included during cold weather operations:

- extra clothing for all personnel,
- blankets and/or sleeping bag,

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- high-energy food and drinking water supply,
- toboggan, and
- tow ropes.

In extreme cold conditions, add the following safety items:

- electric blanket (if an electrical source is available),
- portable emergency generator (with fuel, oil, and cords), and
- space heater and fuel.

E.2.4 General Winter Operations Cold weather conditions can severely affect winter operations. The Site Manager and HSO must plan work schedules and project tasks accordingly.

E.2.4.1 Preliminary Assessment If you will be working outdoors in cold weather, assess the local weather conditions through the news media (i.e., radio, television, and newspapers) to determine whether work should progress and/or the amount of preparation needed. Carefully consider questions such as the following.

- What are the typical wind and weather conditions for the period in which you will be working?
- Are the areas in which you will work sheltered or open to the wind?
- Is there a place nearby for periodic warming breaks? Can you obtain or heat warm food and beverages there? Is there a source of drinking water?
- Are there ways to minimize the length of time that crew members will have to work outdoors in the cold?
- If you use a vehicle for a warming area or will use a heater in a closed room, how can you ensure there is adequate ventilation to prevent carbon monoxide poisoning?

E.2.4.2 Scheduling Wherever possible, try to schedule work during the least severe weather. Rotate crew members to keep cold exposures short and allow sufficient time for frequent warming breaks. Remember that workers in heavy clothing often need more time to complete the tasks and may become fatigued more easily. Be aware that operations may have to be discontinued if winds increase or the temperature drops.

Because winter days are short, scheduling should allow time for taking care of equipment and supplies before nightfall. Once it becomes dark, it is more difficult to gauge terrain, and temperatures are likely to drop.

E.2.4.3 Site Access Snow and ice could make travel on site access roads impossible or treacherous at best. Personnel should not be allowed to work onsite if conditions could severely hamper the arrival or departure of emergency vehicles. If the route to offsite medical facilities is blocked by snow or ice, an otherwise minor injury could result in a major medical emergency. If conditions warrant, the following provisions should be made:

- snow removal/plowing services for site access roads;

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- a dependable, four-wheel-drive vehicle available to onsite personnel for transporting an injured person to an offsite medical facility; and
- sleeping bags, blankets, food supply, and water kept onsite in the event a sudden storm requires personnel to remain overnight.

The HSO is responsible for deciding when weather conditions make site access unsafe, thereby requiring work to stop until conditions improve.

E.2.4.4 Equipment and Supplies Obtain equipment and supplies that will help prevent cold stress and will help in the treatment of cold stress disorders. Required equipment includes a reliable ambient temperature thermometer, a wind gauge, and a windchill chart. If the site is potentially windy due to a lack of natural or manmade windbreaks (e.g., trees, valleys, and structures), try to provide means of shielding workers from the wind. If working at a remote location, carry extra food and water because hunger and dehydration contribute to cold stress. If possible, make provisions for hot food and beverages. Ensure that emergency communication equipment is available and operational for crew members working in the cold, at heights, or in remote locations.

Close attention must be given to the effects of cold weather on field equipment. Batteries can be severely affected by cold resulting in disabled radios, air monitoring equipment, sampling pumps, and vehicles. A supply of fresh batteries, a sufficient number of charging units, and a set of automotive jumper cables should be maintained onsite. In addition, the electronics in many field instruments such as PID, LEL, and oxygen meters, as well as the chemical reactions in detector tubes (e.g., Draeger tubes) can also be adversely affected by the cold. The manufacturers' literature must be consulted for minimum operating temperatures.

If at all possible, monitoring well sampling tasks should not be scheduled during cold weather. These tasks generally require the use of relatively delicate pumps; long, un-insulated stretches of tubing; and significant quantities of decontamination solutions. Unless considerable effort is expended to prevent pumps, hoses, decontamination solutions, and sample containers from freezing, attempting to sample monitoring wells in cold weather may be counterproductive. Portable shelters should be considered if cold weather sampling is necessary.

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**ATTACHMENT F
EMERGENCY PLANNING**

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F.1 EMERGENCY MEDICAL SERVICES. Prior to site investigation or activity on hazardous sites, nearby health facilities will be evaluated to determine their ability to provide for the needs of onsite project staff. Criteria such as emergency department physician coverage, decontamination capabilities, and available medical specialists will be evaluated.

F.1.1 Onsite First Aid An industrial first-aid kit will be provided at the work site; contents of the kit will be checked weekly and restocked as necessary. Other equipment may include oxygen, backboard and straps, splints, and a cervical collar.

At least one person qualified to perform first aid will be present onsite at all times during work activity. This person will have earned a certificate in first-aid training from the American Red Cross or will have received equivalent training. Designated first aides will receive regular review training from the American Red Cross or the equivalent.

An eye-wash station will be provided at the work site, as well as flushing water for decontamination of boots, gloves, clothing, and tools.

F.1.2 Transportation to Emergency Treatment A vehicle will be available at all times to transport personnel to the hospital (in the event an ambulance is unnecessary or unavailable). Stretchers will be located at the work site to transport personnel to the vehicle. Under no circumstances will injured persons transport themselves to a medical facility for emergency treatment.

F.2 CONTINGENCY PLANNING. Prior to commencement of onsite activities, the HSO will review safety considerations with the field crew. The HSO has overall responsibility for adherence to the designated safety precautions and assumes the role of onsite coordinator in an emergency response situation.

All onsite personnel will be familiarized with both the primary and secondary route to the nearest hospital (which may be shown on a figure or a local map), as well as the location of the nearest working telephone or radio communication device. A list of emergency telephone numbers will be posted in the trailer.

The local hospital and emergency response team will be advised in advance of the work to be performed. The hospital will also be briefed on the availability of personnel health data and technical support through Environmental Medicine Resources, Inc.

Emergency communication will be required to ensure positive preplanned notification of emergency authorities in the event of episodes requiring initiation of contingency plans. Emergency communication will include all or parts of the following.

- Coordinate with local agencies, fire and police departments, the ambulance service, and the hospital emergency room.
- Establish two-way radio communication and a site alarm capable of warning site personnel and summoning assistance (i.e., airborne).

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- Design an emergency evacuation plan for residents of nearby homes. Although evacuation is an unlikely event, as a contingency, the HSO will be designated as onsite coordinator and will be responsible for implementing the plan. The HSO will be made aware of the total number of households within a 2,000-foot radius. The HASP will provide the emergency contacts required and a table will provide a list of residences and identifiable operations in the area in the event that evacuation is deemed a possibility for a particular site.
- Investigate possible routes of evacuation prior to any activity.
- If an accident occurs, a copy of an accident report form (provided in Attachment G) should be filled out by the HSO and filed with the individual's supervisor or the HSM. A copy should also be retained in the project records.

F.3 POTENTIAL HAZARDS. The most common hazards associated with hazardous waste site investigation include (1) accidents; (2) inhalation, contact, or ingestion of hazardous materials; (3) explosion; and (4) fire.

F.3.1 Accidents Accidents must be handled on a case-by-case basis. Minor cuts, bruises, muscle pulls, and the like will still allow the injured person to undergo reasonably normal decontamination procedures before receiving direct first aid. More serious injuries may not permit complete decontamination procedures to be undertaken, particularly if the nature of the injury is such that the victim should not be moved. In these cases, arrangements will be made with the medical facility and transporter to allow them to take proper precautions. The nature and degree of surface contamination at a site is generally low enough that emergency vehicles could reach the victim onsite without undue hazard. However, if onsite access is limited, accident victims may be transported by personnel trained for this response to a point accessible by an ambulance.

F.3.2 Contact and/or Ingestion of Hazardous Materials Properly prescribed and maintained protective clothing and adherence to established safety procedures are designed to minimize this hazard. However, it is still possible that contact or ingestion of materials may occur. For example, puncture of a buried drum of liquid during drilling operations might cause the drum contents to contact personnel. Standard first-aid procedures should be followed. The drilling rig will have a tank of water that may be useful in some circumstances, particularly to flush contaminants from any exposed skin areas. Eye-wash bottles will also be maintained at the site for emergencies. In cases of ingestion or anything other than minor contact with known substances, the local Poison Control Center and hospital should be notified and the victim taken there immediately for further treatment and observation.

F.3.3 Explosion The drilling crew should be keenly aware of combustible gas meter readings and should withdraw at any indication of imminently hazardous conditions (i.e., greater than 20 percent LEL). The detection of such conditions will be reported to local agencies for potential execution of the evacuation plan, if the situation is assessed to warrant such response.

F.3.4 Fire The combustible gas meter also warns of imminent fire hazards at borings. The greatest fire hazard at the site should be recognized as handling

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the fluids (e.g., methanol and acetone) used for certain decontamination procedures. No smoking or open flames are allowed onsite. Carbon dioxide fire extinguishers will be kept at the drilling rig and in the decontamination area and/or field office. The fire department, previously informed of site activities, will be called as needed.

F.4 EVACUATION RESPONSE LEVELS. Evacuation responses will occur at three levels: (1) withdrawal from immediate work area (100 feet or more upwind), (2) site evacuation, and (3) evacuation of surrounding area. Anticipated conditions that require these responses are described in the following subsections.

F.4.1 Withdrawal Upwind (100 Feet or More) Withdrawing upwind (100 feet or more) will be required when (1) ambient air conditions contain greater contaminant concentrations than guidelines allow for the type of respiratory protection being worn (the work crew may return after donning greater respiratory protection and/or assessing the situation as transient and past), (2) a breach in protective clothing or minor accident occurs (the work crew may return when the tear or other malfunction is repaired and first aid or decontamination has been administered), or (3) the respirator malfunctions requiring replacement.

F.4.2 Site Evacuation Evacuation of the site will be required when (1) ambient air conditions contain explosive and persistent levels of combustible gas or excessive levels of toxic gases, (2) a fire or major accident occurs, or (3) explosion is imminent or has occurred.

F.4.3 Surrounding Area Evacuation The area surrounding the site will be evacuated when persistent, unsuppressible toxic or explosive vapors from test pits or borings (e.g., pressure release from punctured drum) are released, or air quality monitored at several points downwind assess danger to the surrounding area.

F.5 EVACUATION PROCEDURES.

F.5.1 Withdrawal Upwind The work crew will continually observe general wind directions while onsite. (A simple wind sock may be set up near the work site for visual determinations.) Upon observing conditions that warrant moving away from the work site, the crew will relocate upwind a distance of approximately 100 feet or farther, as indicated by the site monitoring instruments. Donning SCBA and a safety harness and line, the HSO and a member of the crew may return to the work site to determine whether the conditions noted were transient or persistent. If persistent, an alarm should be raised to notify onsite personnel of the situation and the need to leave the site or don SCBA. An attempt should be made to decrease emissions only if greater respiratory protection is donned. The HSM and client will be notified of conditions. When access to the site is restricted and escape is thereby hindered, the crew may be instructed to evacuate the site rather than move upwind, especially if withdrawal upwind moves the crew away from escape routes.

F.5.2 Site Evacuation After determining that site evacuation is warranted, the work crew will proceed upwind of the work site and notify the security force, HSO, and field office of site conditions. If the decontamination area is upwind and more than 500 feet from the work site, the crew will pass quickly through

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decontamination to remove contaminated outer suits. If the hazard is toxic gas, respirators will be retained. The crew will proceed to the field office to assess the situation, where the respirators may be removed (if instrumentation indicates an acceptable condition). As more facts are determined from the field crew, they will be relayed to the appropriate agencies. The advisability and type of further response action will be coordinated and implemented by the HSO.

F.5.3 Evacuation of Surrounding Area When the HSO determines that conditions warrant evacuation of downwind residences and commercial operations, the local agencies will be notified and assistance requested. Designated onsite personnel will initiate evacuation of the immediate offsite area without delay.

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ATTACHMENT G

HEALTH AND SAFETY FORMS AND DATA SHEETS

ABB ENVIRONMENTAL SERVICES INC.

ACCIDENT REPORT

SITE INFORMATION:

Site: _____ Job Number: _____
 Location: _____
 Location of Accident (if different from above): _____
 Did injury involve ABB-ES employee?: _____ Subcontractor?: _____ Other?: _____

PERSONAL INFORMATION:

Name of Injured Person: _____
 Address of Injured Person: _____
 SSN: _____ DOB: _____ Marital Status: _____
 Department: _____ Date of Hire: _____

ACCIDENT INFORMATION:

Date of Accident: _____ Time of Accident: _____ Weather Conditions: _____
 Name of Witness: _____ Telephone No.: _____
 Address: _____

Accident Category: Chemical Exposure Physical Injury Motor Vehicle Fire
 Property Damage (list): _____ Other: _____

Severity: Medical Treatment Non-disabling Disabling Fatality
 Estimated Amount of Property Damage: _____

Classification of Injury:

| | | | |
|--|--|--------------------------------------|---------------------------------------|
| <input type="checkbox"/> Heat Burns | <input type="checkbox"/> Allergic Reaction | <input type="checkbox"/> Lacerations | <input type="checkbox"/> Fracture |
| <input type="checkbox"/> Chemical Burns | <input type="checkbox"/> Bites | <input type="checkbox"/> Punctures | <input type="checkbox"/> Dislocations |
| <input type="checkbox"/> Radiation Burns | <input type="checkbox"/> Poison Ivy | <input type="checkbox"/> Abrasions | <input type="checkbox"/> Nausea |
| <input type="checkbox"/> Toxic-Respiratory | <input type="checkbox"/> Heat Stroke | <input type="checkbox"/> Sprains | <input type="checkbox"/> Headache |
| <input type="checkbox"/> Toxic-Dermal | <input type="checkbox"/> Cold Exposure | <input type="checkbox"/> Bruises | <input type="checkbox"/> Faint/Dizzy |
| <input type="checkbox"/> Toxic-Ingestion | <input type="checkbox"/> Blisters | <input type="checkbox"/> Concussion | |
| <input type="checkbox"/> Other: _____ | | | |

If chemical exposure, list all possible contaminants of concern: _____

Part(s) of Body Affected: _____ Degree of Disability: _____
 Date Medical Care Received: _____ Emergency Service: _____ Follow-up Examination Needed: _____
 Name and Address of Medical Facility: _____

Name of Attending Physician: _____ Telephone Number: _____
 Date/Time Employee went back to work: _____ Employee on Restricted Duty? _____
 Estimated Number of Days Away From Work: _____

CAUSE OF INJURY/ACCIDENT:

Causitive agent(s) most directly related to accident (e.g., object, substance, material, machinery, equipment, or weather): _____

Were there unsafe mechanical/physical/environmental condition(s) at the time of the accident?: _____

Did an unsafe act contribute to the accident? If yes, specify: _____

Did personal factors contribute to the accident (e.g., improper attitude, lack of knowledge or skill, slow reaction, fatigue, inattention, or horseplay.): _____

ACCIDENT PREVENTION:

Level of Personal Protective Equipment required in the HASP: _____

Was injured using required equipment?: _____. If not, how did actual equipment differ from what was required in the HASP. Describe: _____

Was personal protective equipment required in the HASP adequate for site conditions? _____

If no, what additional equipment was needed?: _____

What can be done to prevent a re-occurrence of this type of accident? (e.g., ventilation, machine modification/guarding, modification of work practices, or additional training.): _____

NARRATIVE:

Provide a detailed description of how and why the accident occurred. Include objects, equipment, tools, circumstances of assigned duties, weather, etc. Be specific.: _____

Signature of Preparer: _____

Date: _____

Signature of Site Manager: _____

Date: _____

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Requirements of the Act include the following:

EMPLOYERS

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm or employees. Employers must comply with occupational safety and health standards issued under the Act.

EMPLOYEES

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

INSPECTION

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

COMPLAINT

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides the employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discriminatory action.

CITATION

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

PROPOSED PENALTY

The Act provides for mandatory civil penalties against employers of up to \$7,000 for each serious violation and for optional penalties of up to \$7,000 for each nonserious violation. Penalties of up to \$7,000 per day may be proposed for failure to correct violations within the proposed time period and for each day the violation continues beyond the prescribed abatement date. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to \$70,000 for each such violation. A violation of posting requirements can bring a penalty of up to \$7,000.

There are also provisions for criminal penalties. Any willful violation resulting in the death of any employee, upon conviction, is punishable by a fine of up to \$250,000 (or \$500,000 if the employer is a corporation), or by imprisonment for up to six months, or both. A second conviction of an employer doubles the possible term of imprisonment. Falsifying records, reports, or applications is punishable by a fine of \$10,000 or up to six months in jail or both.

VOLUNTARY ACTIVITY

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

OSHA has published Safety and Health Program Management Guidelines to assist employers in establishing or perfecting programs to prevent or control employee exposure to workplace hazards. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for health such as training.

VOLUNTARY ACTIVITY

Free assistance in identifying and correcting hazards and in improving safety and health management is available to employers, without citation or penalty, through OSHA-supported programs in each State. These programs are usually administered by the State labor or Health department or a State university.

POSTING INSTRUCTIONS

Employees in States operating OSHA approved State Plans should obtain and post the State's equivalent poster.

Under provisions of Title 29, Code of Federal Regulations, Part 1903.2(a)(1) employers must post this notice (or facsimile) in a conspicuous place where notices to employees are customarily posted.

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:

Atlanta, Georgia
Boston, Massachusetts
Chicago, Illinois
Dallas, Texas
Denver, Colorado
Kansas City, Missouri
New York, New York
Philadelphia, Pennsylvania
San Francisco, California
Seattle, Washington

(404) 347-3573
(617) 565-7164
(312) 353-2220
(214) 767-4731
(303) 844-3061
(816) 426-5861
(212) 337-2378
(215) 596-1201
(415) 744-6670
(206) 442-5930

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Lynn Martin, Secretary of Labor
U.S. Department of Labor
Occupational Safety and Health Administration

To report suspected fire hazards, imminent danger safety and health hazards in the workplace, or other job safety and health emergencies, such as toxic waste in the workplace, call OSHA's 24-hour hotline: 1-800-321-OSHA.

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ATTACHMENT H
RESPIRATORY PROTECTION PROGRAM

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H.1 INTRODUCTION. This program was developed to govern the selection and use of respiratory protective devices. The program is intended to comply with OSHA requirements as set forth in 29 CFR 1910.134(b). The scope of this program is limited to activities related to field investigations of potentially hazardous waste disposal sites.

H.2 PERSONNEL REQUIREMENTS. All personnel assigned to field activities at hazardous or potentially hazardous locations are enrolled in the medical surveillance program. This program must include a spirometry test. The test is a measure of the respiratory system status. No personnel may be assigned to the use of or may withdraw from stock any respiratory protective device without a physician's certification that use of the device will not be injurious to health. Psychological limitations (e.g., claustrophobia) are also considered in personnel assignments. Training in the use of the selected device and fit testing, as described herein, are also required.

Personnel will not be assigned duties that require a respirator when facial hair, skullcaps, or eyeglasses will interfere with a proper fit. Contact lenses may not be worn with any respiratory protective device. Eyeglass frames that fit inside the respirator face piece are provided as necessary.

H.3 APPLICABLE EQUIPMENT. ABB Environmental maintains the following respiratory protective equipment:

- full-face chemical/mechanical air-purifying respirators;
- SCBA,
- full-face airline-supplied breathing apparatus, and
- 5-minute escape air supply.

This equipment is intended for use on an as-needed basis, to be determined by an evaluation of onsite conditions. Respiratory protective equipment should not be used arbitrarily by any person. Selection criteria are presented separately; training is required in the use of each type of equipment before drawing from stock.

H.4 PERSONNEL TRAINING. Training of personnel in the proper use and care of respiratory protective equipment is considered essential to the success of the program. Training encompasses the following topics:

- respiratory protection principles,
- selection of appropriate equipment,
- use of equipment,
- maintenance of equipment, and
- fit testing.

Information regarding each topic is presented as standard respiratory protection procedures in the corporate health and safety program manual.

H.5 PROGRAM ADMINISTRATION AND DOCUMENTATION. Administration of the Respiratory Protection Program is the responsibility of the HSM and includes the following:

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- respirator selection,
- personnel training,
- fit testing,
- respirator maintenance,
- documentation,
- program evaluation and improvements, and
- personnel pulmonary testing and certification.

Fit testing and respirator maintenance is performed by the company of the person onsite. All fit-testing and respirator maintenance is conducted under the administration of the HSM. Major maintenance is performed by manufacturer-certified technicians only. Personnel training in respiratory protection is one aspect of the HSM's ongoing personnel training programs. Program evaluation is a dynamic process, occurring each time a project HASP is prepared.

Medical surveillance is required for all personnel assigned to hazardous or potentially hazardous site activities.

Documentation of the various elements of the respiratory protection program is achieved through several media, as follows.

- Documentation of respirator selection is included in the hazard assessment of each site's HASP.
- Documentation of personnel training is maintained in both hard copy and computerized files.
- Documentation of medical surveillance is achieved indirectly by maintaining a list of enrolled employees in the health monitoring program and directly through physician certification of personnel allowed to be assigned respiratory protective devices.
- Using the appropriate form, documentation of fit-testing is maintained on file with the equipment manager of the Sample Control and Staging Center and with the HSM or designee.
- Documentation of site surveillance is required both by this program and by the HASP for each site. Records of site surveillance are created by the HSO and maintained in project files.
- Respirator inspection and maintenance records are created and maintained by the equipment manager for each respirator, SCBA, and escape respirator.

Inspection and documentation occurs either before each unit is removed from stock and when it is returned, or monthly.

H.6 INSPECTION, MAINTENANCE, AND STORAGE.

H.6.1 Introduction Respirator maintenance is an integral part of the overall respirator program. Wearing a poorly maintained or malfunctioning respirator, in one sense, is more dangerous than not wearing a respirator at all. Personnel wearing defective devices think they are protected when, in reality, they are not.

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Emergency escape and rescue devices are particularly vulnerable to poor maintenance because they generally are used infrequently, and then in the most hazardous and demanding circumstances. Serious injury or death can result from wearing a defective device during an emergency escape or rescue. The respirator program includes the following components.

- inspection for defects (including a leak check),
- cleaning and disinfecting,
- repair as required, and
- proper and sanitary storage of equipment.

H.6.2 Inspection for Defects The most important part of a respirator maintenance program is continual inspection of the devices. If properly performed, inspections will identify damaged or malfunctioning respirators before they can be used. Two types of inspections will be performed (1) while the respirator is in use and (2) while it is being cleaned. Because the use and cleaning will be performed primarily by the same personnel, these inspections may become concurrent.

H.6.3 Frequency of Inspection OSHA requires that "All respirators be inspected before and after each use," and that those not used routinely (i.e., emergency escape and rescue devices) "shall be inspected after each use and at least monthly...." Obviously, emergency escape and rescue devices do not require inspection before each use.

H.6.4 Inspection Procedures Respirator inspection will include checking of the following:

- tightness of the connections;
- face piece;
- valves;
- connecting tubes; and
- canisters, filters, or cartridges.

In addition, the regulator and warning devices on a SCBA will be checked for proper functions.

H.6.5 Field Inspection of Air-purifying Respirators Routinely used air-purifying respirators will be checked as follows before and after each use.

1. Examine the face piece for:

- excessive dirt;
- cracks, tears, holes, or physical distortion of shape from improper storage;
- inflexibility of rubber face piece (stretch and knead to restore flexibility);
- cracked or badly scratched lenses in full face pieces;
- incorrectly mounted full face piece lenses, or broken or missing mounting clips;

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- cracked or broken air-purifying element holder(s), badly worn threads, or missing gasket(s).
2. Examine the head straps or head harness for:
- breaks,
 - loss of elasticity,
 - broken or malfunctioning buckles and attachments, and
 - excessively worn serrations on head harness, which might permit slippage (full face pieces only).
3. Examine the exhalation valve for the following after removing the cover:
- foreign material (e.g., detergent residue, dust particles, or human hair under valve seat);
 - cracks, tears, or distortion in the valve material;
 - improper insertion of the valve body in the face piece;
 - cracks, breaks, or chips in the valve body, particularly the sealing surface;
 - missing or defective valve cover; and
 - improper installation of the valve in the valve body.
4. Examine the air-purifying element(s) for:
- incorrect cartridge, canister, or filter for the hazard;
 - incorrect installation, loose connections, missing or worn gasket, or cross-threading in the holder;
 - expired shelf-life date on the cartridge or canister;
 - cracks or dents in the outside case of the filter, cartridge, or canister indicated by the absence of sealing material, tape, or foil over the inlet; and
 - identical cartridges if more than one are used.

H.6.6 Care and Cleaning of Self-contained Breathing Apparatus The proper care of SCBAs involves the following:

- inspection for defects,
- cleaning and disinfecting,
- repair, and
- storage.

The following checklist is to be used by personnel whenever they check out a SCBA. (Note: Any discrepancy found should be cause to set the unit aside until it can be repaired by a certified repairperson.)

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1. Preliminary Inspection. Check to ensure that:
 - high-pressure hose connector is tight on cylinder fitting,
 - bypass valve is closed,
 - mainline valve is closed,
 - there is no cover or obstruction on regulator outlet, and
 - pressure in the tank is at least 1,800 psi.
2. Backpack and Harness Assembly.
 - Straps
 - visually inspect for complete set
 - visually inspect for frayed or damaged straps that may break during use
 - Buckles
 - visually inspect for mating ends
 - check locking function
 - Backplate and Cylinder Lock
 - visually inspect backplate for cracks and for missing rivets or screws
 - visually inspect cylinder hold-down strap and physically check strap tightener and lock to ensure that it is fully engaged
3. Cylinder and Cylinder Valve Assembly.
 - Cylinder
 - physically check cylinder to ensure that it is tightly fastened to backplate
 - check hydrostatic test date to ensure that it is current
 - visually inspect cylinder for large dents or gouges in metal
 - Head and Valve Assembly
 - visually inspect cylinder for presence of valve lock
 - visually inspect cylinder gauge for condition of face, needle, and lens
 - open cylinder valve and listen or feel for leakage around packing (if leakage is noted, do not use until repaired); note function of valve lock
4. Regulator and High-pressure Hose.
 - High-pressure Hose and Connector. Listen or feel for leakage in hose or at hose-to-cylinder connector. (Bubble in outer hose covering may be caused by seepage of air through hose when stored under pressure. This does not necessarily mean a faulty hose.)
 - Regulator and Low-pressure Alarm

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- Cover outlet of regulator with palm of hand. Open mainline valve and read regulator gauge (must read at least 1,800 psi and not more than rated cylinder pressure).
 - Close cylinder valve and slowly move hand from regulator outlet to allow slow flow of air. Gauge should begin to show immediate loss of pressure as air flows. Low-pressure alarm should sound between 650 and 550 psi. Remove hand completely from outlet and close mainline valve.
 - Place mouth onto or over regulator outlet and blow. A positive pressure should be created and maintained for 5 to 10 seconds without any loss of air. Next, establish a slight negative pressure in regulator and hold for 5 to 10 seconds. Vacuum should remain constant. This tests the integrity of the diaphragm. Any loss of pressure or vacuum during this test indicates a leak in the apparatus.
 - Open cylinder valve.
 - Place hand over regulator outlet and open mainline valve. Remove hand from outlet and replace in rapid movement. Repeat twice. Air should escape when hand is removed each time, indicating a positive pressure in chamber. Close mainline valve and remove hand from outlet.
 - Ascertain that no obstruction is in or over the regulator outlet. Open and close the bypass valve momentarily to ensure flow of air through bypass system.
5. Face Piece and Corrugated Breathing Tube.
- Face piece
 - Visually inspect head harness for damaged serrations and deteriorated rubber. Visually inspect rubber face piece body for signs of deterioration or extreme distortion.
 - Retaining clamp properly in place, visually inspect lens for proper seal in rubber face piece, and for cracks or large scratches.
 - Visually inspect exhalation valve for visible deterioration or foreign materials buildup.
 - Breathing Tube and Connector
 - Stretch breathing tube and visually inspect for deterioration and holes.
 - Visually inspect connector to ensure good condition of threads and for presence and proper condition of "O" ring or rubber gasket seal.

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- Perform a negative pressure test on face piece.
 - a. Don backpack and face piece.
 - b. With face piece held tightly to face or face piece properly donned, stretch breathing tube to open corrugations and place thumb or hand over end of connector.
 - c. Inhale. Negative pressure should be created inside mask, causing it to pull tightly to face. This negative pressure should be maintained for 5 to 10 seconds. If negative pressure leaks down, the face piece assembly is not adequate and should not be worn.

6. Storage of Units. Check that:

- cylinder is refilled as necessary and unit is cleaned and inspected
- cylinder valve is closed
- high-pressure hose connector is tight on cylinder
- pressure is bled off high-pressure hose and regulator
- bypass valve is closed
- mainline valve is closed
- all straps are completely loosened and laid straight
- face piece is properly stored to protect against dust, sunlight, heat, extreme cold, excess moisture, and damaging chemicals

H.6.7 Cleaning and Sanitizing Any good detergent may be used, followed by a disinfecting rinse or a combination disinfectant-detergent for a one-step operation. Reliable, effective disinfectants can be made from readily available household solutions, including the following.

- Hypochlorite solution (50 ppm of chlorine) can be made by adding approximately 2 milliliters of bleach (e.g., Clorox[™]) to 1 liter of water or 2 tablespoons of bleach per gallon of water. A 2-minute immersion disinfects the respirators.
- Aqueous solution of iodine (50 ppm of iodine) can be made by adding approximately 0.8 milliliter of tincture of iodine per liter of water, or 1 teaspoon of tincture of iodine per gallon of water. A 2-minute immersion is sufficient to disinfect the respirators.

To prevent damaging the rubber and plastic in the respirator face pieces, the cleaning water should not exceed 140 °F; however, to ensure adequate cleaning, it should not be less than 120 °F.

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H.6.8 Rinsing The cleaned and disinfected respirators should be rinsed thoroughly in water (140 °F maximum) to remove all traces of detergent and disinfectant. This is important for preventing dermatitis.

H.6.9 Drying The respirators may be allowed to dry in room air on a clean surface. They may also be hung from a horizontal wire, like drying clothes; however, care must be taken not to damage or distort the face pieces.

H.6.10 Reassembly and Inspection To avoid contamination, the clean, dry respirator face pieces should be reassembled and inspected in an area separate from the disassembly area. The inspection procedures were discussed previously; special emphasis should be given to inspecting the respirators for detergent or soap residue left by inadequate rinsing. This appears most often under the seat of the exhalation valve, and can cause valve leakage or sticking. The respirator should be thoroughly inspected and all defects corrected. New or retested cartridges and canisters should be installed, and the completely reassembled respirator should be tested for leaks. For SCBA devices, the face piece should be combined with the tested regulator and the fully charged cylinder and an operational check should be performed.

H.6.11 Maintenance and Repair Replacement or repair should be done only by trained, experienced persons using parts designed for the respirator. Besides being contrary to OSHA requirements, substitution of parts from a different brand or type of respirator invalidates approval of the device. This restriction applies particularly to maintenance of the more complicated devices, especially SCBA, and more specifically, regulator valves and low-pressure warning devices. These devices should be returned to the manufacturer or to a trained technician for adjustment or repair. No problems are anticipated in repairing and maintaining most simple respirators, particularly the commonly used air-purifying type.

H.6.12 Respirator Storage Respirators must be stored properly to protect against the following:

- dust,
- sunlight,
- heat,
- extreme cold,
- excessive moisture,
- damaging chemicals, and
- mechanical damage.

Damage and contamination of respirators may occur if they are stored on a workbench; in a tool cabinet or toolbox among heavy tools, greases, and dirt; or in a vehicle.

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ATTACHMENT I

OTHER

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I.1 ILLUMINATION. Site operations will not be permitted without adequate lighting. Therefore, unless provisions are made for artificial light, downrange operations must halt in time to permit personnel and equipment to exit the exclusion zone and proceed through decontamination before dusk. Conversely, operations will not be permitted to begin until lighting is adequate.

I.2 SANITATION. Provisions must be made for sanitation facilities for the site work force. At a minimum, the provision of toilet facilities must meet the requirements of 29 CFR 1910.120(n), which includes one facility for less than 20 employees, or one toilet and one urinal for every 40 employees, up to 200; then one of each for every 50 employees. If it is a mobile crew and they have transport readily available, the requirements do not apply.