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US Army Corps of Engineers

Toxic and Hazardous Materials Agency

FINAL

HEALTH AND SAFETY PLAN

Data Item A009

HAMILTON ARMY AIRFIELD
Novato, California

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Contract DAAA15-88-D-0006
Task Order 12

Prepared for:

Commander
U.S. Army Toxic and Hazardous Materials Agency
Aberdeen Proving Ground, Maryland 21010-5401

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Portland, Maine

November 1990

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HAMILTON ARMY AIRFIELD
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

DRAFT FINAL
HEALTH AND SAFETY PLAN
DATA ITEM A009

CONTRACT NO. DAAA15-88-D-0006

Prepared for:

UNITED STATES ARMY
TOXIC AND HAZARDOUS MATERIALS AGENCY
ABERDEEN PROVING GROUND, MARYLAND

Prepared by:

E.C. JORDAN CO.
PORTLAND, MAINE

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

E.C. Jordan has prepared a Health and Safety Plan for conducting an Environmental Investigation/Alternative Assessment at the base closure portion of Hamilton Army Airfield. This document was prepared under contract to the U.S. Army Toxic and Hazardous Materials Agency, Base Closure Division. The work plan is being developed for the purpose of gathering sufficient information to allow a comprehensive evaluation of the environmental conditions which exist at the base closure portion of Hamilton Army Airfield from a property transfer perspective.

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1.0 GENERAL

1.1 SCOPE AND PURPOSE

The Scope of Work as detailed in the Technical Plan (Data Item A005) and Sampling Design Plan (Data Item A004) for the Hamilton Army Airfield (HAA) is to characterize known and potential environmental problems at numerous sites by conducting confirmation sampling or an Environmental Investigation/Alternatives Assessment (EI/AA). Although HAA is not on the National Priorities List (NPL) under the Comprehensive Environmental Response Compensation, and Liability Act (CERCLA), the EI/AA will be conducted under the approach and terminology of a Remedial Investigation and Feasibility Study (RI/FS).

This Health and Safety Plan (HASP) has been prepared in response to Task Order 12 of Contract DAAA15-88-D-0006 for Field Investigations at HAA. This HASP addresses all those activities associated with the field program at HAA, and is intended to meet the requirements found in 29 CFR 1910.120 and 29 CFR 1910.134. An example respirator protection program which complies with 29 CFR 1910.134 is presented in Appendix D. Compliance with this HASP is required of all personnel, subcontractors, and vendors conducting the studies identified in the HAA Technical Plan and Sampling Design Plan.

1.2 HEALTH AND SAFETY PERSONNEL

The following briefly describes the health and safety designations and general responsibilities which will be employed for the HAA project.

1.2.1 Health and Safety Officer

The EI/AA contractor's Health and Safety Officer (HSO) has the responsibility to implement this site-specific HASP. The HSO will conduct safety inspections, and investigate all accidents, illnesses, and incidents occurring on this site. The HSO will also conduct safety briefings and site-specific training for on-site 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 at the site in response to health and safety issues. The HSO, in consultation with the Health and Safety Manager (HSM), is responsible for updating and modifying this HASP as site or environmental conditions change.

The HSO is vested with the authority to stop site operations (STOP WORK AUTHORITY) if he determines that an imminent health or safety hazard or other potentially dangerous situation exists. The HSO is to immediately notify the HSM and the United States Army Toxic and Hazardous Materials Agency (USATHAMA) Contracting Officer's Representative (COR) of any Stop Work Orders issued. The HSO may also recommend to the HSM or Health and Safety Supervisor (HSS) that investigation area authorization of individual site personnel be revoked for health and/or safety causes.

The HSO, through the HSM or the HSS, assures that all personnel entering the HAA work areas are qualified for investigation area deployment in accordance with 29 CFR 1910.120.

1.2.2 Health and Safety Supervisor

The HSS is the Health and Safety Professional serving as the HSM's designee for this project. As such, the HSS will be responsible for (1) approval of the individuals chosen to serve as the site HSO for this field operation; (2) the review and approval of the site-specific HASPs developed by the HSO as well as any significant changes made over time to the site HASP; (3) overseeing the daily efforts of the HSO; (4) resolving site disputes involving health and safety issues; and (5) assuring the implementation of the HASP by the HSO. The HSS also conducts safety inspection audits at 10 percent of the EI/AA Contractors work sites. The HSS will notify the HSM of any Stop Work Orders issued by an HSO.

1.2.3 Health and Safety Manager

The HSM in concurrence with USATHAMA has final authority to resolve health and safety issues that are not resolved at the site or through the HSS, and has overall responsibility for ensuring that the policies and procedures of this HASP are implemented by the HSO. The HSM may delegate additional functions to an HSS.

1.3 TRAINING

All personnel working in investigation areas must complete all the training required by 29 CFR 1910.120. This training includes 40 hours of initial training, three days of on-the-job training, 8-hour annual refresher training, and, if acting in an on-site supervisory capacity, 8 hours of supervisory safety training. Personnel without the required training will not be permitted to enter the exclusion zone. Certificates of training will be on-site for each person working in the investigation area.

1.4 MEDICAL SURVEILLANCE

All personnel entering potentially contaminated areas of this site must be medically qualified for the site assignment through a medical surveillance program. This program provided by the contractor, consists of an initial medical examination to establish the employee's general health profile and to provide baseline laboratory data for later comparative study. The contents of the physical exam include medical history, medical examination, vision, audiometry, spirometry, and electrocardiogram. The laboratory analysis includes hematology, blood chemistry, and urinalysis. Follow-up examinations are conducted on an annual basis or more frequently if project assignments warrant testing. Personnel who have not received medical clearance will not be permitted to work in the exclusion zone.

2.0 SITE CHARACTERIZATION AND ANALYSIS

2.1 SITE NAME, LOCATION, AND SIZE

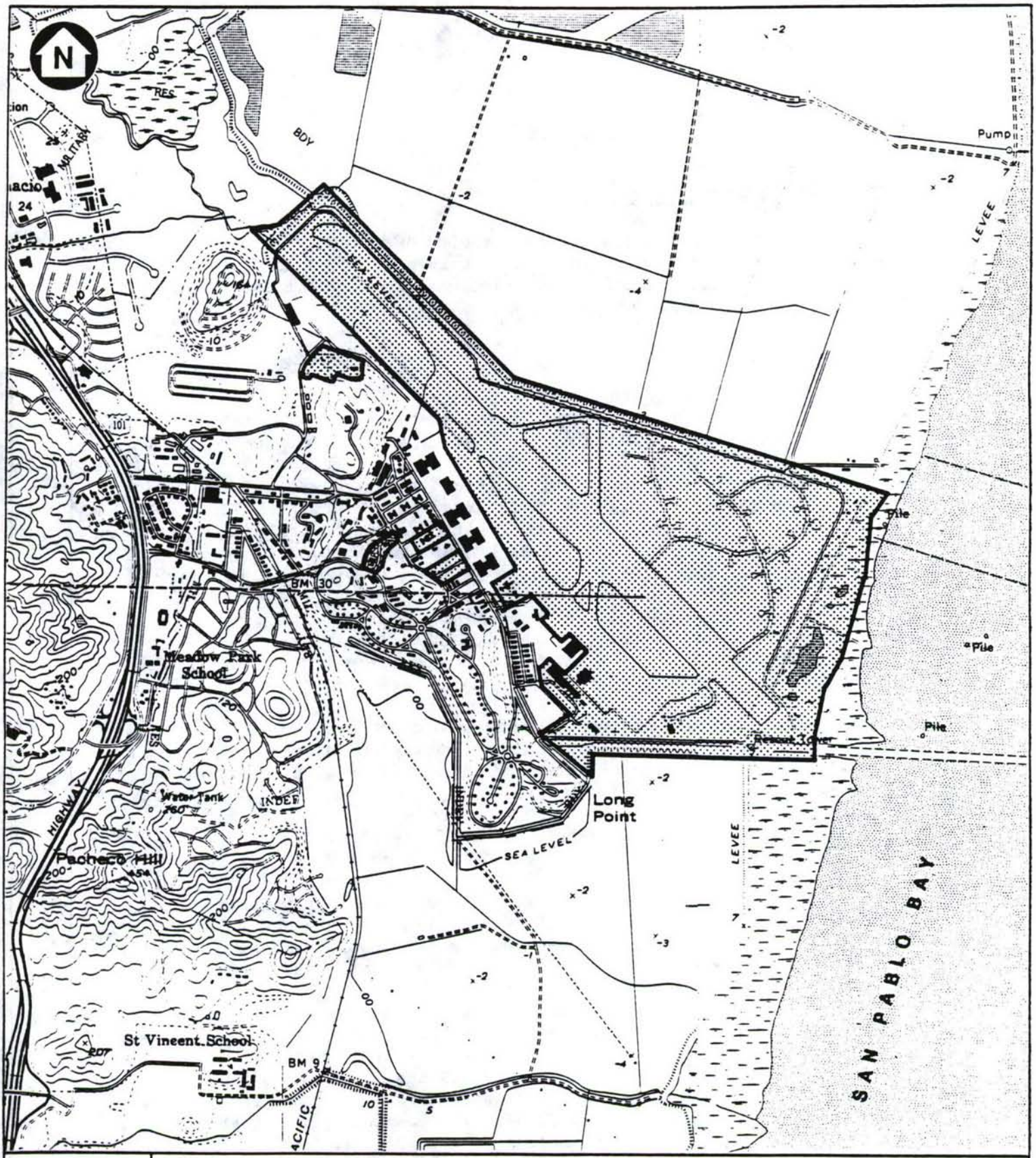
HAA is located in Central California in the city of Novato, Marin County. The combined army properties considered in the field program consist of approximately 700 acres situated on the northwestern shore of San Pablo Bay, approximately 22 miles north of San Francisco (Figure 2-1).

2.2 SITE HISTORY

The property for HAA was acquired from Marin County and private landowners in 1932. The original property was over 2,000 acres in size (Figure 2-2). HAA was opened in 1934 as an Army Air Corps facility to train fighter and bomber pilots and was known as Hamilton Field. Hamilton Field was used extensively during World War II. In 1947, the base was transferred to the U.S. Air Force (USAF) as part of the transfer of aircraft responsibilities from the Army to the USAF and was renamed Hamilton Air Force Base (AFB). Hamilton AFB functioned until 1974, when it was listed as excess property. In 1975, base command by military personnel ceased and civilian managers commenced operation. However, shortly thereafter the Department of Defense withdrew the housing area portion of the base from the excess property listing and designated that portion as the responsibility of the U.S. Navy. In 1976, the Army received permission from the USAF to use the runway and other ancillary facilities for aircraft operation.

Also in 1976, the State of California determined that lands subject to tidal action belong to the State. Consequently, the State of California claimed a portion of the land outside the levees that encircle the site (referred to as "State" properties in Figure 2-2).

From 1976 to 1983, a number of potential uses of the site were proposed by government agencies and private developers. Some plans called for the resumption of air traffic in a civilian capacity; for example, a regional airport. Other plans called for inundating the area and creating an artificial wetland. In 1983, the State courts accepted a plan that allowed for the division of the site. The first property was given the installation number 6160 and included the airfield, a noncontiguous petroleum, oil, and lubricants (POL) area, and other miscellaneous areas. Installation 6160 was transferred to the Army in 1984. The second property was designated Installation 6200 and consisted of three noncontiguous parcels. The three parcels are used primarily for Army Reserve activities. Installation 6200 was transferred to the Army in 1976. The scope of the Base Closure Program originally included only Installation 6160. Installation 6200 was added to the Enhanced Preliminary Assessment (PA) at the request of USATHAMA. The combined properties (Installations 6160 and 6200) total approximately 700 acres.



SOURCE: U.S.G.S. TOPOGRAPHIC MAP 7.5 MINUTE SERIES NOVATO, CALIFORNIA, 1954 AND PETALUMA POINT, CALIFORNIA, 1959, PHOTOREVISED 1980.

CALIF

QUADRANGLE LOCATION

LEGEND

BASE CLOSURE STUDY AREA

SCALE IN FEET

0 2000 4000

FIGURE 2-1
SITE LOCATION MAP
HEALTH AND SAFETY PLAN
HAMILTON ARMY AIRFIELD

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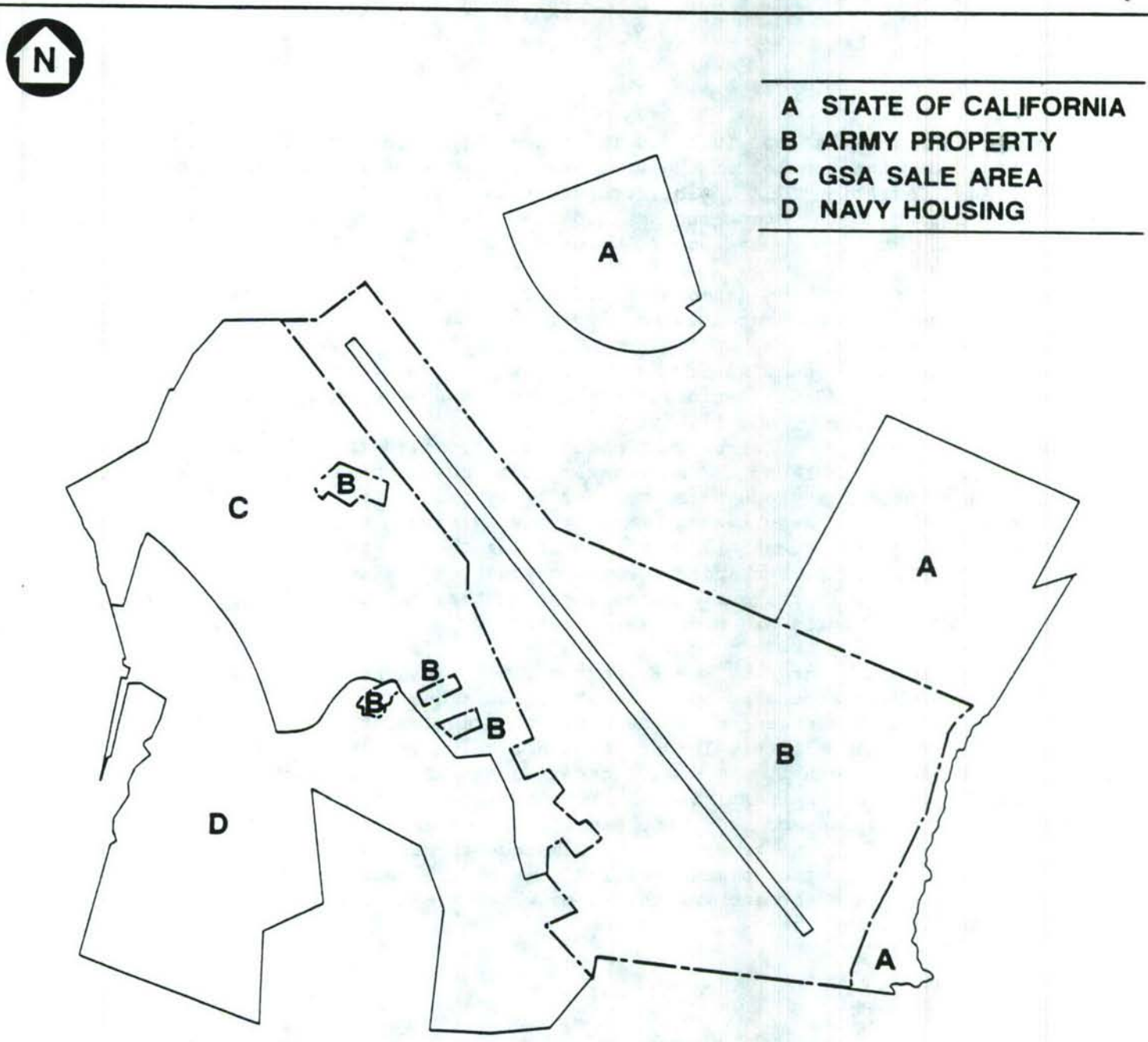

BASE MAP OBTAINED FROM HAMILTON ARMY AIRFIELD "ENHANCED PRELIMINARY ASSESSMENT" PREPARED BY ROY F. WESTON, INC., WESTCHESTER, PENNSYLVANIA, DATED JANUARY 1990.

SCALE IN FEET

0 2000 4000

FIGURE 2-2
AREA LAND OWNERSHIP
HEALTH AND SAFETY PLAN
HAMILTON ARMY AIRFIELD

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The remaining property (not included in this report) consists of approximately 400 acres under the control of the U.S. Army and will be sold by the General Service Administration (GSA). This property includes buffer zones that currently belong to the State and small parcels that belong to the Novato School District, U.S. Navy, and U.S. Coast Guard.

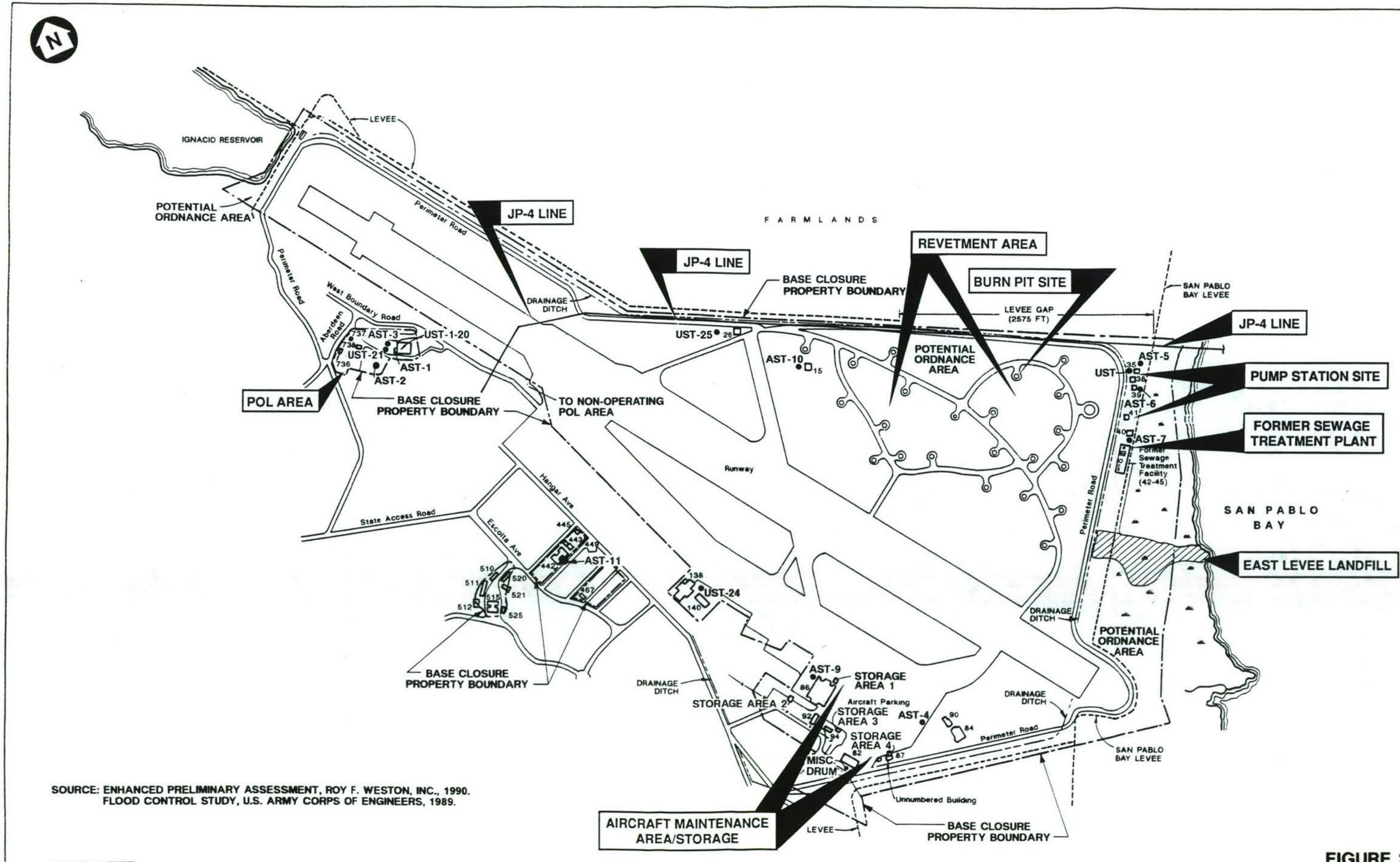
In March 1985, the GSA conducted an auction that resulted in a successful bid by a private developer who wanted to develop light industry and residential housing on the site. However, a landfill (known as Landfill 26) is located on the site, which presented the potential for hazardous waste. Therefore, the U.S. Army Corps of Engineers (USACE) decided that the sale should be halted pending further investigation. Landfill 26, along with its buffer zone consisting of approximately 47 acres of land, was subsequently removed from the sale property. An RI/FS has been completed and a recommendation has been made to cap the landfill and install a groundwater monitoring system. Plans are underway to remediate this site. A subsequent interagency agreement between the USAF and the USACE split the responsibility for resolving the hazardous waste issue at Landfill 26. The USAF is responsible for payment of the investigations at the site, and the USACE is responsible for ensuring that any investigations or subsequent field efforts are properly executed.

The Enhanced PA, conducted by Roy F. Weston, Inc. (Weston), is the latest investigation which addressed environmental conditions at Installations 6160 and 6200 (subsequently referred to as the base closure property or HAA). The Enhanced PA included a site walkover, record review, and interviews with past and present HAA personnel. No environmental sampling was conducted as part of the assessment. Weston identified 12 "Environmentally Significant Operations (ESOs)" or study areas and made recommendations for sampling or survey activities at most of the study areas. Subsequent information obtained during the preparation of project plans modified some of the recommendation made by Weston. A description of each of the sites where field investigation will be conducted is described below.

2.3 SITE DESCRIPTION

Based on information presented in the Enhanced PA and information gathered by E.C. Jordan Co. (Jordan) during a site visit conducted subsequent to the PA, the following 10 sites have been identified as requiring field investigations (Figure 2-3):

- Transformers
- POL Area
- Pump Station Area
- Aircraft Maintenance Area/Storage Areas
- Burn Pit
- JP-4 Line
- Revetment Area



SOURCE: ENHANCED PRELIMINARY ASSESSMENT, ROY F. WESTON, INC., 1990.
FLOOD CONTROL STUDY, U.S. ARMY CORPS OF ENGINEERS, 1989.

SCALE IN FEET
0 1200 2400

FIGURE 2-3
STUDY AREAS
HEALTH AND SAFETY PLAN
HAMILTON ARMY AIRFIELD
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- o East Levee Landfill
- o Former Sewage Treatment Facility
- o Building 442

These study areas are presented as either property-wide investigations or site-specific investigations. Property-wide investigations (Subsection 2.3.1) include transformer sampling. All other investigations are presented as site-specific investigations (Subsections 2.3.2.1 through 2.3.2.10).

2.3.1 Property-wide Investigations

The following sections describe field investigation activities associated with property-wide investigations for PCB transformers and radon.

2.3.1.1 Transformers. Field screening of HAA transformers for polychlorinated biphenyl(PCB)-contaminated dielectric fluid will be necessary during RI activities. If field screening indicates the presence of PCBs, a sample of the cooling oil will be submitted for laboratory analyses. Woodward-Clyde Consultants has tested many transformers on the base, but only 13 of these were within the base closure property (Woodward-Clyde Consultants, 1987). Because there is no other available information on transformers within base closure property and because there are at least 29 additional transformers on base closure property, further field screening for transformers with PCB-contaminated dielectric fluid is necessary. Transformers already sampled during the Woodward-Clyde survey will not be included in this survey. Those transformers to be sampled during this FS survey are identified in the Sampling Design Plan.

2.3.2 Site-specific Investigations

2.3.2.1 POL Area. The POL Area at HAA consists of approximately 7.5 acres located in the north-central part of the base (see Figure 2-3), approximately 1,000 feet southeast of Ammo Hill and at the base of Reservoir Hill. The POL Area is surrounded by GSA Sale Area Property, including Landfill Number 26 to the northwest. The northwestern end of the runway is located approximately 500 feet north of the POL Area. The ground surface at the POL Area is partly paved and partly covered with gravel.

The POL Area contained 21 USTs and several ASTs previously used to store aircraft fuel. The tanks are described in Subsections 2.3.2.1.1 through 2.3.2.1.5. Only one 25,000-gallon AST is currently operational. All of the USTs and one AST were removed in 1986 by IT Corporation (ITC) as part of the POL Area remediation contracted by the USACE. There are three vacant buildings (Building Nos. 736, 737, and 738) at the POL Area which have been used for the temporary storage of waste oil prior to removal by a refuse company. Building 737 remains in use for this purpose. No staining or other evidence of spills or releases was found in the vicinity of the building. Figure 2-4 shows the locations of the former USTs, the former and existing ASTs, and the buildings at the POL Area.

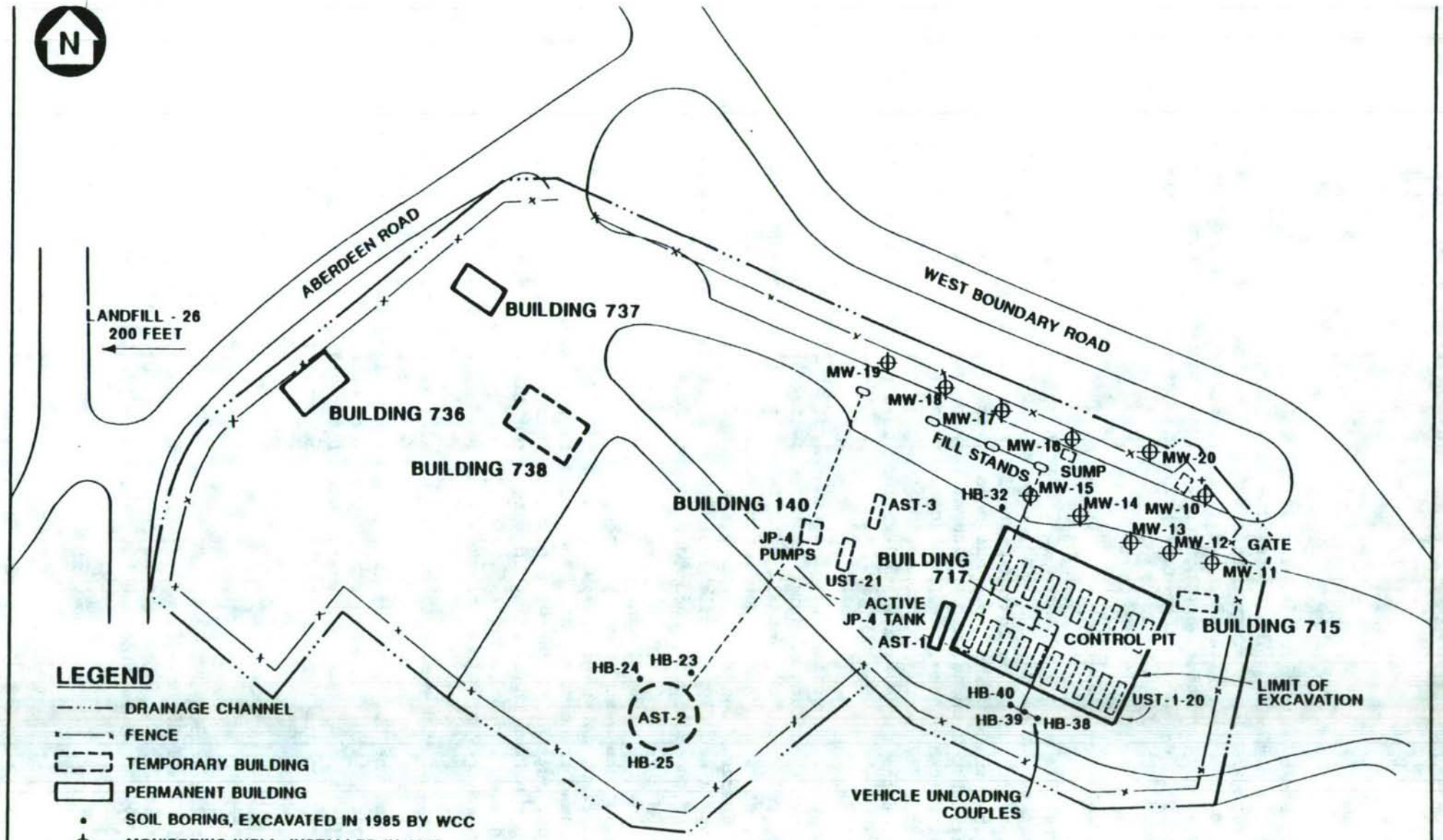

FIGURE 2-4
POL AREA
HEALTH AND SAFETY PLAN
HAMILTON ARMY AIRFIELD

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An investigation and remediation of soils at the POL Area is currently being conducted by the Omaha USACE. Therefore, the field program at the POL Area will focus only on groundwater. A program consisting of boring, monitoring well installation, and groundwater sampling will be conducted to assess groundwater quality and investigate vertical and horizontal groundwater gradients, in-situ hydraulic conductivities and geotechnical properties of the soils and bedrock at the POL Area.

2.3.2.1.1 UST-1 through UST-20

Twenty of the USTs at the POL Area (UST-1 through UST-20) were located in the southeast corner of the POL Area, arranged in two rows of 10 tanks each. The tanks were supported by four 3-foot high concrete strip footings built on the original grade. The tanks had been covered with 20 feet of soil and formed a hill that blended into a natural rock outcrop on both the southeast and southwest sides of the site. A water control pit and water separator house (Building 717) were constructed on the ground directly above this UST area. Each of the tanks were 25,000-gallons in size and contained JP-4 (jet fuel).

In 1986, the USACE contracted for the removal of the POL tanks and subsequent investigations of soils and groundwater in the area. The water control pit, Building 717, and all 20 USTs and associated piping were removed at that time. Eleven monitoring wells were placed downgradient of the excavated area. Contaminated soils with up to 11,000 parts per million (ppm) (489 ppm average) volatile fuel hydrocarbons (VFH) were documented (ITC, 1984) in the following locations at the POL Areas:

- below the removed tanks,
- along the west boundary fence,
- adjacent to the drainage ditch,
- around the meter pad at the truck fill stand,
- just outside of the west boundary fence near the drainage ditch,
- at the sump that collected water from the water control pit,
- adjacent to Building 715, and
- under the upper road truck fill area.

Elevated levels of VFH were detected in groundwater samples, collected from the ITC monitoring wells at the POL Area. MW-13, located immediately downgradient of the UST-1 through UST-20 area contained 600 ppm VFH. Lower concentrations of VFH (0.07 ppm to 1.0 ppm) were detected in MW-11, MW-12, MW-14, and MW-15, all located downgradient of the UST-1 through 20 area. MW-16, located immediately downgradient of the meter pad and several JP-4 lines, had 250 ppm VFH.

2.3.2.1.2 UST-21

UST-21 was a 750-gallon UST in the POL area formerly located 150 feet northwest of USTs 1-20 (see Figure 2-4). The age and material of UST-21 is unknown (Weston, 1990). The contents are thought to have been JP-4. UST-21 was removed by ITC as part of the POL remediation in 1986. No soil staining

was observed upon excavation of the tank and VFH were not detected above 10 ppm in the soil samples collected from beneath the tank. Another sample collected from the area was analyzed for organic lead, and none was detected above the 0.3 ppm detection level. The excavation was backfilled with clean material (Weston, 1990).

2.3.2.1.3 AST-1

AST-1 is an active 25,000-gallon JP-4 storage tank located immediately north of the former location of USTs 1-20 (see Figure 2-4). This tank is used to refuel the aircraft which currently use HAA. There have been no documented spills or leaks from this tank.

2.3.2.1.4 AST-2

AST-2 was an 840,000-gallon JP-4 bulk storage tank which was located above the POL Area on a ridge (Reservoir Hill) and was removed in 1986 (see Figure 2-4). AST-2 received fuel through a 6-inch-diameter pipe and a pump station located below the ridge near AST-1.

Leaks from AST-2 were known to have occurred, although there was not evidence of soil discoloration beneath the tank during excavation. Following tank removal, 10 trenches were dug to bedrock north and west of where the tank had been located. A total of 27 soil samples were collected, and of these, five samples contained VFHs at levels exceeding 1,000 ppm. Two of the contaminated samples were collected from areas immediately downgradient of a 3-inch-diameter drain valve located on the west side of the tank, indicating that there had been a leak or spill from the drain valve. The spill was thought to have been contained within the bermed area. Five contaminated soil samples were collected near the concrete drain box, located west of AST-2. Contaminated soils and clay-filled rock fractures were not removed but were buried in place with clean material at the direction of the USACE (Weston, 1990). Remediation of this area is currently underway with a fall 1990 completion date.

2.3.2.1.5 AST-3

The area referred to as AST-3 includes several 55-gallon drums, a 600-gallon AST, and a 2500-gallon AST, all of which are now reportedly empty (Weston, 1990). Also associated with AST-3 are approximately 10 55-gallon full drums from Storage Area 2 which are stored in a concrete-lined truck ramp with no drains. The drums are removed annually by an outside contractor (Weston, 1990). There have been no documented leaks or spills from any of the tanks or drums referred to as AST-3.

2.3.2.2 Pump Station Area. The Pump Station Area is located on the east side of HAA between Perimeter Road and the east levee (see Figure 2-3). It includes Buildings 35, 39, 40, and 41, which house and support three stormwater pumps used to pump runoff from HAA into San Pablo Bay.

The stormwater pumps are located in Buildings 35, 39, and 40, with the pump in Building 39 operating automatically and those in the other buildings operating manually. An aboveground diesel storage tank is associated with each of the three pumphouses (ASTs 5, 6, and 7) and an inactive UST is located immediately north of Building 35. The UST is also assumed to have been used for diesel but this could not be confirmed. Beneath the south end of AST 5, located adjacent to Building 35, is a several-square-foot area of discolored soil and distressed vegetation where a spill of diesel apparently occurred. There is staining at the bases of ASTs 6 and 7 located adjacent to Buildings 39 and 40, respectively. During their site visit, Jordan also observed a visibly stained soil stockpile of approximately 75 cubic yards located on plastic sheeting adjacent to the north side of Building 41. According to HAA, this material is fuel-contaminated soil stockpiled during remediation of a leaking tank associated with one of the pumphouses.

Storm runoff from HAA and surrounding areas is pumped to the tidal wetland area east of the east levee via a separate outfall pipe for each stormwater pump. Each outfall pipe discharges to a separate shallow depression in the wetland that has been lined with concrete to minimize erosion. The combined discharge capacity for the three pumps is greater than 100,000 gallons per minute.

No soil sampling or groundwater monitoring has been conducted in the vicinity of the pumphouses. A program of surface and subsurface soil sampling, groundwater monitoring, and sediment sampling in the pump discharge basins will be conducted to characterize and determine the extent of contamination in this area.

2.3.2.3 Aircraft Maintenance Area/Storage Areas. The aircraft maintenance area and associated storage areas are located at the southern end of HAA, adjacent to a paved aircraft parking area (Figure 2-5). The area includes Building 86, the adjacent aircraft maintenance areas, and four separate materials storage areas. Aircraft maintenance, repair, and washing and the storage of maintenance fluids are the main activities that have occurred in the area. The potential exists for releases of aircraft-related oil, fuel, or cleaning solvents to have occurred during these activities.

Although spills or releases have not been documented in this area, the quantities of hazardous materials present and typical waste handling practices of the past suggest that it is likely that releases have occurred. No previous sampling has been conducted in the area.

A program consisting of borings, monitoring well installations and groundwater sampling, surface soil sampling, surface water sampling, and storm drain sediment sampling will be conducted to characterize and determine the extent of contamination in these areas. A description of each study area is described below.

2.3.2.3.1 Building 86

Building 86 is the last hanger on base closure property being used for the maintenance of aircraft at HAA. Light maintenance of aircraft occurs inside the hanger and in the adjacent areas. Two of the four materials storage

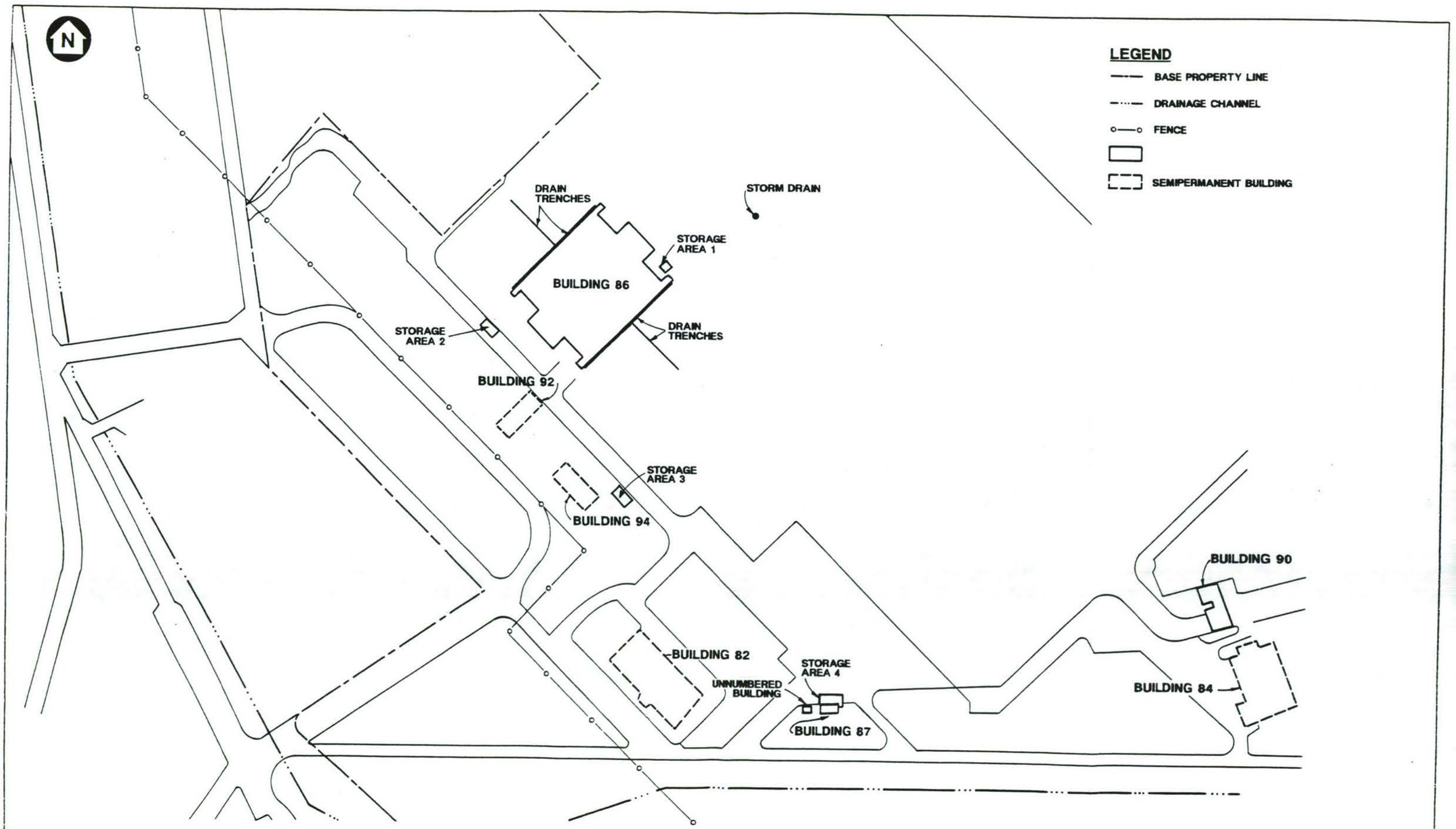

FIGURE 2-5
AIRCRAFT MAINTENANCE AREA/STORAGE AREAS
HEALTH AND SAFETY PLAN
HAMILTON ARMY AIRFIELD

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areas are located next to Building 86. Storage Area 1 is located on the northeast side of Building 86 and Storage Area 2 is located a short distance southwest of the building. Pavement that is contiguous with the airfield surrounds Building 86, but Storage Area 2 is located in a gravel area that begins a short distance to the southwest. The hanger has a concrete floor with trench floor drains, located at the bay doors, that discharge into the storm sewer. Additional storm drains are located throughout the paved aircraft parking area.

A flammable materials locker and at least one recirculating solvent parts cleaner are located inside Building 86. The locker contains POL, paint, and spray cans in one gallon or smaller containers and includes a well at the bottom of the locker to contain potential spills. The parts cleaner uses PD-680 solvent that is contained in an estimated 35-gallon tank within the unit. The parts cleaner is reportedly used daily. Waste material from activities at building 86 is taken to Storage Area 2 by Army personnel.

2.3.2.3.2 Storage Area 1

Storage Area 1, on the northeast side of Building 86, is a drum storage area with nine 55-gallon drums placed horizontally on metal storage and dispensing racks. The drums present during Jordan's site visit were labeled as containing aircraft and engine cleaning compounds and PD-680 solvent (Jordan, 1990). Drip pans were positioned under the drums to contain drips and small spills but not the contents of an entire drum.

2.3.2.3.3 Storage Area 2

Storage Area 2, located southwest of Building 86, is a waste materials storage area consisting of approximately 12 55-gallon drums and several smaller containers. Stored materials include waste oil, waste fuel, and other maintenance related fluids. The materials are currently stored within a CONEX container that rests on a gravel surface and is surrounded by a berm.

2.3.2.3.4 Storage Area 3

Storage Area 3, northeast of Building 94, is used for the storage of maintenance-related fluids. Five metal CONEX containers are located on broken asphalt pavement. The contents of the sheds (according to Weston (1990)) are as follows:

- POL and spray cans; largest container is 5 gallons; total material estimated to be 100 to 150 gallons.
- Diesel and MoGas fuel in 5-gallon cans; 10 cans total.
- Paint, isopropyl alcohol; largest container 5 gallons; estimated total material is 200 to 300 gallons.

- o Paint, spray cans, ethyl glycol, denatured alcohol, naptha, toluene, methyl ethyl ketone, corrosion resistant compound; estimated total materials at 150 to 200 gallons.

- o One 55-gallon drum cleaning compound.

2.3.2.3.5 Storage Area 4/Building 87

Storage Area 4, located just off the southeastern end of the aircraft parking area, consists of Building 87, a small unnumbered building, and a CONEX container. Building 87 is surrounded by 55-gallon drums on a gravel surface. Contents of the 55-gallon drums are as follows: two 55-gallon drums of PD-680; two 55-gallon drums of aircraft cleaning compound, and two 55-gallon drums of turbine engine cleaner. Several empty drums are also present. Drip pans are present under drums to contain drips. Stains were visible on the ground surface.

Building 87 has a concrete floor and no floor drain. No curb at the door exists. The building is divided into two rooms by a cinderblock wall. Flammables, mainly paint, are stored on one side of the building in containers up to 5 gallons is size. Stored on the other side of the building are oil, grease, antifreeze, solvent, and aircraft cleaning compound in containers no larger than 5 gallons in size. Only packaged (unopened) products are stored within this building. A metal CONEX is located just north of Building 87 and contains approximately 15 5-gallon cans of unleaded gasoline. No curb or other containment is provided. The small, unnumbered, red wooden shed reportedly contains tires and parts.

2.3.2.4 Burn Pit. The burn pit is located in the east corner of the revetment area at aircraft staging pad number 10 which is located approximately 400 feet south of Perimeter Road (see Figure 2-3). The burn pit, approximately 100-feet in diameter, is a paved pad. The adjacent unpaved areas appear to have been impacted by site activities.

The burn pit was used for firefighter training activities from 1975 to 1987 (Weston, 1990). During that period, fuels and/or solvents as well as vehicles were placed on the pad and burned to provide training. In 1987, the pit was rebermed with clean fill, but no liner was installed, and the pit was never used. The east side of the pad is stained black. Earth moving activities have spread contaminated soil beyond the paved area. The pavement is broken by expansion joints which may provide a migration pathway to the subsurface.

In June, 1986, three soil borings were drilled at the burn pit (Woodward-Clyde, 1987) (Figure 2-6). Boring HB-88 was drilled through the northwest side of the pad to 11 feet below ground surface (bgs). Borings HB-89 and HB-90 were drilled northeast and south of the pad, respectively, each to 10.5 feet bgs. HB-89 was drilled through the black stain. Soil samples were collected at depths of 1, 3, 6, and 9 feet bgs in each boring, with the exception that no sample was taken at 9 feet bgs from HB-89. Soils were analyzed for petroleum hydrocarbons and polynuclear aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), and 13 metals. Sample HB-88-1 (at one foot bgs) contained high concentrations of

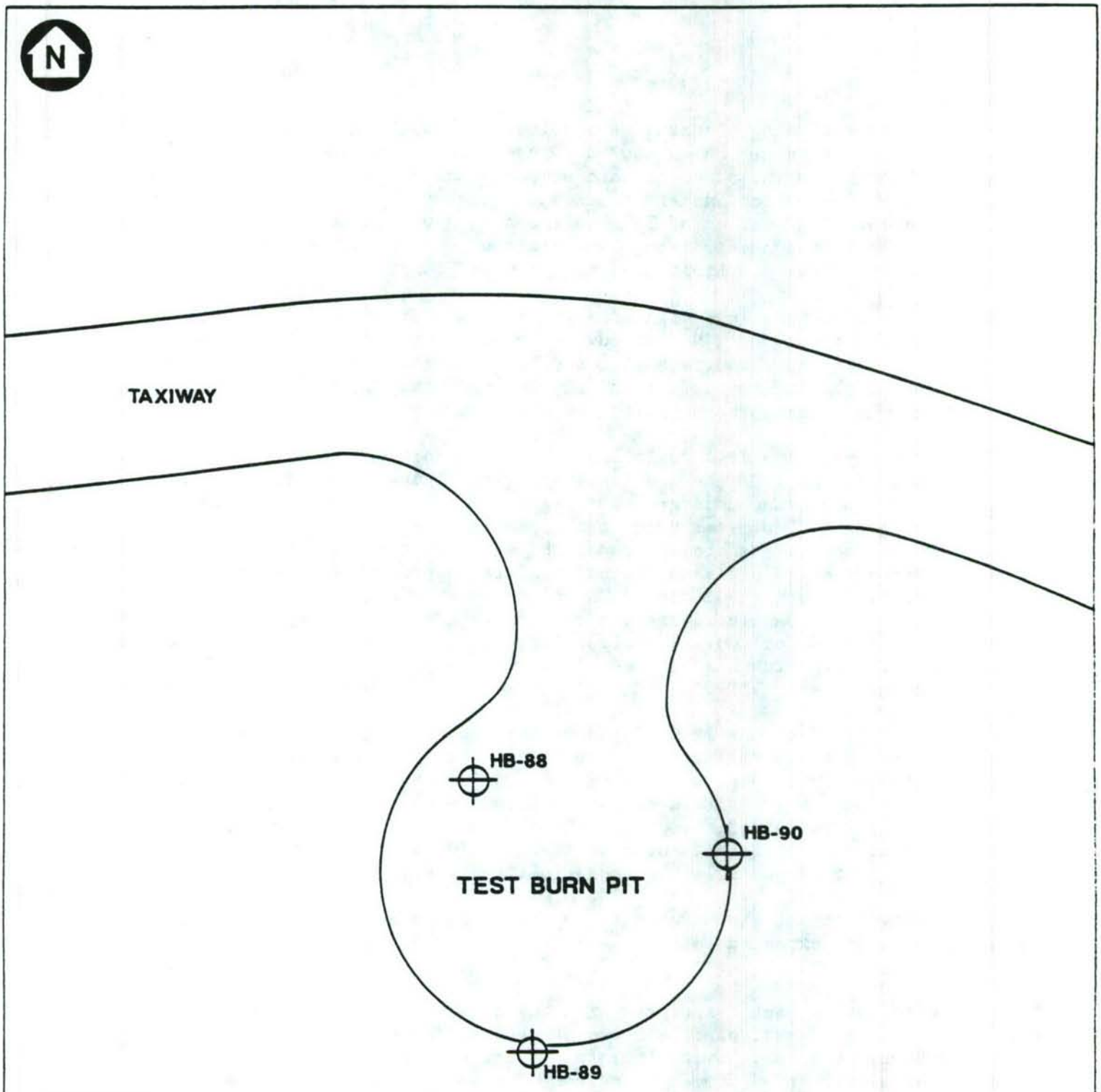

FIGURE 2-6
BURN PIT SITE
HEALTH AND SAFETY PLAN
HAMILTON ARMY AIRFIELD

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diesel #1, kerosene, ethyl benzene, and toluene, as well as a lower concentration of benzene. HB-89 and HB-90 contained high concentrations of methylene chloride but no other organic compounds at all depths, with the exception of HB-90-3 which instead contained kerosene. No PAHs were detected in any of the samples. Thirteen of 19 metals analyzed were detected, with iron being the highest in concentration. No metals were found at levels above California Total Threshold Limit Concentrations (TTLCs).

Although soils have been investigated at this site, further soil characterization is needed. No groundwater monitoring has been conducted. A program of surface and subsurface soil sampling, monitoring well installations, and groundwater quality investigation will be conducted at this site to determine to what extent the soils and groundwater have been impacted.

2.3.2.5 JP-4 Line. The JP-4 fuel line enters the northeast corner of the base from the unloading pier in the San Pablo Bay (see Figure 2-3). The 6-inch inside diameter pipe runs underground along the northern property boundary, immediately south of Perimeter Road, for approximately 6,500 feet to where it turns to the southwest and crosses under the airfield runway. It ends at the former POL area located off base-closure property approximately 500 feet southeast of the existing POL area. The pipe runs above ground for approximately 10 feet as it enters the culvert that runs beneath Perimeter Road and the airfield and for approximately 50 feet at the pump station near the east end of HAA. The pipeline has not been in use since 1975 and its installation date is unknown (Weston, 1990).

No leaks or spills from the JP-4 line have been documented and no previous investigations of the pipeline have been made. The JP-4 line is a concern because of the potential for leakage of JP-4 fuel to soils and groundwater anywhere along its length within the base-closure property. Leaking pipe joints or general deterioration of the pipe could result in the release of contaminants to the environment. It is not known if the pipeline was emptied when taken out of service, but it is possible that some fuel remains in the line.

It is not known whether groundwater is anywhere in contact with the pipeline, but groundwater is expected to exist within 10 feet of the ground surface in this area.

The suspected contaminant associated with the pipeline, JP-4 jet fuel, is a mixture of aviation gas (volatile hydrocarbons) and kerosene (semi- and non-volatile components). Over time, the volatile components dissipate, degrade, and migrate away from the source. The semi- and non-volatile components are less mobile and degradable. The pipeline is essentially a long linear potential source of contamination that is both mobile and immobile. No soil or groundwater monitoring have been conducted at the site. A ground-penetrating radar survey will be conducted in the area assumed to be housing the pipeline in order to more precisely define the location and depth of the pipeline. Soil gas samples will be taken along the length of the pipeline to determine if leakage from the JP-4 line has occurred.

2.3.2.6 Revetment Area. The revetment area occupies approximately 200 acres in the eastern corner of HAA (Figure 2-7). It consists of 24 paved, circular aircraft parking pads roughly 100 feet in diameter connected by taxiways. The pads are spread out to reduce potential aircraft loses from an air assault. The revetment area has been out of active service since 1974 (Weston, 1990). Currently, the area is used during an annual air show, army drill sessions, and police auto and cycle training.

As an active revetment area, routine aircraft maintenance was performed and, according to interviews with past employees, waste oils were spilled onto the ground (Weston, 1990). Mobile fuel trucks also refueled aircraft in the revetment area. One enlarged pad (No. 6) was used as a jet engine test cell and has a large bolt in the center to which engines were anchored. Another pad (No. 10) was used as a burn pit for the purposes of fire training. A description of that site, which is considered separately, is provided in Subsection 2.3.2.5. In 1986, the taxiways were used to aerate soils removed during various tank excavations. The taxiways were bermed and lined with visqueen. Soils contaminated with petroleum hydrocarbons greater than 100 ppm were spread 12 inches thick and physically manipulated and aerated until the target level of 100 ppm total petroleum hydrocarbons (TPH) was achieved, and then were used to backfill the tank excavations (Weston, 1990).

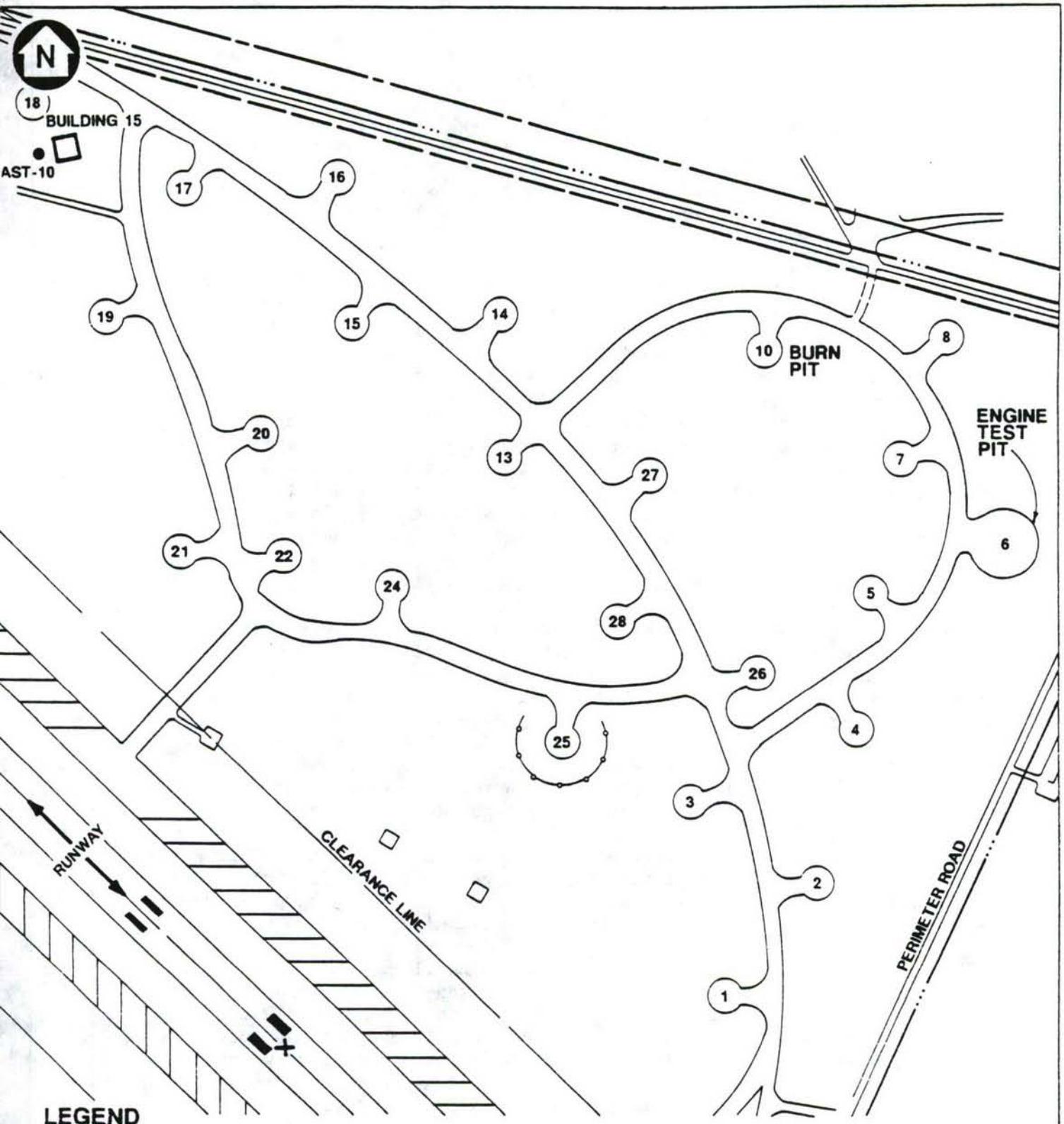
No previous investigations have been conducted at the revetment area (except at the burn pit) beyond visual inspection during Jordan's site visit. Groundwater flow directions and depth to water are not known, however, water was found at approximately 9 feet in the three borings drilled at the burn pit. Depth to bedrock is not known.

Because of potential fuel spills and suspected waste oil dumping in the area, the revetment area needs further characterization. No previous soil or groundwater monitoring have been conducted at the revetment area.

A program that includes monitoring well installation, test pitting and surface soil sampling around the engine test pad will be conducted. Surface soils will also be sampled at each of the parking pads (excluding the burn pit and engine test pad) to assess the nature and extent of contamination.

2.3.2.7 East Levee Landfill. The East Levee Landfill is located along the eastern side of the site, within the intertidal zone of San Pablo Bay. The landfill is approximately 2500 feet long, and is bordered by wetlands to the north and south, by San Pablo Bay to the east, and by the base perimeter levee to the west (see Figure 2-3). Part of the landfill is on State-owned property. Ninety percent of the landfill is below mean sea level during periods of high tide, therefore landfill soils are continually saturated (Weston, 1990).

The landfill was used primarily for the disposal of construction debris, beginning around 1961 (Weston, 1990). A site on the State-owned portion of the landfill was used as a burn pit (Woodward-Clyde Consultants, 1987). The debris layer ranges from 2 to 6 feet thick and includes sticks, logs, lumber, concrete, asphalt, bricks, metal, and small amounts of glass and plastics (Woodward-Clyde Consultants, 1987). The debris layer is overlain by a 6-inch to 2-foot thick



LEGEND

- BOUNDARY OF BASE CLOSURE PROPERTY
- DRAINAGE CHANNEL
- EXISTING FENCE
- JP-4 FUEL LINE
- (10) REVETMENT AREA
- AST-10 ABOVEGROUND STORAGE TANK NO. 10

SCALE IN FEET

0 400 800

FIGURE 2-7
REVETMENT AREA
HEALTH AND SAFETY PLAN
HAMILTON ARMY AIRFIELD

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cap of stiff-to-hard brown sandy clay with gravel and concrete. The easternmost tip of the landfill extends approximately 150 feet into the bay and contains large pieces of concrete, steel, and asphalt, forming a riprap barrier for the landfill (Woodward-Clyde Consultants, 1987). Both the landfill and cap materials overlie bay mud, which is a medium- to highly-plastic silty clay of low permeability.

Woodward-Clyde Consultants conducted an investigation into the soils at the East Levee Landfill in 1985. They completed and logged 19 exploratory trenches, each 15 to 20 feet long, and collected a total of 36 composite soil samples from 15 of these trenches. The soil samples were analyzed for PCBs, VOAs, SVOAs, cyanide, organochloride pesticides, petroleum hydrocarbons, and metals (Woodward-Clyde Consultants, 1987). The analytical results indicate the presence of heavy-end petroleum hydrocarbons (i.e., motor oil and C21-C36), 1,1,1-trichloroethane (1,1,1-TCE), and polynuclear aromatic hydrocarbons (fluoranthene and phenanthrene) in a limited number of samples (Woodward-Clyde Consultants, 1987). Fourteen metals were detected in the soil samples in trace to minor concentrations (Woodward-Clyde Consultants, 1987). Included were arsenic, barium, chromium, copper, lead, molybdenum, nickel, vanadium, zinc, and boron. Iron was present in the highest concentrations and was most pervasive. Woodward-Clyde Consultants concluded that the low concentrations of a few hydrocarbons and other chemicals represented only limited contamination at this site (Woodward-Clyde Consultants, 1987).

Soils have been investigated at this site, however, no groundwater monitoring has been conducted. A program consisting of borings, monitoring well installation, groundwater sampling, and landfill gas monitoring will be conducted to assess environmental impact. Geotechnical properties of the soils, in-situ hydraulic conductivities, horizontal groundwater gradients and the influence of tides on groundwater levels will also be investigated.

2.3.2.8 Former Sewage Treatment Facility. A former Sewage Treatment Plant (STP) was located on the east side of HAA between Perimeter Road and the east levee (see Figure 2-3). The STP provided primary and secondary treatment in aboveground concrete tanks. Only sanitary wastes were presumably treated at the STP (Weston, 1990). Non-specific chemicals, including coagulants, were used in the treatment process. The STP operated until 1986, at which time all sanitary wastes were pumped to the Novato Sanitation District (Weston, 1990). Sometime between 1986 and 1987, all of the buildings were demolished (USEPA, 1990). No USTs or ASTs remain at the STP (Weston, 1990). The outfall pipe extending from the levee to the bay (approximately 1000 feet) still exists (Jordan, 1990). During their site visit, Jordan observed a black sludge-like fungus associated with surface seeps at two locations near the STP (Jordan, 1990, Figure 2-8).

In 1985, soil samples were collected at the STP. One soil boring was completed in each of the three sludge drying beds (HB-95, HB-96, and HB-97) to a depth of 10.5 feet bgs. Four soil samples were collected from each boring, at depths of 2, 4, 6, and 9 feet bgs. In addition, one surface soil sample was collected from each of the three active sludge drying beds (HSC-1, HSC-2, HSC-3). Each sample was a composite from three points on the bed.

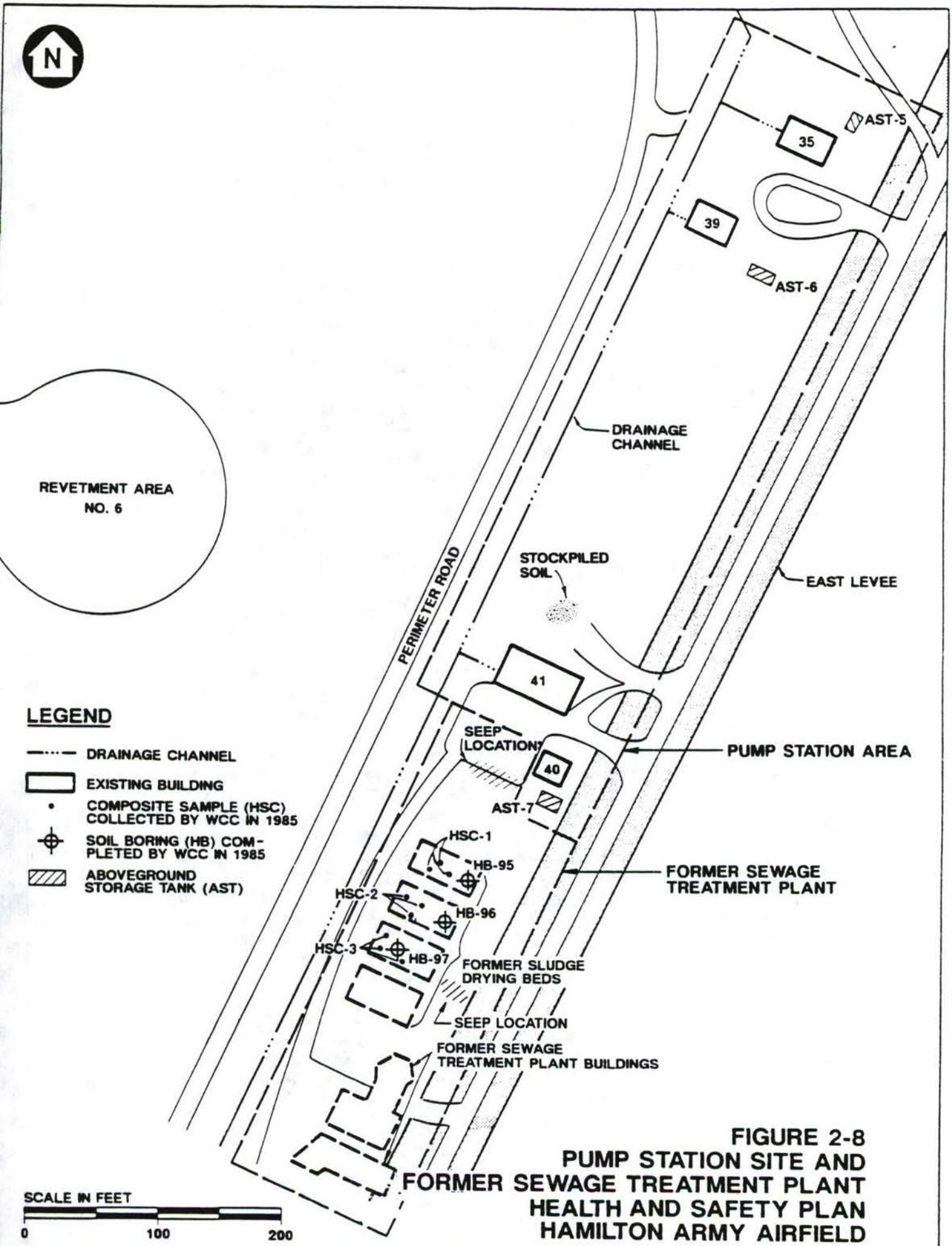

FIGURE 2-8
PUMP STATION SITE AND FORMER SEWAGE TREATMENT PLANT
HEALTH AND SAFETY PLAN
HAMILTON ARMY AIRFIELD

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In general, the results indicate that the composite surface soil samples contained more analytes and higher concentrations than did the subsurface soil samples (Woodward-Clyde Consultants, 1987). This pattern is indicative of the presence of STP filter cake material on the sludge drying beds. The processing typically concentrates heavy metals while removing volatile and semivolatile compounds (Woodward-Clyde Consultants, 1987). The concentrations of metals detected in the soil samples were below the California Total Threshold Limit Concentration (TTLC) for Biological Accumulative and Environmentally Persistent Compounds criteria (Woodward-Clyde Consultants, 1987). In the case of three metals (chromium, mercury, and silver), levels detected did exceed California's designated levels for the protection of marine environments and/or surface water, but were below designated levels for protection of groundwater. No background soil samples are available for comparison.

Although soils have been investigated at this site, no groundwater monitoring has been conducted. A program consisting of boring, monitoring well installation and groundwater sampling beneath the former STP sludge drying beds including on-site hydraulic conductivity and geotechnical soil property investigations, as well as sediment and surface water sampling at the two observed seep locations will be conducted to assess groundwater and seep water quality.

2.3.2.9 Building 442. An approximately 500-gallon tank (AST 11) is located adjacent to Building 442 (see Figure 4-1). The tank is currently inoperative and contains approximately 300 to 400 gallons of diesel fuel (Jordan, 1990b). AST 11 was used to store fuel that powered emergency generators for Building 442. It has been reported that diesel fuel from AST 11 has been observed in the utility trench adjacent to the tank.

No previous investigations have been conducted at AST 11. A program consisting of soil gas and surficial soil sampling will be conducted to determine contamination associated with AST 11.

2.4 HAZARDOUS SUBSTANCES/CONDITIONS

Appendix A lists the hazardous compounds detected or believed to be present at HAA. The major potential chemical hazards identified at HAA, which will be of concern during the RI investigation are:

- Inhalation of VOCs during soil boring, monitoring well installation, test pit excavation, and soil/groundwater sampling. VOCs have been detected at many of the sites.

- Dermal absorption or ingestion of PCBs during soil/material sampling at the potentially PCB-contaminated sites. These sites include the PCB drum site and all PCB transformers.

- Dermal adsorption, eye and skin contact, ingestion and respiration of metals at the burn pits, Former Sewage Treatment Facility, and the East Levee Landfill. Antimony, arsenic, barium, boron, cadmium, chromium

cobalt, copper, iron, lead, mercury, molybdenum, nickel, selenium, silver, vanadium, and zinc have been detected in soil samples.

- Inhalation of VOCs and dermal adsorption of petroleum hydrocarbons, solvents, and/or other chemicals from the POL area, the Pump Station Area, the Aircraft Maintenance Area/Storage Areas, the Burn Pit, the JP-4 line, the Revetment Area, and the East Levee Landfill.

Some physical hazards also exist for the RI field work at HAA. Most important are:

- drilling and test pitting operations involve potentially hazardous heavy equipment.

Specific health hazards associated with each site are presented in Section 2.6.

2.5 INITIAL SITE ENTRY

2.5.1 Initial Level of Protection

The initial level of protection for all sites is Modified Level D. When invasive activities (e.g., drilling or test pitting) are conducted, the level of protection will be as described in Section 4.3.3.

2.5.2 Initial Monitoring

Where the development of site information shows the potential for (or is unable to rule out the possibility of) "immediately dangerous to life or health" (IDLH) conditions, initial monitoring will consist at a minimum of air monitoring using such devices as a combustible gas indicator, oxygen meter, and photoionization detectors. It is intended that real-time monitoring instrumentation will be used to assist in the determination of the appropriate level of protection for the initial site entry team.

2.6 SITE RISKS

2.6.1 General Site Hazards

In addition to the site-specific hazards discussed in the following section, the following items apply to all sites.

- Heavy equipment necessary for excavation, drilling, etc. is potentially hazardous.

- Underground utilities may be present in many areas.

2.6.2 Specific Site Hazards

The site-specific hazards for each of the study areas/activities is presented below.

2.6.2.1 Asbestos. Asbestos containing materials are present in most of the buildings at HAA. A survey conducted by Occusafe, Inc. identified the asbestos containing structures and their associated health risks. No buildings were identified as having significant health risk. Therefore, based on the survey, it is expected that the asbestos respiratory risk will be minimal.

2.6.2.2 Transformers. The sampling of transformers poses the risk of dermal exposure to PCB containing fluids. Physical hazards are expected with sampling of pole mounted transformers.

2.6.2.3 Radon. The underlying geology of HAA consists mostly of sandstones. Radon is not expected to be present at significant amounts in this bedrock formation. No physical hazards are expected.

2.6.2.4 POL Area. Health hazards in this area will involve potential inhalation and dermal contact with VOC and non-VOC fuel compounds during borings and installation and sampling of groundwater wells. Previous investigations have detected the presence of VFHs and semi- and non-volatile fuel hydrocarbons. Specific chemicals detected are benzene, toluene, xylene, dichloromethane, bromodichloromethane, delta BHC, and trans-1,2-dichloroethylene. There is also a potential for inhalation/dermal contact with metals during investigative activities. Metals detected include barium, boron, chromium, copper, iron, nickel, silver, vanadium, and zinc. Physical hazards are present associated with work around heavy equipment for drilling.

2.6.2.5 Building 442. Chemical hazards in this area involve exposure to petroleum hydrocarbons during soil boring and sediment or water sampling in the utility trench. Leakage of fuel into the utility trench has been reported.

2.6.2.6 Pump Station Area. Chemical hazards in this area involve exposure to petroleum hydrocarbons during borings, monitoring well installation and sampling, and soil and sediment sampling. Surface soil staining has been reported under some of the ASTs. Physical hazards present include work near heavy equipment and sediment sampling of the outfall.

2.6.2.7 Aircraft Maintenance Area/Storage Areas. Chemical hazards at this area involve exposure to petroleum hydrocarbons, solvents, and other parts cleaning compounds, methyl ethyl ketone and other chemicals. Chemical stains were visible on the ground surface at Storage Area 4. Physical hazards include working near heavy equipment and sampling storm drain sediments.

2.6.2.8 Burn Pit. The potential exists at this area for exposure to VOCs including ethylbenzene, toluene, methylene chloride and benzene. Petroleum hydrocarbons detected include diesel, kerosene, jet fuel, motor oil and C10, C11-C20 and C21-C36. Potential inhalation/dermal contact with metals also exists. Metals detected include arsenic, barium, boron, chromium, cobalt, copper, iron, lead, molybdenum, nickel, selenium, vandium, and zinc. Physical hazards will be associated with work near heavy equipment during borings and monitoring well installation.

2.6.2.9 JP-4 Line. Potential exposure to petroleum contaminated soils is the hazard associated with this area. No previous investigations have been conducted associated with the JP-4 Line.

2.6.2.10 Revetment Area. Routine aircraft maintenance reportedly resulted in the spilling of waste oils and aircraft fuels on and around the aircraft parking pads. Surface soils sampling and test pitting activities pose a risk of exposure to petroleum contaminated soils. Physical hazards are associated with working around the backhoe used for test pitting.

2.6.2.11 East Levee Landfill. Previous investigations have shown the presence of petroleum hydrocarbons, 1,1,1-trichloroethane, fluoranthene, and phenanthrene as well as various metals. These chemicals pose a hazard associated with inhalation and dermal contact. Physical hazards are associated with drilling.

2.6.2.12 Former Sewage Treatment Facility. Dermal contact with heavy metals is a potential chemical hazard at this area. Previous investigations showed elevated levels of chromium, mercury and silver. Work around drilling equipment will present physical hazards.

2.6.3 Conclusion/Risk Assessment

Based on these potential health risks, site work will be conducted in accordance with Section 4.3.3, Operational Levels of Protection. Locations of proposed borings/monitoring wells will be cleared by HAA personnel of any underground utilities prior to invasive work.

3.0 SITE CONTROL

3.1 ZONATION

Work areas will normally be divided into three zones. The working area of each site will be considered the Exclusion Zone with limited areas serving as the Support Zone, and an area for decontamination called the Contamination Reduction Zone (CRZ).

3.1.1 Exclusion Zone

The intent of the Exclusion Zone is to isolate the area of contaminant generation, and to restrict to the extent possible the spread of contamination from active areas of the site to support areas and off-site locations. The Exclusion Zone is demarcated from the remainder of the site by the Hot Line, which will be a tape line. Personnel entering into the Exclusion Zone must: enter through the CRZ; be wearing the prescribed level of protection (see Section 4.3.1); and be found otherwise authorized to enter the Exclusion Zone (see Sections 1.3, 1.4, and 9.1). Personnel, equipment, or materials exiting the Exclusion Zone will be considered contaminated. Personnel will be decontaminated; equipment and materials will be decontaminated or containerized in uncontaminated devices.

Within the overall 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, sources of combustible gases or air contaminants, or other dangerous areas as they are identified. Specific access for emergency services to areas of specific site operations will be established.

3.1.2 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 concept of the CRZ is that of a transition zone between contaminated and uncontaminated areas of the site. As such, when contaminated personnel, equipment, or materials cross the Hot Line they are assumed to be contaminated from site operations. Then, by being subjected to decontamination processes, they become less contaminated so that when they reach the Contamination Control Line they are clean and can exit this zone without spreading contamination.

A Contamination Reduction Corridor (CRC), which includes materials necessary for full personnel and portable equipment decontamination, will be located within the CRZ. A separate facility will be established for heavy equipment decontamination needs. In addition, safety equipment (e.g., emergency eye wash, fire extinguisher, stretcher, and first aid kit) will be staged in this zone.

3.1.3 Support Zone

The Support Zone (i.e., the outermost zone of the site) is separated from the CRZ by the Contamination Control Line and is considered a clean area. Movement of personnel and materials from this zone into the CRZ is generally unrestricted except as required through access points controlled for administrative purposes. However, only uncontaminated/decontaminated personnel or materials may enter this zone from the CRZ.

The Support Zone will contain the necessary support facilities (including personal hygiene facilities) for site operations and will serve as the communications center and source of emergency assistance to operations occurring in the Exclusion Zone and CRZ. A log of all persons entering the site will be maintained by the HSO, the Field Operations Leader (FOL), or site designee.

3.2 MEDICAL ASSISTANCE

The primary source of emergency medical assistance for HAA is the Novato Community Hospital. The alternate source of medical assistance is the Kaiser Permanente Medical Center in San Rafael, California. In the event of a medical emergency, 911 will be dialed to provide ambulance service and/or fire and police. A Coast Guard medical clinic is present at HAA, however, due to military insurance limitations and staffing constraints, adequate medical emergency assistance could not be guaranteed on-site. Thus, the two local medical facilities have been identified.

Appendix E contains a list of emergency phone numbers for the HAA site, along with maps and directions to the two hospitals. The telephone numbers and addresses for the hospitals are:

1. Novato Community Hospital
   1625 Hill Road
   Novato, California
   (415) 897-3111

2. Kaiser Permanente Medical Center
   99 Monticillo Road
   San Rafael, California
   (415) 499-2400

4.0 ENGINEERING CONTROLS, WORK PRACTICES, AND PERSONAL PROTECTIVE EQUIPMENT

This section summarizes engineering controls, work practices, and personal protective equipment necessary to promote worker health and safety at HAA.

4.1 ENGINEERING CONTROLS

Use of engineering controls at HHA is anticipated to be limited. On occasion, blowers may be utilized to disperse hazardous/flammable vapors from the drilling rig area during boring/well installation. The decision to use blowers will be made on a case-by-case basis depending on vapor levels, nature of work, power availability, etc.

4.2 WORK PRACTICES

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

- In any unknown situation, always assume the worst conditions and plan responses accordingly.

- Employ the buddy system. Under no conditions will any person be permitted to enter the Exclusion Zone of a site alone. Establish and maintain communication. 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 to accomplish this. Do not place equipment on drums or 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.

- Smoking, eating, or drinking after entering the work zone and before decontamination will not be allowed. Oral ingestion of contaminants is probably the second-most likely means of introduction of the toxic substances into the body (inhalation being first).

- Avoid heat and other work stresses related to wearing the protective gear. Work breaks should be planned to prevent stress-related accidents or fatigue.

- To the extent feasible, handling of contaminated materials should be done remotely, particularly when drummed or other containerized hazardous waste materials are on-site.

- Be observant of not only one's own immediate surroundings but also those 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 and while utilizing personnel protective gear because vision, hearing, and communication can be restricted.

- Use of contact lenses will not be allowed on-site; they prevent proper flushing should corrosive or lachrymose substances enter the eyes.

- Sites potentially requiring Level C or B protection will require the removal of facial hair (except moustaches) to allow a proper facepiece fit.

- Rigorous contingency planning, and dissemination of plans to all personnel, minimizes the impact of rapidly changing safety protocols in response to changing site conditions.

- Be aware that chemical contaminants may mimic or enhance symptoms of other illnesses or intoxication. Avoid excess use of alcohol and working with an illness during field investigation assignments.

- The site leader and HSO will maintain project records in a bound notebook recording daily activities, meetings, facts, incidents, and data relating to the project. These record books will remain on-site during the full duration of the project so that replacement personnel may add information in the same record book, maintaining continuity. These notebooks and daily records will become part of the permanent project file.

4.3 PERSONAL PROTECTIVE EQUIPMENT

4.3.1 Levels of Protection

The following descriptions provide the basic composition of the generally recognized personal protective equipment (PPE) that are to be used for site operations. Specific components for any level of protection will be selected based on hazard assessment and additional elements added as necessary. Disposable protective clothing, gloves, and other equipment, exclusive of respirators, should be used where feasible to minimize risks during decontamination.

Level A
- pressure-demand full-facepiece Atmosphere Supplying Respirator (ASR) (if ASR is an airline respirator, it must have an escape self-contained breathing apparatus [SCBA])
- fully-encapsulating, chemical-resistant suit
- inner chemical-resistant gloves
- chemical-resistant safety boot/shoes
- two-way radio communications
- cooling unit*
- coveralls*
- hard hat*
- disposable gloves and boot covers*

Level B
- pressure-demand full-facepiece ASR (if ASR is an airline respirator, it must have escape SCBA)
- chemical-resistant clothing (i.e., coveralls and long sleeved jacket; hooded, one- or two-piece chemical splash suit; and disposable chemical-resistant one-piece suit)
- inner and outer chemical-resistant gloves
- chemical-resistant safety boot/shoes
- hardhat
- two-way radio communications
- coveralls*
- disposable boot covers*
- face shield*
- long cotton underwear*

Level C
- full-facepiece, air-purifying respirator with appropriate sorbents
- chemical-resistant clothing (i.e., coveralls and long sleeved jacket; hooded, one- or two-piece chemical splash suit; and disposable chemical-resistant one-piece suit)

- o inner and outer chemical-resistant gloves
- o chemical-resistant safety boot/shoes
- o hardhat
- o two-way radio communications
- o coveralls*
- o disposable boot covers*
- o face shield*
- o escape mask*
- o long cotton underwear*

Level D
- o coveralls
- o safety boot/shoes
- o safety glasses or chemical splash goggles
- o hardhat
- o gloves*
- o escape mask*
- o face shield*

Modified Level D
- o Level D PPE
- o coated Tyvek chemical-resistant suit
- o inner and outer chemical-resistant gloves
- o chemical-resistant safety boots or shoes

* optional

4.3.2 Other Protective Equipment

Hearing protection will be worn at all times by workers when in the vicinity of the drilling rig.

4.3.3 Operational Levels of Protection and Specialized Procedures

The operational levels of protection were based on Section 2.6 and Maximum Volatile Concentration Estimate Calculation (MVCEC) using Henry's Law constants. The MVECs were based on existing chemical data for HAA from previous investigations. The sites where MVECs were calculated include: petroleum contaminated groundwater at the POL Area, petroleum and methylene chloride contaminated soils at the Burn Pit, and petroleum and VOC contaminated materials at the East Levee Landfill.

The initial levels and rationale for the PPE selected for operations at each site are presented in Table 4-1. Levels of protection may be upgraded or downgraded at any time as described in Figures 4-1 through 4-4.

TABLE 4-1
LEVEL OF PERSONAL PROTECTION
HAMILTON ARMY AIRFIELD

SITE	PERSONAL PROTECTION LEVEL[1]	RATIONALE
Property Wide:		
- Transformers	Modified D	PCBs pose a potential risk through dermal contact; respiratory protection not required due to low PCB volatility.
POL Area	C	Potential dermal and respiratory exposure to petroleum hydrocarbons from borings and monitoring well installation and sampling activities. Upgrade or downgrade respiratory protection based on air monitoring of the breathing zone. Follow Respiratory Protection Flowchart Figure 4-1.
Building 442	Modified D	Potential exposure to petroleum contaminated surface soils, sediments or water. Upgrade respiratory protection based on continuous air monitoring of the breathing zone. Follow Respiratory Protection Flow chart Figure 4-2.
Pump Station Area	Modified D	Potential exposure to petroleum contaminated surface soils. Previous investigations indicate some surficial soil staining in the fuel tank areas. Upgrade respiratory protection based on continuous air monitoring of the breathing zone. Follow Respiratory Protection Flowchart Figure 4-2.

TABLE 4-1 (cont.)
LEVEL OF PERSONAL PROTECTION
HAMILTON ARMY AIRFIELD

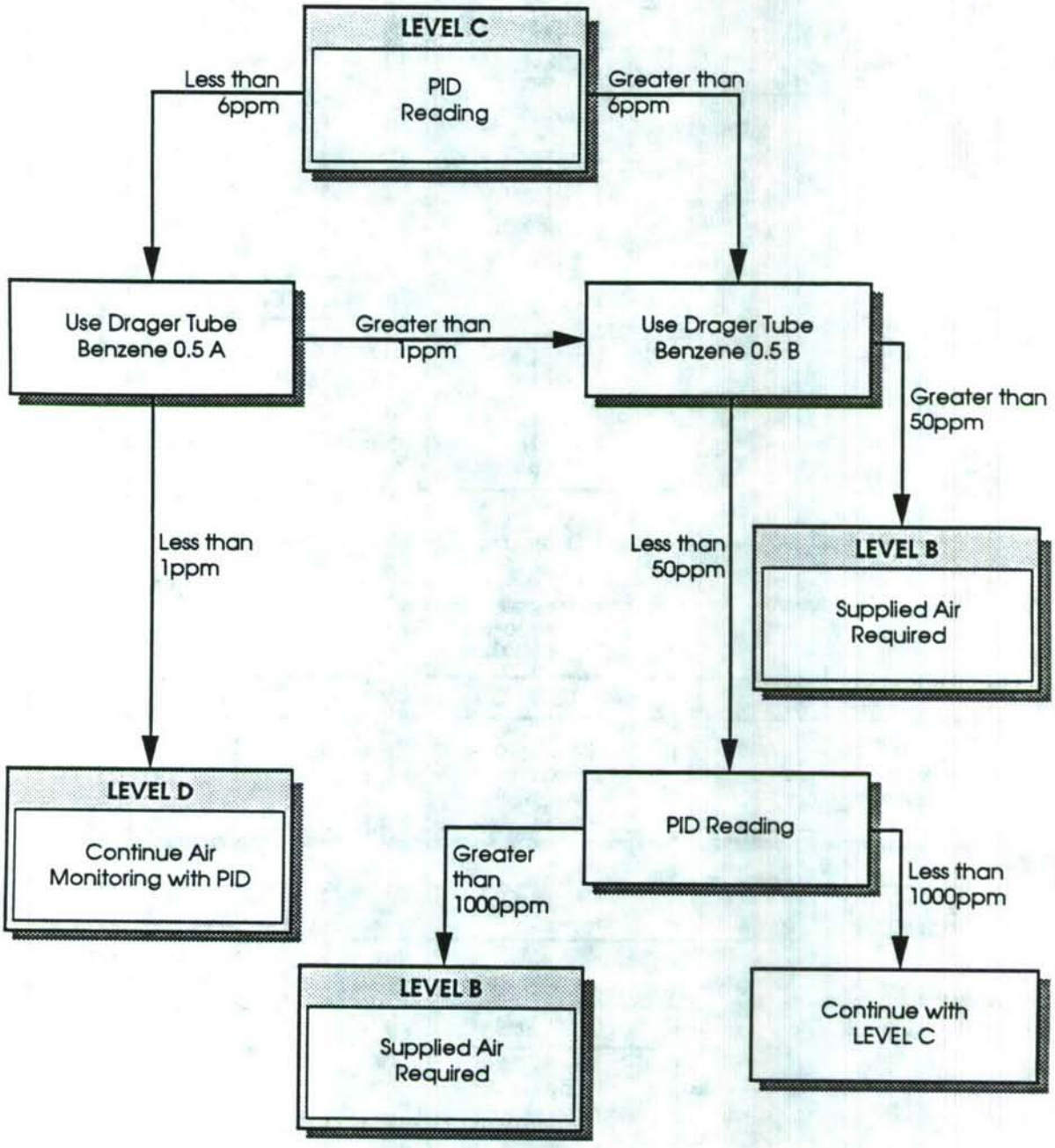
SITE	PERSONAL PROTECTION LEVEL[1]	RATIONALE
Aircraft Maintenance Area/Storage Areas	Modified D	Potential exposure to petroleum hydrocarbons, solvents, and various cleaning compounds during sampling activities; upgrade respiratory protection based on continuous air monitoring of the breathing zone. Follow Respiratory Protection Flowchart Figure 4-2.
Burn Pit	Modified D	Potential for dermal contact with petroleum and methylene chloride contaminated soils and groundwater based on previous investigations; upgrade respiratory protection based on continuous air monitoring of the breathing zone. Follow Respiratory Protection Flowchart Figure 4-3.
JP-4 Line	Modified D	Potential exposure to petroleum contaminated soils during invasive activities; upgrade respiratory protection based on continuous monitoring of the breathing zone. Follow Respiratory Protection Flowchart Figure 4-2.
Revetment Area	Modified D	Potential exposure to petroleum contaminated soils based on reports of previous aircraft maintenance activities; upgrade respiratory protection based on continuous air monitoring of the breathing zone. Follow Respiratory Protection Flowchart Figure 4-2.

TABLE 4-1 (cont.)
LEVEL OF PERSONAL PROTECTION
HAMILTON ARMY AIRFIELD

SITE	PERSONAL PROTECTION LEVEL[1]	RATIONALE
East Levee Landfill	Modified D	Potential for contact with contaminated soils. Previous investigation indicated the presence of petroleum hydrocarbons, 1,1,1-trichloroethane, fluoranthene and phenanthrene as well as various metals. Upgrade respiratory protection based on continuous air monitoring of the breathing zone. Follow Respiratory Protection Flowchart Figure 4-4.
Former Sewage Treatment Facility	Modified D	Potential for dermal contact with contaminated soils. Previous investigations indicated elevated levels of chromium, mercury, and silver.

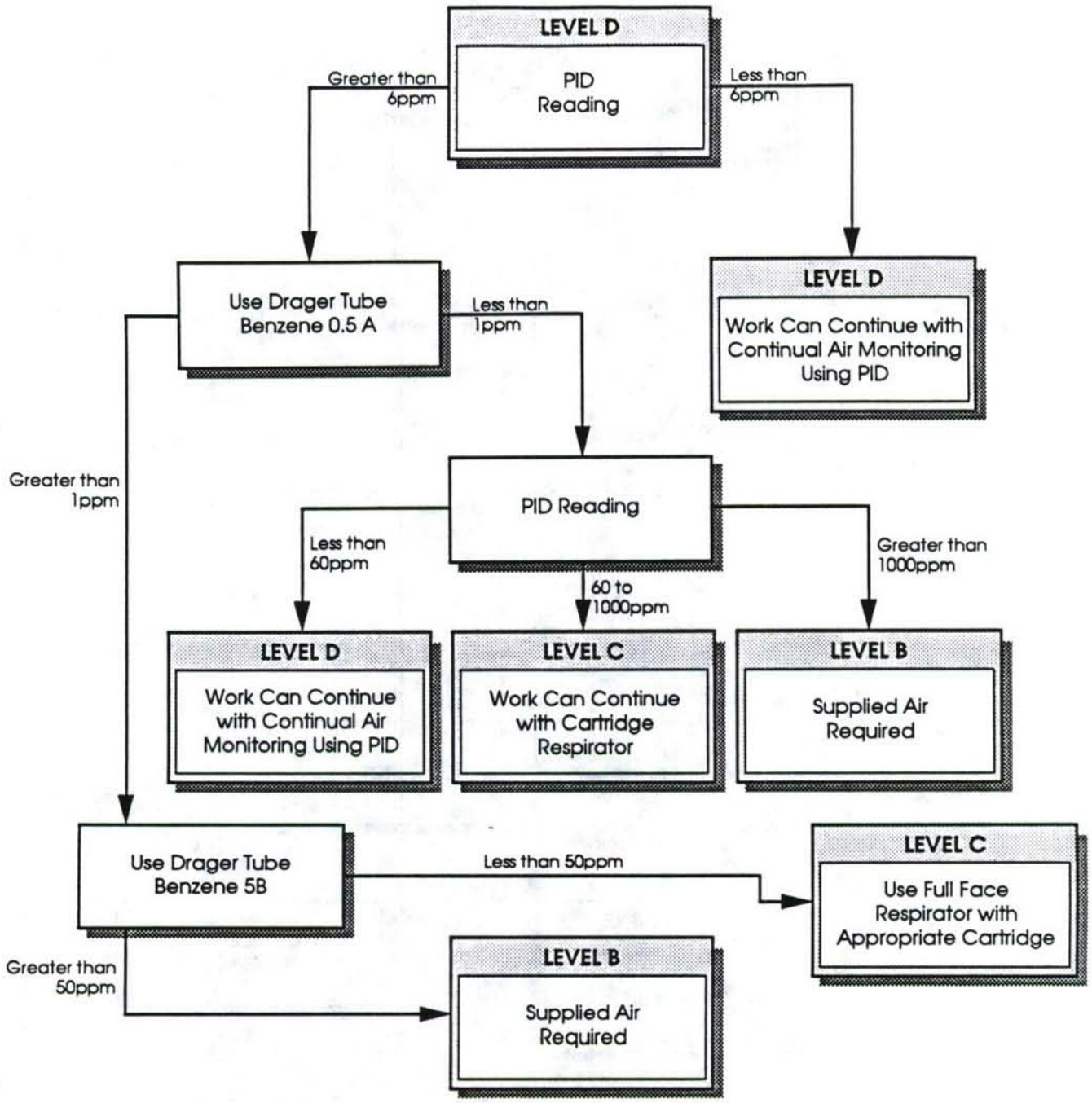
Note:

[1] The initial Personal Protection Levels may be upgraded based on site conditions and instrument readings as described in Subsection 4.3.3, Operational Levels of Protection. Personal Protective Equipment corresponding to each Personal Protection Level is discussed in Subsection 4.3.1, Levels of Personal Protection.



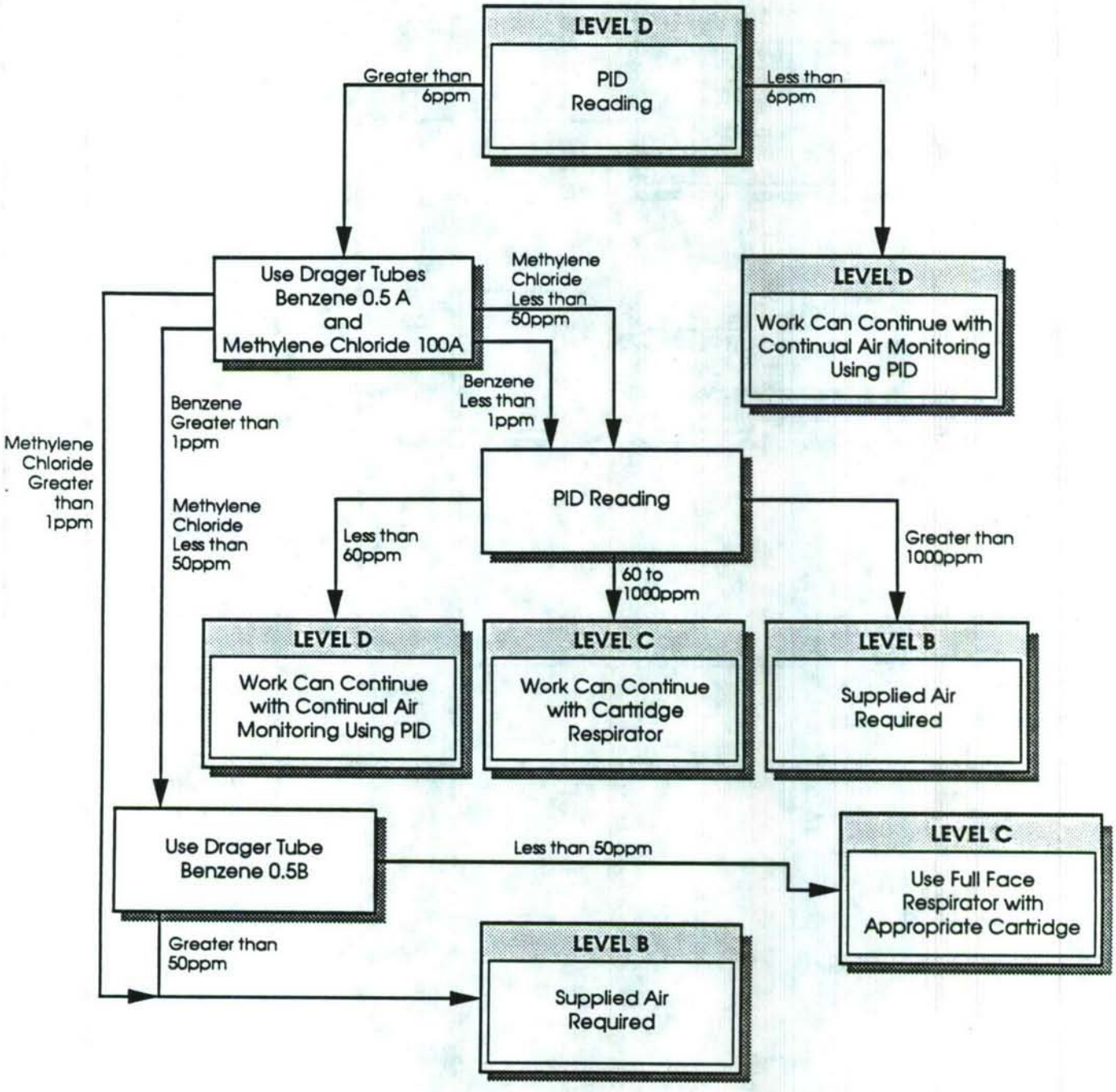
NOTE: FLOW CHART ESTABLISHED FOR POTENTIAL EXPOSURE TO PETROLEUM HYDROCARBONS AT THE POL AREA.

FIGURE 4-1
POL AREA - RESPIRATORY PROTECTION FLOW CHART
HEALTH AND SAFETY PLAN
HAMILTON ARMY AIRFIELD



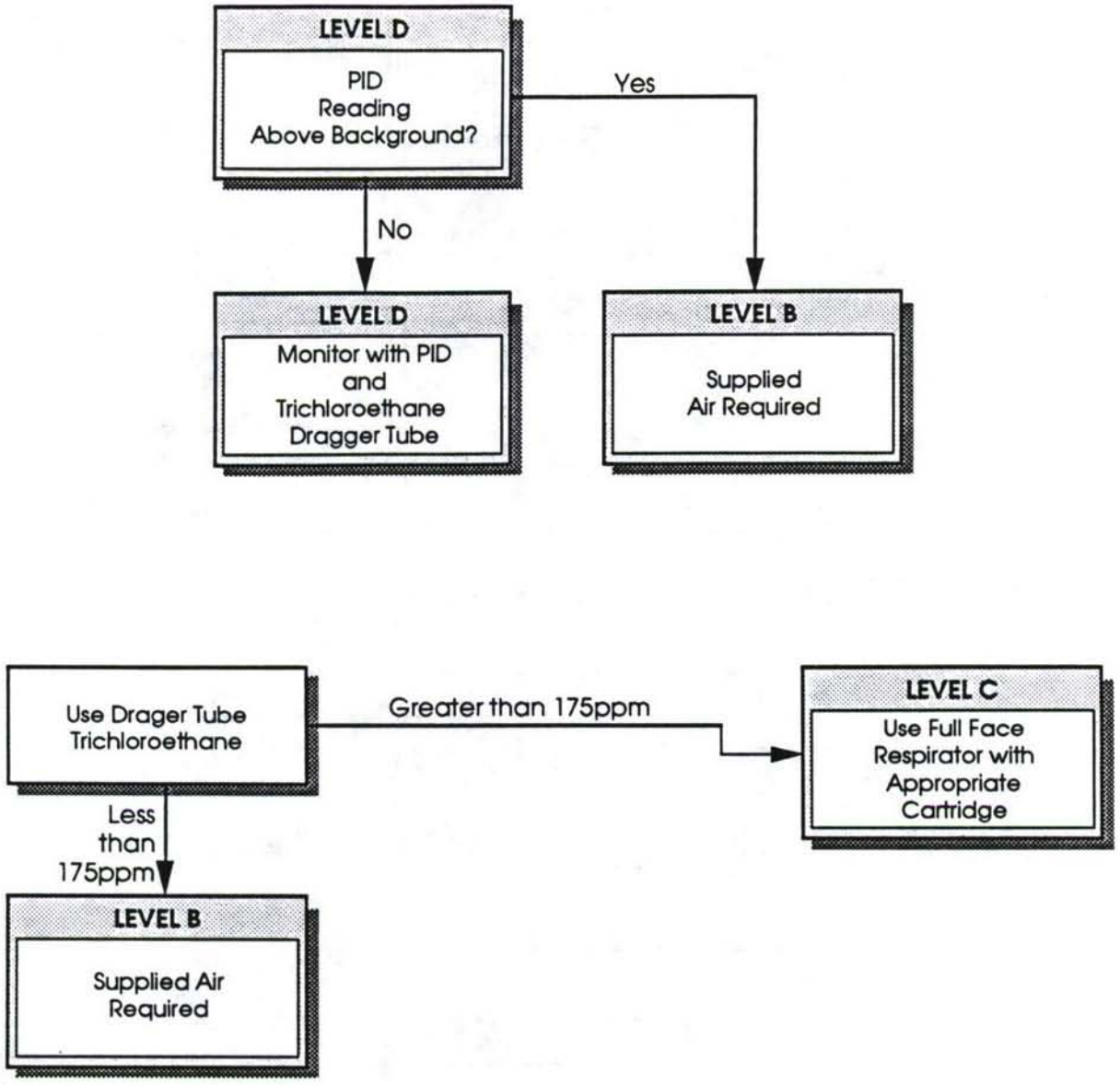
NOTE: FLOW CHART ESTABLISHED FOR POTENTIAL EXPOSURE TO PETROLEUM HYDROCARBONS AT THE PUMP STATION AREA, AIRCRAFT MAINTENANCE AREA/STORAGE AREAS, JP-4 LINE, AND REVETMENT AREA.

FIGURE 4-2
PUMP STATION AREA -
RESPIRATORY PROTECTION FLOW CHART
HEALTH AND SAFETY PLAN
HAMILTON ARMY AIRFIELD



NOTE: FLOW CHART ESTABLISHED FOR POTENTIAL EXPOSURE TO PETROLEUM HYDROCARBONS AND METHYLENE CHLORIDE AT THE BURN PIT.

FIGURE 4-3
BURN PIT SITE
RESPIRATORY PROTECTION FLOW CHART
HEALTH AND SAFETY PLAN
HAMILTON ARMY AIRFIELD
E.C. JORDAN CO.



NOTE: FLOW CHART ESTABLISHED FOR POTENTIAL EXPOSURE TO PETROLEUM HYDROCARBONS AND 1,1,1, - TRICHLOROETHANE AT THE EAST LEVEE LANDFILL.

FIGURE 4-4
EAST LEVEE LANDFILL
RESPIRATORY PROTECTION FLOW CHART
HEALTH AND SAFETY PLAN
HAMILTON ARMY AIRFIELD

E.C. JORDAN CO.

5.0 MONITORING

Monitoring of the work environment will be undertaken by the contractor to assure that IDLH or other dangerous conditions are identified. At a minimum, this monitoring will include evaluations for combustible atmospheres, oxygen deficient environments, and hazardous concentrations of airborne contaminants.

5.1 AIR SAMPLING

To the extent feasible, efforts will be made by the contractor to evaluate the presence of airborne contaminants through continuous use of direct reading instrumentation. Information gathered will be used to assure the adequacy of the levels of protection being employed at the site, and may be used as the basis for upgrading or downgrading the levels of protection at the discretion of the site HSO.

5.1.1 Equipment, Calibration, and Maintenance

- MSA 360/361 or equivalent: This meter is capable of monitoring for combustible gases and oxygen. It will be used to determine if an area contains concentrations of combustible gases in some percentage of the lower explosive limit, and for determining the percentage of oxygen in the breathing zone. The calibration of this equipment will be done in accordance with the manufacturer's instructions.

- HNU IS101 and Photovac TIP photoionization detectors (PIDs) or equivalent: The PID operates on the basis of ionization of the contaminant which results in a meter deflection proportional to the concentration of the contaminant. In the PID, the ionization is caused by a UV light source. The strength of the UV (measured in electron volts or eV) determines what contaminants can be ionized. The HNU can use three different strength UV sources, including 9.6, 10.2, and 11.7 eV. The TIP operates using a UV light source of 10.6 eV. Calibration and maintenance will be performed in accordance with the manufacturer's specifications. The HAA site will use either the TIP or HNU PID.

- Detector Tubes (MSA and Draeger or equivalent): Colorimetric Detector Tubes are direct-reading instruments that consist of a glass tube impregnated with an indicating chemical that 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 whose length is proportional to the contaminant concentration. Care must be taken when using the Detector Tubes as the reliability of the results depends on proper calibration, the degree of stability of the reacting chemical, and the ambient temperature. Interfering gases or vapors can also positively or negatively effect the measured results. Calibration and maintenance will be performed in accordance with the manufacturer's specifications.

5.2 PERSONAL MONITORING

Personal monitoring will be undertaken by the contractor to characterize the personal exposure of high-risk employees to the hazardous substance they encounter on-site. Dosimeters as presented in Subsection 5.2.1, must be worn at all times while working at HAA.

5.2.1 Equipment, Calibration, and Maintenance

Thermoluminescent Dosimetry (TLD) Body Badge. These devices are non-mechanical collection devices and are used to monitor for x-ray, beta, and gamma radiation exposure. They are worn by the employee and sent quarterly to Tech/Ops Landauer, Inc., for analysis.

5.3 OTHER

Radiation Alert Monitor. This instrument senses alpha, beta, gamma, and x-ray radiation by means of a Geiger-Muller tube with a thin mica window. When a ray or particle of ionizing radiation strikes the tube, it is sensed electronically. A selector switch gives the instrument three sensitivity ranges, x1, x10, and x100 mR/hr. Calibration is conducted by a certified lab.

6.0 DECONTAMINATION/DISPOSAL

All personnel and/or equipment leaving contaminated site areas will be subject to decontamination, which will take place in the CRZ, as noted in Section 3.1.

6.1 PERSONNEL DECONTAMINATION

Decontamination procedures are followed by all personnel leaving hazardous waste sites. Under no circumstances (except emergency evacuation) will personnel be allowed to leave the site prior to decontamination. Generalized procedures for removal of protective clothing are as follows:

1. Drop tools, monitors, samples, and trash at designated drop stations (i.e., plastic containers or drop sheets).

2. Step into the designated shuffle pit area and scuff feet to remove gross amounts of dirt from outer boots.

3. Scrub outer boots and outer gloves with decontamination solution or detergent and water. Rinse with water.

4. Remove tape from outer boots and remove boots; discard in disposal container.

5. Remove tape from outer gloves and remove gloves; discard in disposal container.

6. If the worker has left the Exclusion Zone to change the air tank on his/her SCBA, or the canister on his/her air purifying respirator, this is the last step in the decontamination procedure. The tank or cartridge should be exchanged, new outer gloves and boot covers donned, the joints taped, and the worker returns to duty.

7. Remove outer garments and discard in disposal container.

8. Remove respirator and place or hang in the designated area.

9. Remove inner gloves and discard in disposal container.

10. If the site requires use of a decontamination trailer, all personnel must shower before leaving the site at the end of the work day.

Note: Disposable items (i.e., Tyvek coveralls, inner gloves, and latex overboots) will be changed on a daily basis unless there is reason for changing sooner. Dual respirator canisters will be changed daily unless more frequent changes are deemed appropriate by site surveillance data or personnel assessment.

Pressurized sprayers or other designated equipment will be available in the decontamination area for wash down and cleaning of personnel, samples, and equipment.

Respirators will be decontaminated daily. Taken from the drop area, the masks will be disassembled, the cartridges set aside, and all other parts placed in a cleansing solution. Parts will be precoded (e.g., #1 on all parts of Mask #1). After an appropriate time in the solution, the parts will be removed and rinsed off with tap water. The old cartridges will be marked to indicate length of usage (i.e., if means to evaluate the cartridges' remaining utility are available) or will be discarded into the container for contaminated trash disposal. In the morning, the masks will be reassembled and new cartridges installed. Personnel will inspect their own masks to be sure of proper readjustment of straps for proper fit.

6.2 SMALL EQUIPMENT DECONTAMINATION

Small equipment will be protected as much as possible from contamination by draping, masking, or otherwise covering as much of the instruments as possible with plastic without hindering the operation of the unit. The PID and Dual Detector meters will be placed in a clear plastic bag that allows reading of the scale and operation of the knobs. The sensors 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 removed and disposed of in the appropriate containers. Any dirt or obvious contamination will be brushed or wiped with a disposable paper wipe. The units can then be taken inside in a clean plastic tub, wiped off with damp disposable wipes and dried. The units will be checked, standardized, and recharged as necessary for the next day's operation. They will then be prepared with new protective coverings.

6.3 HEAVY EQUIPMENT DECONTAMINATION

It is anticipated that the downhole equipment of the drilling rigs and buckets of backhoes will be contaminated during the borehole or test pitting activities. They will be cleaned at the work area or central staging area with high-pressure steam. Loose material will be removed by brush. The person performing this activity will be at least at the level of protection utilized during the personnel and monitoring equipment decontamination.

A decontamination pad will be constructed to allow collection and storage of decontamination fluids in U.S. DOT-approved 55-gallon drums.

6.4 DISPOSAL OF DECONTAMINATION MATERIALS

All protective gear and other disposable materials will be staged on-site for disposal. Disposable materials (e.g., gloves and Tyveks) will be double-bagged

and stored as is or placed in U.S. DOT-approved 55-gallon drums. Drummed soils (i.e., soils that register PID readings above background or that are visually contaminated) will be transported to a designated staging area for future disposal. Disposal of hazardous and non-hazardous materials will be the responsibility of HAA.

7.0 EMERGENCY/CONTINGENCY PLAN

This section identifies the emergency contingency planning that has been undertaken for operations at this site. Other sections of the HASP also provide information that would be used under emergency conditions. Refer to Appendix E for emergency telephone numbers, routes to emergency medical facilities, and emergency signals.

7.1 PERSONNEL ROLES, LINES OF AUTHORITY, AND COMMUNICATION

The site HSO is the primary authority for directing operations at the site under emergency conditions. All communications both on- and off-site will be directed through the HSO.

7.2 EVACUATION

Withdrawal Upwind. The work party will continually note general wind directions while on-site. A simple wind sock or flag will be set up near the work site for visual determinations. Upon noting the conditions warranting movement away from the work site, the crew will move 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 (the buddy system must be used) may return to the work site to determine if the condition noted was transient or persistent. If persistent, an alarm should be raised to notify on-site personnel and HAA of the situation and the need to leave the site or don an SCBA. An attempt should be made to decrease emissions only if greater respiratory protection is donned. The HSO, HSS and USATHAMA will be notified of conditions. When access to the site is restricted and escape may thus be 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.

Site Evacuation. Upon determination of conditions warranting site evacuation, the work party will proceed upwind of the work site and notify HSO and the field office of site conditions. If the decontamination area is upwind and greater than 500 feet from the work site, the crew will pass quickly through decontamination to remove contaminated outer suits. If the hazard is toxic gas, respirators will be retained. The crew will proceed to the field office to assess the situation. As more facts are determined from the field crew, these will be relayed to the appropriate agencies. The advisability and type of further response action will be coordinated and carried out by the HSO.

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 on-site personnel will initiate evacuation of the immediate off-site area without delay.

7.3 EMERGENCY MEDICAL TREATMENT/FIRST AID

Any personnel injured on-site will be rendered first aid and/or CPR as appropriate and transported to competent medical personnel for further examination and/or treatment. The transport will be through professional emergency transportation means based on-site; however, if this is not readily available or results in excessive delay, other transport is authorized. Under no circumstances will the injured person transport him/herself to a medical facility for emergency treatment.

In the event an injury occurs in an investigation area, provisions for decontamination of the victim will be made. However, life threatening conditions may preclude normal decontamination procedures. As such, arrangements will be made with the medical facility and transporter so that they are both aware of the situation and can make appropriate provisions.

8.0 ACCIDENT/INCIDENT REPORTING

An accident/incident report will be prepared and submitted to USATHAMA (Data Item A012) if necessary due to the occurrence of an accident/incident as specified in the USATHAMA Request for Proposal for this contract. An accident/incident report will be generated when any one or more of the following occur as a result of an accident or incident: fatality, disabling injury, occupational illness, property damage exceeding $1000, fire, explosion, or exposure to chemical agent/hazardous materials.

Telephone notification of any accident/incident will be to the USATHAMA safety office within 24 hours of occurrence and reported in writing within seven days of occurrence on ENG form 3394. The Point of Contact is Mr. James Arnold, 301-671-4811.

The report will contain the following information:

- o contractor and telephone number;
- o name and title of the person reporting;
- o brief summary of accident/incident giving pertinent details including type and quantity of material and operation type;
- o cause of accident/incident, if known;
- o casualties (i.e., fatalities, disabling inquiries, and exposure to nuclear, biological, and chemical agents);
- o details of any chemical hazard or other hazardous material or contamination;
- o estimation of property damage, if applicable;
- o nature of damage; effect on production, operations training, or other activity;
- o action taken by contractor to ensure safety and security;
- o other damage or injuries sustained (public or private);
- o whether a release was made to news media; if so, attach a copy of the published article or statement;
- o any indication of sabotage or espionage (reports of possible theft or loss of chemical agent/agent-filled munition will be submitted immediately);
- o any other pertinent information including cause factors (when they are known; state any possible political implications);

- type of carrier, if one is involved; and
- assistance required.

If a malfunction of equipment is involved, the following additional information will be furnished:

- equipment nomenclature;
- quantity involved;
- production lot number(s);
- brief technical description of malfunction; and
- availability of replacement equipment and time estimate to continue activity.

A sample accident/incident report is included as Appendix C.

The accident/incident report will be submitted as follows. Copies will be furnished to the HAA safety office, the COR, the USATHAMA safety office, and the HSS. The primary report will be forwarded to:

Commander
U.S. Army Toxic and Hazardous Materials Agency
ATTN: CETHA-TS-S (Mr. James Arnold)
BLDG E4435
Aberdeen Proving Ground, Maryland 21010-5401

9.0 OTHER

9.1 ILLUMINATION

Site operations will not be permitted without adequate lighting. Therefore, unless provisions are made for artificial light meeting the 5-footcandle requirement of 29 CFR 1910.120, downrange operations must halt in time to permit personnel and equipment to exit the Exclusion Zone and proceed through decontamination during adequate daylight. Conversely, operations will not be permitted to begin until adequate lighting is present.

9.2 CONFINED SPACE ENTRY

Confined space entry presents special problems and substantial risks to the personnel involved directly in the entry and those that might be called upon to attempt a rescue of the initial entrants. Therefore, entry into a confined space is a MEANS OF LAST RESORT, and will only be permitted where no other mechanism is feasible to achieve the desired goal. At this time, no confined space entry is anticipated during HAA RI activities. In the event confined space entry is deemed necessary, entry will be conducted under the provisions of Appendix B.

9.3 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.

10.0 ADMINISTRATIVE

10.1 PERSONNEL AUTHORIZED DOWNRANGE

Personnel authorized to participate in downrange activities at this site have been reviewed and authorized for site operations by the Task Manager and the HSS. The authorization involves the completion of appropriate training, medical examination, and a review of this site-specific HASP. All persons entering the site must utilize the buddy system, and check-in with the Field Operations Leader and/or HSO before going downrange.

Certified EI/AA Contractor team personnel:

HSO: _____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

Other Certified Personnel:

_____ _____

_____ _____

_____ _____

_____ _____

* Current First Aid Training
+ Current CPR Training

10.2 ACCIDENT PREVENTION AND SAFETY PLAN APPROVALS

By their signature, the undersigned approve this HASP for applicability in the protection of the health and safety of all persons entering the HAA site.

Health and Safety Officer	Date
Project Manager	Date
EI/AA Contractor Health and Safety Supervisor	Date

10.3 FIELD TEAM REVIEW

I have read and reviewed the site-specific HASP for the HAA and understand the information contained therein and will comply.

NAME:

_____

DATE:

_____

SITE/PROJECT:

_____

10.4 MEDICAL DATA SHEET

This Medical Data Sheet will be completed by all on-site personnel and will be kept in the Support Zone during the conduct of site operations. It is in no way a substitute for the Medical Surveillance Program requirements consistent with the EI/AA Contractor Health and Safety Program for Hazardous Waste Sites. This data sheet will accompany any personnel when medical assistance is required or if transport to hospital facilities is required. If more information is required, use the back of this sheet.

Project _____

Name _____

Address _____

Home Telephone _____ Area Code ( ) _____

DOB _____ Height _____ Weight _____

In case of emergency, contact: _____ (name) _____

Address _____

Telephone _____ Area Code ( ) _____

Do you wear contacts? ( ) Yes ( ) No

Allergies _____

List medication taken regularly _____

Particular sensitivities _____

Provide a checklist of previous/recent illnesses or exposures to hazardous chemicals _____

Name of personal physician _____

Telephone _____ Area Code ( ) _____

REFERENCES

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Roy F. Weston, Inc., 1990. "Enhanced Preliminary Assessment, Hamilton Army Airfield, Novato, California"; prepared for U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland; Contract No. DAAA15-88-D-0007; January 1990.

USEPA Environmental Monitoring Systems Laboratory, 1990. "Installation Assessment, Army Base Closure Program, Hamilton Army Airfield, Ignacio, California"; prepared for U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland; Contract No. 68-03-3532; April 1990.

Wissenhunt, R. et at., 1990. Telephone interview conducted by S. Buckley, Environmental Engineer, of E.C. Jordan Co., with R. Wissenhunt, F. Conrad, G. Gregg, and F. Torr, former Hamilton Army Airfield Employees; March 18, 20, and 24, 1990.

Woodward-Clyde Consultants, 1987. "Confirmation Study for Hazardous Waste, Hamilton Air Force Base, Novato, California"; prepared for Omaha District Corps of Engineers; January 1987.

GLOSSARY OF ACRONYMS

ACMs	Asbestos Containing Materials
AFB	Air Force Base
ASR	Atmosphere Supplying Respirator
ASTs	Aboveground storage tanks
bgs	below ground surface
CAP	Civil Air Patrol
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CTF	Consolidated Training Facility
COR	Contracting Officer's Representative
CRC	Contamination Reduction Coridor
CRZ	Contamination Reduction Zone
ESOs	Environmentally Significant Operations
FOL	Field Operation Leader
GSA	General Service Administration
HAA	Hamilton Army Airfield
HASP	Health and Safety Plan
HSM	Health and Safety Manager
HSO	Health and Safety Officer
HSS	Health and Safety Supervisor
IDLH	immediately dangerous to life or health
ITC	IT Corporation
MVCEC	Maximum Volatile Concentration Estimate Calculations
NPL	National Priorities List
OSHA	Occupational Safety and Health Administrator
PA	Preliminary Assessment
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PID	photoionization detector
POL	Petroleum, Oil, and Lubricants
PPE	personal protective equipment
ppm	part per million
RI/FS	Remedial Investigation/Feasibility Study
SCBA	self-contained breathing apparatus
STP	Sewage Treatment Plant
TDL	Thermoluminescent Dosimetry

USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USATHAMA	United States Army Toxic and Hazardous Materials Agency
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USTs	Underground storage tanks
VFH	volatile fuel hydrocarbons
VOCs	volatile organic compounds

APPENDIX A

CHRIS DATA SHEETS/MATERIAL SAFETY DATA SHEETS FOR CONTAMINANTS OF CONCERN

LIST OF CHEMICALS INCLUDED IN THIS APPENDIX

benzene
toluene
xylene
111,-trichloroethylene
PCBs
ethylbenzene
Jet fuel JP-4
naphta
methyl ethyl ketone
fluoranthene*
phenanthrene*
motor oil C21-C36
diesel #1
kerosene
methylene chloride
asbestos*
radon*
bromochloromethane*
delta BHC
trans-1,2-dichloroethylene

arsenic*
barium*
chromium*
copper*
lead*
molybdenum*
nickel*
vanadium*
zinc*
boron*
chromium*
mercury*
silver*

* Chemicals not part of CHRIS Table, a separate table has been prepared.

TABLE 1
CONTAMINANTS OF CONCERN

Chemical	PEL (mg/m^3)	Physical Characteristics	Remarks
Phenanthrene	0.2 (based on PEL for coal tar pitch volatiles)	Solid or monoclinic crystals.	A skin irritant, and an allergen. Known carcinogen.
Fluoranthene	--	Colorless solid	Moderate toxicity via oral and skin.
Bromodichloromethane	--	Colorless liquid	Narcotic at high concentrations.
Arsenic and Compounds (as As)	0.5 organic 0.01 inorganic	Appearance, odor, and properties vary depending upon specific compound.	Causes ulceration of the nasal septum, dermatitis, gastrointestinal disturbances, respiratory irritation, carcinogen.
Asbestos	0.2 fibers/cc	Fine, slender flaxy fibers; resists fire and most solvents.	Causes pulmonary fibrosis. Restricts pulmonary function, carcinogen.
Barium (soluble compound as Ba)	0.5	Appearance, odor, and properties vary depending on specific compound.	Upper respiratory irritant, effects gastrointestinal tract, causes muscle spasms, slow pulse, skin burns.
Boron Compounds		Appearance, odor, and properties vary depending upon specific compound.	Effects the central nervous system. Boron poisoning causes depression of the circulation, persistent vomiting, and diarrhea, followed by profound shock and coma. May cause rash over the entire body.

TABLE 1 (cont.)
CONTAMINANTS OF CONCERN

Chemical	PEL (mg/m^3)	Physical Characteristics	Remarks
Chromium (II) and (III) Hexavalent (IV*)	0.5 0.05	Steel gray metal or silver metal powder.	The toxicity of chromium varies with different chromium compounds. Chromic acids and chromates appear to be more toxic than chromium metal dust, insoluble chromium salts, and soluble chromic and chromous salts. Exposure to certain hexavalent chromium compounds is associated with an increased lung cancer incidence in humans. Symptoms: Inhalation: Dust may cause irritation of nose, throat, respiratory passages, and lungs. Repeated or prolonged exposure to chronic acid or dust may cause ulceration and perforation of the nasal septum. Skin: Dermatitis, repeated exposure may cause an allergic skin rash. Incompatabilities: Alkalies, dil H_2SO4 & HCl.

TABLE 1 (cont.)
CONTAMINANTS OF CONCERN

Chemical	PEL (mg/m^3)	Physical Characteristics	Remarks
Copper (fume) (dust & mist)	0.2 1.0	Reddish, lustrous metal	Inhalation symptoms include fume fever-chills, fever, aching muscles, dry mouth and throat, headache, nausea, vomiting, diarrhea, and stomach pains. May cause skin irritation - metal solutions can cause swelling and itching. Ingestion may cause stomach pain, nausea, vomiting and diarrhea from ingestion of 10 mg of copper by an adult and 8.5 mg by a child. No long-term effects from inhalation or ingestion reported. Copper fragment in cornea may cause cataracts. Seek medical attention for ingestion; pennillamine or triethylene-tetramine dihydrochloride may be beneficial in reducing body burden.
Iron Dust	5	Silvery-White tenacious, lustrous, ductile metal density - 7.86 insoluble.	High toxicity via oral route can cause cancer of the lung, liver, and connective tissue.

TABLE 1 (cont.)
CONTAMINANTS OF CONCERN

Chemical	PEL (mg/m^3)	Physical Characteristics	Remarks
Lead	0.05	Bluish white or silvery gray solid.	Lead is a cumulative poison. Increasing amounts build up in the body and eventually a point may be reached where symptoms and disability occur. Symptoms of long-term exposure include decreased physical fitness, fatigue, sleep disturbances, headache, aching bones, constipation, decrease appetite, and abdominal pain. Inhalation of large amounts of lead may lead to seizures, coma, and death. Target organs are the GI, CNS, kidneys, blood, and gingival tissue.
Mercury and inorganic compounds (as Hg)	0.1 (ceiling)	Silvery, mobile, odorless liquid VP - 0.0012 mm Hg	Causes cough, bronchitis; pneumonia; tumors; insomnia; irritability; indecision; headache; fatigue; weakness; irritates eyes and skin.
Mercury (organo) alkyl compounds (as Hg)	0.05 0.01	Appearance, odor, and properties vary depending upon specific compound.	Causes visual and hearing disturbances; jerky motions; dizziness; hypersalavation; nausea; vomiting; diarrhea; dermatitis; and constipation.

TABLE 1 (cont.)
CONTAMINANTS OF CONCERN

Chemical	PEL (mg/m^3)	Physical Characteristics	Remarks
Molybdenum, soluble compounds (as Mo)	5	Appearance, odor, and properties vary depending upon specific compound.	Causes loss of appetite; incoordination, irritated eyes, nose, throat; anemia; colic; and gout.
Molybdenum, insoluble compounds (as Mo)	10 (Total dust) 5 (respirable fraction)	Appearance, odor, and properties vary depending upon specific compound.	Visual disturbances; cough; irritates nose, respiratory tract, skin, and eyes.
Nickel		Silvery white workable metal	Nickel is an insoluble metal, but most common salts are soluble.
Soluble Nickel Compounds	0.3	White or colored crystal or powder	Symptoms from nickel dust and salts inhalation include lung irritation, shortness of breath, coughing, and wheezing. May cause itching, burning, and skin sores, referred to as "nickel itch;" irritation and damage to cornea; giddiness and nausea from ingestion. Long-term exposure, in addition to symptoms listed above, can cause impairment of sense of smell, chest pain, destruction of nasal tissue, and asthmatic lung disease. Dust inhalation has been associated with an increased risk of lung and nasal cancer.

TABLE 1 (cont.)
CONTAMINANTS OF CONCERN

Chemical	PEL (mg/m^3)	Physical Characteristics	Remarks
			First Aid for ingestion includes giving large amounts of water. Seek medical attention. Nickel dust is flammable and reacts violently with fluorine, strong mineral acids; ammonium nitrate, etc.
Radon	inert	Colorless, odorless, inert gas very dense.	Natural isotope, ^{220}Rn decays to radioactive ^{219}Po with the emission of alpha particles. Chief hazard is inhalation of gaseous element and its daughters. Causes lung cancer.
Silver, metal, and soluble compounds (as As)	0.01	Appearance, odor, and properties vary depending upon specific compounds.	Causes blue-gray eyes, nasal septum, throat, and skin; irritates skin and causes ulceration; effects gastro-intestinal tract.
Vandium (pentoxide) dust and fume	0.05	Yellow-orange powder or dark gray flakes, odorless.	Causes eye and throat irritation; green tongue; metal taste in mouth; cough; fine rales, wheeze; bronchitis; and eczema.

TABLE 1 (cont.)
CONTAMINANTS OF CONCERN

Chemical	PEL (mg/m^3)	Physical Characteristics	Remarks
Zinc (Dust)	--	Blue powder	Zinc is considered an essential trace element, necessary for normal growth and development. Most zinc compounds have a relatively low order of toxicity; however, occupational exposure to zinc chloride and zinc oxide has been associated with adverse health effects. Spontaneous combustion may occur if zinc dust is stored in a damp place. Zinc dust forms an explosive mixture with air. Symptoms of inhalation of mists or fumes include respiratory or gastrointestinal irritation, shortness of breath, a feeling of constriction in the chest, and coughing with phlegm and bloody sputum. It may also produce a cyanosis, resulting in a blue color of the skin and lip. Exposure to freshly formed zinc oxide fumes can cause a flu-like illness called metal fume fever, with symptoms similar to those encountered with viral influenza. Skin contact with zinc chloride may produce dermatitis. Ingestion of 12 grams of zinc metal over two days has caused sluggishness, light-headedness, a staggering gait, and difficulty in writing.
(Fume)	10		
zinc chloride	2		

BENZENE

BNZ

Common Synonyms	Watery liquid	Colorless	Gasoline-like odor
Benzol Benzole	Floats on water. Flammable, irritating vapor is produced. Freezing point is 42°F.		

Avoid contact with liquid and vapor. Keep people away.
Wear goggles and self-contained breathing apparatus.
Shut off ignition sources and call fire department.
Stop discharge if possible.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause headache, 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.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Restrict access

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Aromatic Hydrocarbon
3.2 Formula: C_6H_6
3.3 HSO/UN Designation: 3.2/1114
3.4 DOT ID No.: 1114
3.5 CAS Registry No.: 71-43-2

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Aromatic; rather pleasant aromatic odor; characteristic odor

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Hydrocarbon vapor canister, supplied air or a hose mask; hydrocarbon-insoluble rubber or plastic gloves; chemical goggles or face splash shield; hydrocarbon-insoluble apron such as neoprene.
5.2 Symptoms Following Exposure: Dizziness, excitation, pallor, followed by flushing, weakness, headache, breathlessness, chest constriction. Coma and possible death.
5.3 Treatment of Exposure: SKIN: flush with water followed by soap and water; remove contaminated clothing and wash skin. EYES: flush with plenty of water until irritation subsides. INHALATION: remove from exposure immediately. Call a physician. IF breathing is irregular or stopped, start resuscitation, administer oxygen.
5.4 Threshold Limit Value: 10 ppm
5.5 Short Term Inhalation Limits: 75 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 3; LD_{50} = 50 to 500 mg/kg
5.7 Late Toxicity: Leukemia
5.8 Vapor (Gas) Irritant Characteristics: If present in high concentrations, vapors may cause irritation of eyes or respiratory system. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 4.68 ppm
5.11 IDLH Value: 2,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 12°F C.C.
6.2 Flammable Limits in Air: 1.3%-7.9%
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: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back
6.7 Ignition Temperature: 1097°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 6.0 mm/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

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 32

8. WATER POLLUTION

8.1 Aquatic Toxicity:
5 ppm/6 hr/minnow/lethal/distilled water
20 ppm/24 hr/sunfish/TL_m/tap water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 1.2 lb/lb, 10 days
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity:
Industrial pure .....99+ %
Thiophene-free .....99+ %
Nitration .....99+ %
Industrial 90% .....85+ %
Reagent .....99+ %
9.2 Storage Temperature: Open
9.3 Inert Atmosphere: No requirement
9.4 Venting: Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U-V-W

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	3
Water Pollution	
Human Toxicity	3
Aquatic Toxicity	1
Aesthetic Effect	3
Reactivity	
Other Chemicals	2
Water	1
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 78.11
12.3 Boiling Point at 1 atm: 176°F = 80.1°C = 353.3°K
12.4 Freezing Point: 42.0°F = 5.5°C = 278.7°K
12.5 Critical Temperature: 552.0°F = 288.9°C = 562.1°K
12.6 Critical Pressure: 710 psa = 48.3 atm = 4.89 MN/m²
12.7 Specific Gravity: 0.879 at 20°C (liquid)
12.8 Liquid Surface Tension: 28.9 dynes/cm = 0.0289 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 35.0 dynes/cm = 0.035 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 2.7
12.11 Ratio of Specific Heats of Vapor (Gas): 1.081
12.12 Latent Heat of Vaporization: 169 Btu/lb = 94.1 cal/g = 3.94 X 10^5 J/kg
12.13 Heat of Combustion: −17,460 Btu/lb = −9696 cal/g = −406.0 X 10^5 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: 30.45 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 3.22 psa

NOTES

BENZENE HEXACHLORIDE

BHC

Common Synonyms
1, 2, 3, 4, 5, 6-Hexachloro-cyclohexane
Lindane
BHC
Gammexane
Tn-6

Solid crystals or powder, or solution — Solid is light to dark brown — Musty odor

Solid sinks in water. Solution generally floats on water.

Avoid contact with liquid and solid. Keep people away.
Wear goggles and self-contained breathing apparatus.
Stop discharge if possible.
Call fire department.
Stay upwind and use water spray to knock down vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Solid not flammable, but usually dissolved in combustible liquid.
POISONOUS GASES ARE PRODUCED WHEN SOLID IS HEATED OR WHEN SOLUTION BURNS.
Wear goggles and self-contained breathing apparatus.
Extinguish with foam, dry chemical, or carbon dioxide.

Exposure

CALL FOR MEDICAL AID

SOLID OR SOLUTION
POISONOUS IF SWALLOWED.
Irritating to skin and eyes.
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.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and pollution control officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-water contaminant, poison
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: $C_6H_6Cl_6$
3.3 IMO/UN Designation: 6.1/2761
3.4 DOT ID No.: 2761
3.5 CAS Registry No.: 58-89-9

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Solid
4.2 Color: Light tan to dark brown
4.3 Odor: Characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Data not available
5.2 Symptoms Following Exposure: Hyperirritability and central nervous excitation: notably vomiting, restlessness, muscle spasms, ataxia, and clonic and tonic convulsions. Subsequent central nervous depression leading to respiratory failure. Occasional dermatitis and urticaria.
5.3 Treatment of Exposure: Gastric lavage and saline cathartics (not oil laxatives because they promote absorption). Sedatives: pentobarbital or phenobarbital in amounts adequate to control convulsions. Calcium gluconate intravenously may be used in conjunction with sedatives to control convulsions. Rest and quiet. Do NOT use epinephrine because ventricular fibrillation may result.
5.4 Threshold Limit Value: 0.5 mg/m³
5.5 Short Term Inhalation Limits: 1 mg/m³ for 30 min.
5.6 Toxicity by Ingestion: Gamma isomer (Lindane): Grade 3; LD_{50} 50 to 500 mg/kg (rat) Technical mixture: Grade 2; LD_{50} 0.5 to 5 g/kg
5.7 Late Toxicity: Mutagen to human lymphocytes.
5.8 Vapor (Gas) Irritant Characteristics: Moderately irritating. Personnel will not usually tolerate moderate or high concentrations.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 1,000 mg/m³

6. FIRE HAZARDS

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 Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Toxic gases are generated when solid is heated or when solution burns.
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 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity:
0.77 ppm/96 hr/bluegill/TL_m/fresh water
0.138 ppm/96 hr/guppy/TL_m/fresh water
0.034 ppm/10 hr/coho fry/100% lethal/salt water
8.2 Waterfowl Toxicity: 2000 mg/kg
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: High

9. SHIPPING INFORMATION

9.1 Grades of Purity: Fortified grade: 40-45% gamma isomer Lindane: pure gamma isomer
9.2 Storage Temperature: Data not available
9.3 Inert Atmosphere: Data not available
9.4 Venting: Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

II

11. HAZARD CLASSIFICATIONS

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

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Solid
12.2 Molecular Weight: 290.83
12.3 Boiling Point at 1 atm: Not pertinent
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.891 at 19°C (solid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
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: Not pertinent
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

NOTES

1,2-DICHLOROETHYLENE

DEL

Common Synonyms	Liquid	Colorless	Sweet pleasant odor
Acetylene dichloride sym-dichloroethylene Dioform cis-1, 2-dichloroethylene trans-1, 2-dichloroethylene	Sinks in water. Flammable, irritating vapor is produced.		

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.

Fire

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.

Exposure

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.

LIQUID
Harmful if swallowed.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Restrict access
Evacuate area
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: ClCH = CHCl
3.3 IMO/UN Designation: 3.2/1150
3.4 DOT ID No.: 1150
3.5 CAS Registry No.: 540-59-0

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Ethereal, slightly acrid; pleasant, chloroform-like

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Rubber gloves; safety goggles; air supply mask or self-contained breathing apparatus.
5.2 Symptoms Following Exposure: Inhalation causes nausea, vomiting, weakness, tremor, epigastric cramps, central nervous depression. Contact with liquid causes irritation of eyes and (on prolonged contact) skin. Ingestion causes slight depression to deep narcosis.
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 cathartics.
5.4 Threshold Limit Value: 200 ppm
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 2; oral LD_{50} = 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

6. FIRE HAZARDS

6.1 Flash Point: 37°F C.C.
6.2 Flammable Limits in Air: 9.7%-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 chloride fumes may form in fires.
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 Hazard: Data not available
6.9 Burning Rate: 2.6 mm/min.
6.10 Adiabatic Flame 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 Molar 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

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-X-Y

11. HAZARD CLASSIFICATIONS

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

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
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:
cis: 140°F = 60°C = 333°K
trans: 118°F = 48°C = 321°K
12.4 Freezing Point:
cis: —114°F = —81°C = 192°K
trans: —58°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:
(est.)
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 10^4 J/kg
12.13 Heat of Combustion: —4,847.2 Btu/lb = —2,692.9 cal/g = —112.67 X 10^4 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

6. FIRE HAZARDS (Continued)

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

DICHLOROMETHANE

DCM

Common Synonyms	Watery liquid	Colorless	Sweet, pleasant odor
Methylene chloride Methylene dichloride	Sinks in water. Irritating vapor is produced.		

Stop discharge if possible.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Not flammable.
POISONOUS GASES ARE PRODUCED WHEN HEATED.
Wear goggles and self-contained breathing apparatus.
Cool exposed containers with water.

Exposure

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.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.

Notify local health and pollution control officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Disperse and flush

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Halogenated hydrocarbon
3.2 Formula: CH_2Cl_2
3.3 IMO/UN Designation: 6.0/1593
3.4 DOT ID No.: 1593
3.5 CAS Registry No.: 75-09-2

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Pleasant, aromatic; like chloroform; sweet, ethereal

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic vapor canister 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 Limits: 500 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 Late 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 smarting and reddening of the skin.
5.10 Odor Threshold: 206-307 ppm
5.11 IDLH Value: 5,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: Not flammable under conditions likely to be encountered.
6.2 Flammable Limits in Air: 12%-19%
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: Dissociation products generated in a fire may be irritating or toxic.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 1184°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 Flame Temperature: Data not available

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 36

8. WATER POLLUTION

8.1 Aquatic Toxicity: Not pertinent
8.2 Waterfowl Toxicity: Not pertinent
8.3 Biological Oxygen Demand (BOD): Not pertinent
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Aerosol grade; technical grade
9.2 Storage Temperature: Data not available
9.3 Inert Atmosphere: Inerted
9.4 Venting: Data not available

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-X

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-A
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	1
Health	
Vapor Irritant	2
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	2
Aquatic Toxicity	1
Aesthetic Effect	2
Reactivity	
Other Chemicals	2
Water	1
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	0
Reactivity (Yellow)	1

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 18°C and 1 atm: Liquid
12.2 Molecular Weight: 84.93
12.3 Boiling Point at 1 atm: 104°F = 39.8°C = 313.0°K
12.4 Freezing Point: −142°F = −96.7°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 MN/m²
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 = 78.7 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
12.25 Heat of Fusion: 16.89 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 13.9 psia

NOTES

ETHYLBENZENE

ETB

Common Synonyms	Liquid	Colorless	Sweet, gasoline-like odor
Phenylethane EB	Floats on water. Flammable, irritating vapor is produced.		

Avoid contact with liquid and vapor. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Shut off ignition sources and call fire department.
Stop discharge if possible.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness or difficult breathing.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will burn 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.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shorelines.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Aromatic hydrocarbon
3.2 Formula: $C_6H_5CH_2CH_3$
3.3 IMO/UN Designation: 3.3/1175
3.4 DOT ID No.: 1175
3.5 CAS Registry No.: 100-41-4

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Aromatic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Self-contained breathing apparatus; safety goggles.
5.2 Symptoms Following Exposure: Inhalation may cause irritation of nose, dizziness, depression. Moderate irritation of eye with corneal injury possible. Irritates skin and may cause blisters.
5.3 Treatment of Exposure: INHALATION: if ill effects occur, remove victim to fresh air, keep him warm and quiet, and get medical help promptly; if breathing stops, give artificial respiration. INGESTION: induce vomiting only upon physician's approval; material in lung may cause chemical pneumonitis. SKIN AND EYES: promptly flush with plenty of water (15 min. for eyes) and get medical attention; remove and wash contaminated clothing before reuse.
5.4 Threshold Limit Value: 100 ppm
5.5 Short Term Inhalation Limits: 200 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg (rat)
5.7 Late Toxicity: Data not available
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: Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure.
5.10 Odor Threshold: 140 ppm
5.11 IDLH Value: 2,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 60°F O.C.; 58°F C.C.
6.2 Flammable Limits in Air: 1.0%-6.7%
6.3 Fire Extinguishing Agents: Foam (most effective), water fog, carbon dioxide or dry chemical.
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Irritating vapors are generated when heated.
6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to the source of ignition and flash back.
6.7 Ignition Temperature: 810°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 5.8 mm/min.
6.10 Adiabatic Flame 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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data Not Available
7.8 Reactivity Group: 32

8. WATER POLLUTION

8.1 Aquatic Toxicity: 29 ppm/96 hr/bluegill/TL_m/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 2.8% (theor.), 5 days
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Research grade: 99.98%; pure grade: 99.5%; technical grade: 98.0%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	2
Liquid or Solid Irritant	2
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 106.17
12.3 Boiling Point at 1 atm: 277.2°F = 136.2°C = 409.4°K
12.4 Freezing Point: −139°F = −95°C = 178°K
12.5 Critical Temperature: 651.0°F = 343.9°C = 617.1°K
12.6 Critical Pressure: 523 psa = 35.6 atm = 3.61 MN/m²
12.7 Specific Gravity: 0.867 at 20°C (liquid)
12.8 Liquid Surface Tension: 29.2 dynes/cm = 0.0292 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 35.48 dynes/cm = 0.03548 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.071
12.12 Latent Heat of Vaporization: 144 Btu/lb = 80.1 cal/g = 3.35 X 10⁵ J/kg
12.13 Heat of Combustion: −17,790 Btu/lb = −9877 cal/g = −413.5 X 10⁵ 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: 0.4 psa

6. FIRE HAZARDS (Continued)

6.11 Stoichiometric Air to Fuel Ratio: Data Not Available
6.12 Flame Temperature: Data Not Available

JET FUELS: JP-4

JPF

Common Synonyms	Watery liquid	Colorless	Fuel oil odor
	Floats on water.		

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.

Fire

FLAMMABLE.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

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.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shorelines.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-high flammability
Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: C_nH_{2n+2}
3.3 IMO/UN Designation: 3.2/1863
3.4 DOT ID No.: 1863
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless to light brown
4.3 Odor: Like fuel oil

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.
5.2 Symptoms Following Exposure: Vapor causes slight irritation of eyes and nose. Liquid irritates stomach; if taken into lungs, causes coughing, distress, and rapidly developing pulmonary edema.
5.3 Treatment of Exposure: ASPIRATION: enforce bed rest; administer oxygen; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: wash with plenty of water. SKIN: wipe off and wash with soap and water.
5.4 Threshold Limit Value: 200 ppm
5.5 Short Term Inhalation Limits: 2500 mg/m³ for 60 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 Late 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 spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 1 ppm
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: −10°F to +30°F C.C.
6.2 Flammable Limits in Air: 1.3%-8.0%
6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 464°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 4 mm/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

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

8. WATER POLLUTION

8.1 Aquatic Toxicity: 500 ppm/*/salmon fingerling/lethal/fresh water
*Time period not specified
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 53%, 5 days
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: 100%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	1
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	1
Aesthetic Effect	3
Reactivity	
Other Chemicals	0
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	1
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 340-548°F = 170-287°C = 443-560°K
12.4 Freezing Point: < −54°F = < −48°C = <225°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 0.81 at 20°C (liquid)
12.8 Liquid Surface Tension: (est.) 25 dynes/cm = 0.025 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.) 50 dynes/cm = 0.05 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): (est.) 1.030
12.12 Latent Heat of Vaporization: 140 Btu/lb = 78 cal/g = 3.3 X 10^5 J/kg
12.13 Heat of Combustion: −18,540 Btu/lb = −10,300 cal/g = −431.24 X 10^5 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

NOTES

KEROSENE

KRS

Common Synonyms	Watery liquid	Colorless	Fuel oil odor
Illuminating oil Kerosene Range oil Fuel oil No. 1 Jet Fuel: JP-1	Floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

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.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shorelines.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: C_nH_{2n+2}
3.3 IMO/UN Designation: 3.3/1223
3.4 DOT ID No.: 1223
3.5 CAS Registry No.: 8008-20-6

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless to light brown
4.3 Odor: Characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.
5.2 Symptoms Following Exposure: Vapor causes slight irritation of eyes and nose. Liquid irritates stomach; if taken into lungs, causes coughing, distress, and rapidly developing pulmonary edema.
5.3 Treatment of Exposure: ASPIRATION: enforce bed rest; administer oxygen; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: wash with plenty of water. SKIN: wipe off and wash with soap and water.
5.4 Threshold Limit Value: 200 ppm
5.5 Short Term Inhalation Limits: 2500 mg/m³ for 60 min.
5.6 Toxicity by Ingestion: Grade 1; LD_{50} = 5 to 15 g/kg
5.7 Late 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 spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 1 ppm
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 100°F (min.)C.C.
6.2 Flammable Limits in Air: 0.7%-5%
6.3 Fire Extinguishing Agents: 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: 444°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 4 mm/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

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

8. WATER POLLUTION

8.1 Aquatic Toxicity: 2990 ppm/24 hr/bluegill/TL_m/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 53%, 5 days
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Light hydrocarbon distillate: 100%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations:
Combustible liquid

11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	2
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	1
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	1
Aesthetic Effect	3
Reactivity	
Other Chemicals	0
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 302-500°F = 200—260°C = 473—533°K
12.4 Freezing Point: —50°F = —45.6°C = 227.6°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 0.80 at 15°C (liquid)
12.8 Liquid Surface Tension: 23-32 dynes/cm = 0.023-0.032 N/m at 20°C
12.9 Liquid-Water Interfacial Tension: 47-49 dynes/cm = 0.047-0.049 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: 110 Btu/lb = 60 cal/g = 2.5 X 10^4 J/kg
12.13 Heat of Combustion: —18,540 Btu/lb = —10,300 cal/g = —431.24 X 10^4 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: 0.1 psia

NOTES

METHYL ETHYL KETONE

MEK

Common Synonyms	Liquid	Colorless	Sweet odor
MEK 2-Butanone Ethyl methyl ketone	Floats and mixes with water. Flammable, irritating vapor is produced.		

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

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.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea, 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.

LIQUID
Will burn 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.

Water Pollution

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.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Disperse and flush

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Ketone
3.2 Formula: $CH_3COCH_2CH_3$
3.3 IMO/UN Designation: 3.2/1193
3.4 DOT ID No.: 1193
3.5 CAS Registry No.: 78-93-3

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Like acetone; pleasant; pungent

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic canister 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 Limits: 250 mg/m³ for 60 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg (rat)
5.7 Late Toxicity: None
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 spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 10 ppm
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 20°F C.C.; 22°F O.C.
6.2 Flammable Limits in Air: 1.8%-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: 961°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 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 18

8. WATER POLLUTION

8.1 Aquatic Toxicity: 5640 mg/l/48 hr/bluegill/TL$_m$/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

9. SHIPPING INFORMATION

9.1 Grades of Purity: 99.5+ %
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-P-Q-R-S

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

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

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	1
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

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 = 352.8°K
12.4 Freezing Point: −123.3°F = −86.3°C = 186.9°K
12.5 Critical Temperature: 504.5°F = 262.5°C = 535.7°K
12.6 Critical Pressure: 603 psa = 41.0 atm = 4.15 MN/m²
12.7 Specific Gravity: 0.806 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: 191 Btu/lb = 106 cal/g = 4.44 X 10⁴ J/kg
12.13 Heat of Combustion: −13,480 Btu/lb = −7491 cal/g = −313.6 X 10⁴ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: (est.) −9 Btu/lb = −5 cal/g = −0.2 X 10⁴ J/kg
12.16 Heat of Polymerization: Not pertinent
12.35 Heat of Fusion: Data not available
12.36 Limiting Value: Data not available
12.37 Reid Vapor Pressure: 3.5 psa

NOTES

NAPHTHA: SOLVENT

NSV

Common Synonyms	Watery liquid	Colorless	Gasoline-like odor
Petroleum solvent Light naphtha	Floats on water. Vapor is produced.		

Stop discharge if possible. Keep people away.
Call fire department.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with foam, dry chemical or carbon dioxide.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Not irritating to eyes, nose or throat.
If inhaled, will cause dizziness 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.
DO NOT INDUCE VOMITING.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: Data not available
3.3 ISO/UN Designation: 3.2/1256
3.4 DOT ID No.: 1256
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Like kerosene and gasoline

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Goggles or face shield (as for gasolines).
5.2 Symptoms Following Exposure: High concentration of vapors may cause intoxication. If liquid is swallowed, it may get into lungs by aspiration; not very irritating to skin or eyes.
5.3 Treatment of Exposure: INHALATION: remove to fresh air, treat symptoms. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for 15 min. SKIN: wipe off, wash with soap and water.
5.4 Threshold Limit Value: 200 ppm
5.5 Short Term Inhalation Limits: 500 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Vapors are nonirritating to eyes and throat.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 10,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: >100°F C.C.
6.2 Flammable Limits in Air: 0.8%–5.0%
6.3 Fire Extinguishing Agents: Foam, carbon dioxide, or dry chemical
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 444°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 4 mm/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

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Water Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

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: Refined solvent; crude light solvent; crude heavy solvent
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U

11. HAZARD CLASSIFICATIONS

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

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 205—311°F = 130—155°C = 403—428°K
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 0.85—0.87 at 20°C (liquid)
12.8 Liquid Surface Tension: 19-23 dynes/cm = 0.019—0.023 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 39-51 dynes/cm = 0.039-0.051 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): (est.) 1.030
12.12 Latent Heat of Vaporization: 130—150 Btu/lb = 71—81 cal/g = 3.0—3.4 X 10^5 J/kg
12.13 Heat of Combustion: (est.) —18,200 Btu/lb = —10,100 cal/g = —424 X 10^5 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

NOTES

NAPHTHA: STODDARD SOLVENT

NSS

Common Synonyms	Watery liquid	Colorless	Gasoline-like odor
Petroleum solvent Drycleaner naphtha Spotting naphtha	Floats on water.		

Stop discharge if possible. Keep people away.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with foam, dry chemical or carbon dioxide.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

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.
DO NOT INDUCE VOMITING.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: Not applicable
3.3 IMO/UN Designation: 3.3/1268
3.4 DOT ID No.: 1268
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Like gasoline

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Goggles or face shield (as for gasoline).
5.2 Symptoms Following Exposure: High concentration of vapors may cause intoxication. If liquid is swallowed, it may get into lungs by aspiration; not very irritating to skin or eyes.
5.3 Treatment of Exposure: INHALATION: remove patient from exposure; treat symptoms. INGESTION: do NOT induce vomiting! Call a doctor. EYES: flush with water for 15 min. SKIN: wipe off and wash with soap and water.
5.4 Threshold Limit Value: 200 ppm
5.5 Short Term Inhalation Limits: 500 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 Late Toxicity: None
5.8 Vapor (Gas) Irritant Characteristics: Vapors are nonirritating to the eyes and throat.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 10000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 110°F C.C.
6.2 Flammable Limits in Air: 0.8%-5.0%
6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide.
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 540°F (est.)
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 4 mm/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

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

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: Data not available
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

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

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 320—390°F = 160—199°C = 433—472°K
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 0.78 at 20°C (liquid)
12.8 Liquid Surface Tension: 19—23 dynes/cm = 0.019—0.023 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 39—51 dynes/cm = 0.039—0.051 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Data not available
12.11 Ratio of Specific Heats of Vapor (Gas): (est.) 1.030
12.12 Latent Heat of Vaporization: 130—150 Btu/lb = 71—81 cal/g = 3.0—3.4 X 10^5 J/kg
12.13 Heat of Combustion: (est.) —18,200 Btu/lb = —10,100 cal/g = —424 X 10^5 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: 0.1 psia

NOTES

NAPHTHA: VM & P

NVM

Common Synonyms	Watery liquid	Colorless	Gasoline-like odor
Petroleum solvent Light naphtha Painter's naphtha	Floats on water. Flammable, irritating vapor is produced.		

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Extinguish with foam, dry chemical or carbon dioxide.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness 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 or vomiting.
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.
DO NOT INDUCE VOMITING.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Floating to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Disperse and flush

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: Not applicable
3.3 IMO/UN Designation: 3.2/1255
3.4 DOT ID No.: 1255
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Like gasoline

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Goggles or face shield (as for gasoline).
5.2 Symptoms Following Exposure: Vapor irritates respiratory tract, causes coughing and mild depression. Aspiration causes severe lung irritation with coughing, gagging, and rapidly developing pulmonary edema. Ingestion irritates mouth and stomach, causes nausea, vomiting, swelling of abdomen, cardiac arrhythmias.
5.3 Treatment of Exposure: INHALATION: maintain respiration if required. INGESTION: do NOT induce vomiting; observe for pneumonia; support if central nervous system depression occurs. ASPIRATION: enforce rest; administer oxygen; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 Threshold Limit Value: Data not available
5.5 Short Term Inhalation Limits: 500 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 1; LD_{50} = 5 to 15 g/kg
5.7 Late Toxicity: None
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 spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 10,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 20-55°F C.C.
6.2 Flammable Limits in Air: 0.9%-6.7%
6.3 Fire Extinguishing Agents: Foam, carbon dioxide, or dry chemical
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: Vapor is heavier than air and may travel long distances to a source of ignition and flash back.
6.7 Ignition Temperature: 450°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 4 mm/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

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

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: Petroleum hydrocarbons (90%) plus aromatic hydrocarbons such as benzene and toluene (10%)
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U-V-W

11. HAZARD CLASSIFICATIONS

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

Category	Classification
Health Hazard (Blue)	1
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 200—300°F = 93—149°C = 366—422°K
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 0.75 at 20°C (liquid)
12.8 Liquid Surface Tension: 19—23 dynes/cm = 0.019—0.023 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 39—51 dynes/cm = 0.039—0.051 N/m at 20°C.
12.10 Vapor (Gas) Specific Gravity: Data not available
12.11 Ratio of Specific Heats of Vapor (Gas): (est.) 1.030
12.12 Latent Heat of Vaporization: 130—150 Btu/lb = 71—81 cal/g = 3.0—3.4 X 10^4 J/kg
12.13 Heat of Combustion: (est.) —18,200 Btu/lb = —10,100 cal/g = —424 X 10^4 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: 0.12 psia

NOTES

OILS, FUEL: 1-D

OOD

Common Synonyms	Oily liquid	Yellow-brown	Lube or fuel oil odor
Diesel oil (light)	Floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with dry chemical, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

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.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shorelines.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG 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

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Light brown
4.3 Odor: Characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.
5.2 Symptoms Following Exposure: INHALATION causes headache and slight giddiness. INGESTION causes nausea, vomiting, and cramping; depression of central nervous system ranging from mild headache to anesthesia, coma, and death; pulmonary irritation secondary to exhalation of solvent; signs of kidney and liver damage may be delayed. ASPIRATION causes severe lung irritation with coughing, gagging, dyspnea, substernal distress, and rapidly developing pulmonary edema; later, signs of bronchopneumonia and pneumonitis; acute onset of central nervous system excitement followed by depression.
5.3 Treatment of Exposure: INGESTION: do NOT induce vomiting; seek medical attention. ASPIRATION: enforce bed rest; administer oxygen. EYES: wash with copious quantity of water. SKIN: remove solvent by wiping and wash with soap and water.
5.4 Threshold Limit Value: No single value applicable.
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 1; LD_{50} = 5-15 g/kg
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Slight smarting of 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 smarting and reddening of skin.
5.10 Odor Threshold: 0.7 ppm
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 100°F C.C.
6.2 Flammable Limits in Air: 1.3%-6%
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: 350—625°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 4 mm/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

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

8. WATER POLLUTION

8.1 Aquatic Toxicity: 204 mg/1/24 hr/juvenile American shad/TL_m/salt water
8.2 Waterfowl Toxicity: 20 mg/kg LD_{50} (mallard)
8.3 Biological Oxygen Demand (BOD): Data not available
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Diesel fuel 1-D (ASTM)
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

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

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 360—660°F = 183—293°C = 456—566°K
12.4 Freezing Point: —30°F = —34°C = 240°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 0.81—0.85 at 15°C (liquid)
12.8 Liquid Surface Tension: 23—32 dynes/cm = 0.023—0.032 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 47—49 dynes/cm = 0.047—0.049 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: 110 Btu/lb = 60 cal/g = 2.5 X 10^4 J/kg
12.13 Heat of Combustion: —18,540 Btu/lb = —10,300 cal/g = —431.24 X 10^4 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

NOTES

OILS, MISCELLANEOUS: LUBRICATING

OLB

Common Synonyms	Oily liquid	Yellow-brown	Lube oil odor
Crankcase oil Transmission oil Motor oil	Floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with dry chemical, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

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.
DO NOT INDUCE VOMITING.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Fouling to shorelins.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: Not applicable
3.3 IMO/UN Designation: 3.3/1270
3.4 DOT ID No.: 1270
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Yellow fluorescent
4.3 Odor: Characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.
5.2 Symptoms Following Exposure: INGESTION: minimal gastrointestinal tract irritation; increased frequency of bowel passage may occur. ASPIRATION: pulmonary irritation is normally minimal but may become more severe several hours after exposure.
5.3 Treatment of Exposure: INGESTION: do NOT lavage or induce vomiting. ASPIRATION: treatment probably not required; delayed development of pulmonary irritation can be detected by serial chest x-rays. EYES: wash with copious quantity of water. SKIN: wipe off and wash with soap and water.
5.4 Threshold Limit Value: Data not available
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 1; LD_{50} = 5 to 15 g/kg
5.7 Late 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 spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 300°F C.C.
6.2 Flammable Limits in Air: Data not available
6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water or foam may cause frothing.
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 500°F-700°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 4 mm/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

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

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: Various viscosities
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

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

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	1
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: Very high
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: (est.) 0.902 at 20°C (liquid)
12.8 Liquid Surface Tension: 36-37.5 dynes/cm = 0.036—0.0375 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 33—54 dynes/cm = 0.033—0.054 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: —18,486 Btu/lb = —10,270 cal/g = —429.98 X 10^3 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

NOTES

OILS, MISCELLANEOUS: MOTOR

OMT

Common Synonyms	Oily liquid	Yellow-brown	Lube oil odor
Crankcase oil Lubricating oil Transmission oil	Floats on water.		

Stop discharge if possible.
Call fire department.
Avoid contact with liquid.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with dry chemical, foam or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

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.
DO NOT INDUCE VOMITING.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: Not applicable
3.3 IMO/UN Designation: 3.3/1270
3.4 DOT ID No.: 1270
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Yellow fluorescent
4.3 Odor: Characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.
5.2 Symptoms Following Exposure: INGESTION: *minimal gastrointestinal irritation*; increased frequency of bowel passage may occur. ASPIRATION: pulmonary irritation is normally minimal but may become more severe several hours after exposure.
5.3 Treatment of Exposure: INGESTION: do NOT lavage or induce vomiting. ASPIRATION: treatment probably not required; delayed development of pulmonary irritation can be detected by serial chest x-rays. EYES: wash with copious amounts of water. SKIN: wipe off oil and wash with soap and water.
5.4 Threshold Limit Value: Data not available
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 1; LD_{50} = 5 to 15 g/kg
5.7 Late 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 spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 275—600°F C.C.
6.2 Flammable Limits in Air: Data not available
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: 325—625°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 4 mm/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

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

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: Various viscosities
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

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

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: Very high
12.4 Freezing Point: —29.9°F = —34.4°C = 238.8°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 0.84—0.96 at 15°C (liquid)
12.8 Liquid Surface Tension: 36-37.5 dynes/cm = 0.036—0.0375 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 33—54 dynes/cm = 0.033—0.054 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: —18,486 Btu/lb = —10,270 cal/g = —429.98 X 10^4 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

NOTES

POLYCHLORINATED BIPHENYL

PCB

Common Synonyms			
PCB Chlorinated biphenyl Aroclor Halogenated waxes Polychloropolyphenyls	Oily liquid to solid powder	Light yellow liquid, or white powder	Weak odor
	Sinks in water.		

Stop discharge if possible. Keep people away.
Avoid contact with liquid and solid.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with water, foam, dry chemical, or carbon dioxide.

Exposure

CALL FOR MEDICAL AID.

LIQUID OR SOLID
Irritating to skin and eyes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-water contaminant
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: $(C_{12}H_{10-n}Cl_n$
3.3 IMO/UN Designation: Not listed
3.4 DOT ID No.: 2315
3.5 CAS Registry No.: 1336-36-3

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid or solid
4.2 Color: Pale yellow (liquid); colorless (solid)
4.3 Odor: Practically odorless

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Gloves and protective garments.
5.2 Symptoms Following Exposure: Acne from skin contact.
5.3 Treatment of Exposure: SKIN: wash with soap and water.
5.4 Threshold Limit Value: 0.5 to 1.0 mg/m³
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 2; oral rat LD_{50} = 3980 mg/kg
5.7 Late Toxicity: Causes chromosomal abnormalities in rats, birth defects in birds
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause severe irritation of eyes and throat and cause eye and lung injury. They cannot be tolerated even at low concentrations.
5.9 Liquid or Solid Irritant Characteristics: Contact with skin may cause irritation.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 5 to 10 mg/m³

6. FIRE HAZARDS

6.1 Flash Point: >286°F
6.2 Flammable Limits in Air: Data not available
6.3 Fire Extinguishing Agents: Water, foam, dry chemical, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Irritating gases are generated in fires.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Data not available
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Data not available
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

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Groups: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity: 0.279 ppm/96 hr/bluegill/TL_m/fresh water
0.005 ppm/336-1080 hr/pinfish/TL_m/salt water
8.2 Waterfowl Toxicity: LD_{50} 2000 ppm (mallard duck)
8.3 Biological Oxygen Demand (BOD): Very low
8.4 Food Chain Concentration Potential: High

9. SHIPPING INFORMATION

9.1 Grades of Purity: 11 grades (some liquid, some solids) which differ primarily in their chlorine content (20%-68% by weight)
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

II

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-E
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification: Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Solid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: Very high
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.3—1.8 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: 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: Not pertinent
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

NOTES

TOLUENE

TOL

Common Synonyms	Watery liquid	Colorless	Pleasant odor
Toluol Methylbenzene Methylbenzol	Floats on water. Flammable, irritating vapor is produced.		

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea, vomiting, headache, dizziness, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting or loss of consciousness.
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.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Aromatic Hydrocarbon
3.2 Formula: $C_6H_5CH_3$
3.3 IMO/UN Designation: 3.2/1294
3.4 DOT ID No.: 1294
3.5 CAS Registry No.: 108-88-3

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Pungent; aromatic, benzene-like; distinct, pleasant

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Air-supplied mask; goggles or face shield; plastic gloves.
5.2 Symptoms Following Exposure: Vapors irritate eyes and upper respiratory tract; cause dizziness, headache, anesthesia, respiratory arrest. Liquid irritates eyes and causes drying of skin. If aspirated, causes coughing, gagging, distress, and rapidly developing pulmonary edema. If ingested causes vomiting, griping, diarrhea, depressed respiration.
5.3 Treatment of Exposure: INHALATION: remove to fresh air, give artificial respiration and oxygen if needed; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 Threshold Limit Value: 100 ppm
5.5 Short Term Inhalation Limits: 600 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 Late Toxicity: Kidney and liver damage may follow ingestion.
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 spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 0.17 ppm
5.11 IDLH Value: 2,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 40°F C.C.; 55°F O.C.
6.2 Flammable Limits in Air: 1.27%-7%
6.3 Fire Extinguishing Agents: Carbon dioxide or dry chemical for small fires, ordinary foam for large fires.
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: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 997°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 5.7 mm/min.
6.10 Adiabatic Flame 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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 32

8. WATER POLLUTION

8.1 Aquatic Toxicity: 1180 mg/l/96 hr/sunfish/TL$_m$/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 0%, 5 days; 38% (theor), 8 days
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Research, reagent, nitration-at 99.8 + %; industrial: contains 94 + %, with 5% xylene and small amounts of benzene and nonaromatic hydrocarbons; 90/120: less pure than industrial.
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 92.14
12.3 Boiling Point at 1 atm: 231.1°F = 110.6°C = 383.8°K
12.4 Freezing Point: −139°F = −95.0°C = 178.2°K
12.5 Critical Temperature: 605.4°F = 318.6°C = 591.8°K
12.6 Critical Pressure: 596.1 psa = 40.55 atm = 4.108 MN/m²
12.7 Specific Gravity: 0.867 at 20°C (liquid)
12.8 Liquid Surface Tension: 29.0 dynes/cm = 0.0290 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 36.1 dynes/cm = 0.0361 N/m at 25°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.089
12.12 Latent Heat of Vaporization: 155 Btu/lb = 86.1 cal/g = 3.61 X 10⁴ J/kg
12.13 Heat of Combustion: −17,430 Btu/lb = −9686 cal/g = −405.5 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
12.25 Heat of Fusion: 17.17 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 1.1 psa

6. FIRE HAZARDS (Continued)

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

TRICHLOROETHANE

TCE

Common Synonyms	Watery liquid	Colorless	Sweet odor
1,1,1-Trichloroethane Methylchloroform Aerothene Chlorothene	Sinks in water. Irritating vapor is produced.		

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.

Fire

Combustible.
POISONOUS GASES ARE PRODUCED IN FIRE.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, carbon dioxide, or foam.

Exposure

CALL FOR MEDICAL AID.
VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness or difficult breathing.
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, may produce nausea.
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 and have victim induce vomiting.
IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.

Water Pollution

Effect of low concentrations on aquatic life is unknown.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Halogenated hydrocarbon
3.2 Formula: CH_3CCl_3
3.3 IMO/UN Designation: Not listed
3.4 DOT ID No.: 2831
3.5 CAS Registry No.: 71-55-6

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Chloroform-like; sweetish

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Organic vapor-acid gas canister; self-contained breathing apparatus for emergencies; neoprene or polyvinyl-alcohol-type gloves; chemical safety goggles and face shield; neoprene safety shoes (or leather safety shoes plus neoprene footwear); neoprene or polyvinyl alcohol suit or apron for splash protection.
5.2 Symptoms Following Exposure: INHALATION: symptoms range from loss of equilibrium and incoordination to loss of consciousness; high concentration can be fatal due to simple asphyxiation combined with loss of consciousness. INGESTION: produces effects similar to inhalation and may cause some feeling of nausea. EYES: slightly irritating and lachrymatory. SKIN: defatting action may cause dermatitis.
5.3 Treatment of Exposure: Get medical attention for all eye exposures and any other serious overexposures. Do NOT administer adrenalin or epinephrine; otherwise, treatment is symptomatic. INHALATION: remove victim to fresh air; if necessary, apply artificial respiration and/or administer oxygen. INGESTION: have victim drink water and induce vomiting. EYES: flush thoroughly with water. SKIN: remove contaminated clothing and wash exposed area thoroughly with soap and warm water.
5.4 Threshold Limit Value: 350 ppm
5.5 Short Term Inhalation Limits: 1,000 ppm for 60 min. in man
5.6 Toxicity by Ingestion: Grade 1; LD_{50} = 5 to 15 g/kg (rat, mouse, rabbit, guinea pig)
5.7 Late 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 spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 100 ppm
5.11 IDLH Value: 1,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: Data not available
6.2 Flammable Limits in Air: 7%-16%
6.3 Fire Extinguishing Agents: Dry chemical, foam, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Toxic and irritating gases are generated in fires.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 932°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: (est.) 2.9 mm/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

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: Reacts slowly, releasing corrosive hydrochloric acid.
7.2 Reactivity with Common Materials: Corrodes aluminum, but reaction is not hazardous.
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

8. WATER POLLUTION

8.1 Aquatic Toxicity:
75-150 ppm/*/perch/Tl$_m$/salt water
*Time period not specified.
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: Uninhibited; inhibited; industrial inhibited; white room; cold cleaning
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-X-Y

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-A
11.2 NAS 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	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	1
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 133.41
12.3 Boiling Point at 1 atm: 165°F = 74°C = 347°K
12.4 Freezing Point: <−38°F = <−38°C = <234°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.31 at 20°C (liquid)
12.8 Liquid Surface Tension: 25.4 dynes/cm = 0.0254 N/m at 20°C
12.9 Liquid Water Interfacial Tension: (est.) 45 dynes/cm = 0.045 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: 4.6
12.11 Ratio of Specific Heats of Vapor (Gas): 1.104
12.12 Latent Heat of Vaporization: 100 Btu/lb = 56 cal/g = 2.4 X 10^4 J/kg
12.13 Heat of Combustion: (est.) 4700 Btu/lb = 2600 cal/g = 110 X 10^4 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: 4.0 psia

NOTES

m-XYLENE

XLM

Common Synonyms	Watery liquid	Colorless	Sweet odor
1, 3-Dimethylbenzene Xylol	Floats on water. Flammable, irritating vapor is produced.		

Stop discharge if possible. Keep people away.
Call fire department.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Extinguish with foam, dry chemical, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose, and throat.
If inhaled, will cause headache, 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, or loss of consciousness.
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.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Aromatic Hydrocarbon
3.2 Formula: m-$C_6H_4(CH_3)_2$
3.3 IMO/UN Designation: 3.2/1307
3.4 DOT ID No.: 1307
3.5 CAS Registry No.: 108-38-3

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Like benzene; characteristic aromatic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.
5.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma; can be fatal. Kidney and liver damage can occur.
5.3 Treatment of Exposure: INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 Threshold Limit Value: 100 ppm
5.5 Short Term Inhalation Limits: 300 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 3; LD_{50} = 50 to 500 g/kg
5.7 Late Toxicity: Kidney and liver damage.
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 spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 0.05 ppm
5.11 IDLH Value: 10,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 84°F C.C.
6.2 Flammable Limits in Air: 1.1%-6.4%
6.3 Fire Extinguishing Agents: 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: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 986°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 5.8 mm/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

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 32

8. WATER POLLUTION

8.1 Aquatic Toxicity: 22 ppm/96 hr/bluegill/TL_m/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 0 lb/lb, 5 days; 0% (theor.), 8 days
8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION

9.1 Grades of Purity: Research: 99.99%; Pure: 99.9%; Technical: 99.2%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 106.16
12.3 Boiling Point at 1 atm: 288.4°F = 131.8°C = 405.1°K
12.4 Freezing Point: −54.2°F = −47.8°C = 225.3°K
12.5 Critical Temperature: 650.8°F = 343.8°C = 617.0°K
12.6 Critical Pressure: 513.8 atm = 34.95 psia = 3.540 MN/m²
12.7 Specific Gravity: 0.864 at 20°C (liquid)
12.8 Liquid Surface Tension: 28.8 dynes/cm = 0.0288 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 36.4 dynes/cm = 0.0364 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.071
12.12 Latent Heat of Vaporization: 147 Btu/lb = 81.9 cal/g = 3.43 X 10^4 J/kg
12.13 Heat of Combustion: −17,554 Btu/lb = −9752.4 cal/g = −408.31 X 10^4 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: 28.01 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 0.34 psia

NOTES

p-XYLENE

XLP

Common Synonyms	Watery liquid	Colorless	Sweet odor
1, 4-Dimethylbenzene Xylol	Floats on water. Flammable, irritating vapor is produced. Freezing point is 56°F.		

Stop discharge if possible. Keep people away.
Call fire department.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Extinguish with foam, dry chemical, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness, 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, loss of consciousness.
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.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Aromatic Hydrocarbon
3.2 Formula: p-$C_6H_4(CH_3)_2$
3.3 IMO/UN Designation: 3.2/1307
3.4 DOT ID No.: 1307
3.5 CAS Registry No.: 106-42-3

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Like benzene; characteristic aromatic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.
5.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma. Can be fatal. Kidney and liver damage can occur.
5.3 Treatment of Exposure: INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 Threshold Limit Value: 100 ppm
5.5 Short Term Inhalation Limits: 300 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 3; LD_{50} = 50 to 500 mg/kg
5.7 Late Toxicity: Kidney and liver damage.
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 spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 0.05 ppm
5.11 IDLH Value: 10,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 81°F C.C.
6.2 Flammable Limits in Air: 1.1%-6.6%
6.3 Fire Extinguishing Agents: 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: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 870°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 5.8 mm/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

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 32

8. WATER POLLUTION

8.1 Aquatic Toxicity: 22 ppm/96 hr/bluegill/TL_m/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 0 lb/lb in 5 days
8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION

9.1 Grades of Purity: Research: 99.99%; Pure: 99.8%; Technical: 99.0%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 18°C and 1 atm: Liquid
12.2 Molecular Weight: 106.16
12.3 Boiling Point at 1 atm: 280.9°F = 138.3°C = 411.5°K
12.4 Freezing Point: 55.9°F = 13.3°C = 286.5°K
12.5 Critical Temperature: 649.4°F = 343.0°C = 616.2°K
12.6 Critical Pressure: 509.4 atm = 34.66 psia = 3.510 MN/m²
12.7 Specific Gravity: 0.861 at 20°C (liquid)
12.8 Liquid Surface Tension: 28.3 dynes/cm = 0.0283 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 37.8 dynes/cm = 0.0378 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.071
12.12 Latent Heat of Vaporization: 150 Btu/lb = 81 cal/g = 3.4 X 10^5 J/kg
12.13 Heat of Combustion: −17,550 Btu/lb = −9754.7 cal/g = −408.41 X 10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.35 Heat of Fusion: 37.83 cal/g
12.36 Limiting Value: Data not available
12.37 Reid Vapor Pressure: 0.34 psia

NOTES

o-XYLENE

XLO

Common Synonyms
1. 2-Dimethylbenzene
Xylol

Watery liquid | Colorless | Sweet odor

Floats on water. Flammable, irritating vapor is produced.

Stop discharge if possible. Keep people away.
Call fire department.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Extinguish with foam, dry chemical, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause headache, 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, or loss of consciousness.
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.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Aromatic Hydrocarbon
3.2 Formula: o-$C_6H_4(CH_3)_2$
3.3 IMO/UN Designation: 3.2/1307
3.4 DOT ID No.: 1307
3.5 CAS Registry No.: 95-47-6

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Benzene-like; characteristic aromatic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.
5.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma. Can be fatal. Kidney and liver damage can occur.
5.3 Treatment of Exposure: INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 Threshold Limit Value: 100 ppm
5.5 Short Term Inhalation Limits: 300 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 3; LD_{50} = 50 to 500 mg/kg
5.7 Late Toxicity: Kidney and liver damage.
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 spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 0.05 ppm
5.11 IDLH Value: 10,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 63°F C.C.; 75°F O.C.
6.2 Flammable Limits in Air: 1.1%-7.0%
6.3 Fire Extinguishing Agents: 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: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 869°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 5.8 mm/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

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: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Motor Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 32

8. WATER POLLUTION

8.1 Aquatic Toxicity: >100 mg/l/96 hr/D. magna/TL_m/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 0 lb/lb, 5 days; 2.5% (theor.), 5 days
8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION

9.1 Grades of Purity: Research: 99.99%; Pure: 99.7%; Commercial: 95+%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No reaction
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 106.16
12.3 Boiling Point at 1 atm: 291.8°F = 144.4°C = 417.6°K
12.4 Freezing Point: −13.3°F = −25.2°C = 248.0°K
12.5 Critical Temperature: 674.8°F = 357.1°C = 630.3°K
12.6 Critical Pressure: 541.5 atm = 36.84 psia = 3.732 MN/m²
12.7 Specific Gravity: 0.880 at 20°C (liquid)
12.8 Liquid Surface Tension: 30.53 dynes/cm = 0.03053 N/m at 15.5°C
12.9 Liquid Water Interfacial Tension: 36.06 dynes/cm = 0.03606 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.088
12.12 Latent Heat of Vaporization: 149 Btu/lb = 82.9 cal/g = 3.47 X 10^5 J/kg
12.13 Heat of Combustion: −17,568 Btu/lb = −9754.7 cal/g = −408.41 X 10^5 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: 30.64 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 0.26 psia

NOTES

APPENDIX B

CONFINED SPACE ENTRY PROCEDURES

I. CONFINED SPACE CLASSIFICATION

Confined spaces are classified according to their existing or potential chemical and physical hazards. Classification is based on characteristics of the confined space, oxygen level, flammability, and toxicity. Table B-1 defines the parameters of each classification. If any of the hazards present a situation that is immediately dangerous to life and health (IDLH), the confined space is classified as Class A. Classification is determined by the most hazardous condition of entering, working in, and exiting a confined space. Class B confined spaces have the potential for causing injury and illness but are not IDLH. Class C entry is one in which the chemical hazard potential is minimal and does not require any special modification in work procedures.

II. ENTRY PROCEDURES

TEAM SIZE

A minimum of three workers is required for each confined space activity (two entry and one standby; or one entry, one rescue, and one standby).

The one entry/one rescue/one standby arrangement should only be used when the confined space is relatively small and/or the entry person will be in the line of sight at all times. In this instance, the rescue person acts as the second person in the "buddy system."

The two entry/one standby arrangement is used when the area of the confined space is larger, and the tasks may take the worker away from the entryway. Again, care must be taken with this arrangement because the standby person cannot enter the confined space and attempt rescue unless adequately protected (i.e., respiratory and dermal) and replaced by another qualified standby person.

This number of workers is the minimum required for these activities and, in most cases, should only be used for relatively nonhazardous confined spaces. Additional crew may be needed if entering a Class A or B confined space. Additional crew could include rescue, decontamination, and line-of-sight personnel.

GENERAL ENTRY PROCEDURES

The following steps must be taken when entering a confined space.

1. Inspect all pieces of equipment to ensure they are in good working order. DO NOT ENTER CONFINED SPACE WITH DEFECTIVE EQUIPMENT.

2. Conduct a background check to identify all potential hazards that may be encountered in the confined space. Determine if there is a potential for fire/explosion hazards, as well as a potential for a toxic or oxygen-deficient atmosphere.

3. Before entry, the atmosphere inside the confined space must be tested. An attempt should be made to test the atmosphere without opening the entryway (i.e., through a vent line or a small opening). If the entryway must be opened to test and only low levels are expected in the confined space, crack open entryway, test breathing zone first, and then test the confined space. If potentially high levels are expected in the breathing zone, respiratory protection should be worn prior to opening the entryway cover.

4. If explosive, toxic, or oxygen-deficient atmosphere is detected, purge or ventilate the confined space prior to entry. Retest the atmosphere three times at 5-minute intervals. A person can enter the confined space without respiratory protection only if all three test results are below the Permissible Exposure Limit/Threshold Limit Value (PEL/TLV), 10 percent of the LEL, and above 19.5-percent oxygen (all three conditions must be met).

   (NOTE: Any downward deflection of the readings on the oxygen meter from background (i.e., 20.9 percent) should be viewed as a potential for an IDLH atmosphere. Unless contaminants are known to be nontoxic, do not enter the confined space without respiratory protection if the oxygen level is below background. See Section 6.1.)

5. Blank, block, or otherwise isolate, lockout, and tag all chemical, physical, and/or electrical hazards wherever possible. (See Section 6.2.)

6. If using an air-purifying respirator or if an IDLH and/or explosive atmosphere exists, air monitoring must be on a continuous basis. If respiratory protection is not used and there is potential for atmospheric conditions to change due to work practices or conditions, air monitoring should be done periodically. In all these cases, a 5-minute escape pack must be used.

7. Record all results of the tests for hazardous conditions including the location, time, date, weather (if applicable), and readings on the PID, combustible gas meter, oxygen deficiency meter, Draeger tubes, and any other equipment used on the "Confined Space Entry Checklist-General Entry" form. Send a copy of the completed form to the Health and Safety Supervisor (HSS).

8. Wear appropriate clothing for site conditions, as determined by the Health and Safety Officer (HSO).

9. A safety belt or harness with lifeline must be worn if hazardous conditions exist, although good safety precautions dictate their use regardless of "existing" conditions. If the diameter of the entryway is less than 18 inches, the wrist-type harness must be used (see Section 9.8) and special provisions made if a supplied air respirator is necessary.

10. One person (standby) must remain at the entryway at all times and must keep continuous contact with the person entering the confined space. Contact can be maintained by line of sight, listening for sounds, the safety line,

and/or radio. The standby person must not enter the confined space unless another trained person is available to act as standby, and he/she is equipped with adequate respiratory and dermal protection. (In most cases, respiratory protection would be an airline respirator or SCBA.)

11. Do not smoke when working in or near confined spaces and do not take flash-lighted photographs when explosive gases are known or suspected to be present.

12. Do not rely on permanent ladders because they are often in poor condition. If they must be used, be sure of footing. Inspect permanent ladders for deterioration before entering and while descending. Try each step with one foot, while standing on the step above. When in doubt, use a portable ladder of adequate height to reach 3 feet above opening or a rope ladder, or lower the entry person using the tripod. If a portable ladder is used, it should be tied off, if possible; otherwise, it should be held in place by the standby person.

13. Do not work without adequate lighting. Use only "explosion-proof" lights or hand lamps.

14. The entry person must not remain in the confined space if he/she becomes even slightly drowsy, faint, dizzy, or otherwise uncomfortable. Many of the gases that cause the most problems are odorless, tasteless, and colorless.

APPENDIX C

ACCIDENT/INCIDENT REPORT

ACCIDENT REPORT

Site:_____ Project No.:_____

Location:_____

Location of Accident if different from above:_____

_____

Name and Address of Injured:_____

_____

SSN:_____ DOB:_____ Sex: _____

Years of Service:_____ Time on Present Job:_____ Department No.:_____

Title/Classification:_____

Date of Accident:_____ Time of Accident:_____

Name of Witness:_____ Telephone No.:_____

Address:_____

Accident Category: ___ Motor Vehicle ___ Property Damage ___ Fire
___ Chemical Exposure ___ Near Miss ___ Other

Severity of Injury or Illness: ___ Non-disabling ___ Disabling
___ Medical Treatment ___ Fatality

Amount of Damage $_____ Property Damaged:_____

CLASSIFICATION OF INJURY

___ Fractures
___ Dislocations
___ Sprains
___ Abrasions
___ Lacerations
___ Punctures
___ Bites
___ Respiratory-Allergy
___ Other (explain)_____

___ Heat Burns
___ Chemical Burns
___ Radiation Burns
___ Concussion
___ Toxic-Respiratory
___ Toxic-Ingestion
___ Toxic-Dermal

___ Cold Exposure
___ Heat Stroke
___ Faint/Dizziness
___ Blisters
___ Bruises
___ Poison Ivy
___ Headache

Parts of Body Affected:_____

Degree of Disability:_____

Date Medical Care was Received:_____ Emergency Service?_____

Name and Address of Medical Facility:_____

_____

Follow-up Exam Required?_____ Estimated No. of Days Away From Job:_____

ACCIDENT INFORMATION (use the back of sheet as required)

Causative agent most directly related to accident (object, substance, material, machinery, equipment, condition):

Was weather a factor? How?

Unsafe mechanical/physical/environmental conditions at the time of accident? (be specific):

Unsafe act by injured and/or others contributing to the accident? (be specific):

Personal factors (improper attitude, lack of knowledge or skill, slow reaction, fatigue, inattention, horseplay):

MODIFICATIONS

Level of personal protective equipment required in site safety plan:_____

Was injured using required equipment?_____

If not, how did actual equipment use differ from plan?

Was personal protective equipment required in site safety plan adequate for site conditions?_____

If no, what additional equipment was needed:

What can be done to prevent a reoccurrence of this type of accident? (modification of machine, mechanical guards, modification of work practices, training):

DETAILED NARRATIVE DESCRIPTION (how did this accident occur, why; objects, equipment, tools used, circumstance of assigned duties. Be specific.)

Signature of Preparer:_____ Date:_____

Signature of Site Manager:_____ Date:_____

SEND COPIES OF COMPLETED FORM TO HUMAN RESOURCES
AND THE HEALTH AND SAFETY SUPERVISOR

APPENDIX D

RESPIRATOR PROTECTION PROGRAM

E.C. JORDAN CO.
RESPIRATORY PROTECTION PROGRAM

I. INTRODUCTION

This program has been developed to govern the selection and use of respiratory protective devices by E.C. Jordan Co. (Jordan) personnel. The program is intended to comply with Occupational Safety and Health Administration (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.

II. PERSONNEL REQUIREMENTS

All personnel assigned to field activities at hazardous or potentially hazardous locations are currently required by Jordan's Health and Safety policies to be enrolled in the corporate Health Monitoring Program. A portion of this program involves spirometry, a measure of the respiratory system status. No personnel may be assigned to the use of, or withdraw from stock, any respiratory protective device without physician certification that use of such a 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.

No personnel will be assigned duties which require a respirator when facial hair, skullcaps or eye glasses will interfere with a proper fit. No contact lenses may be worn with any respiratory protective device. Eyeglass frames which fit inside the respirator facepiece are provided as necessary.

III. APPLICABLE EQUIPMENT

Jordan maintains the following respiratory protective equipment:

- full-face chemical/mechanical air purifying respirators
- self-contained breathing apparatus
- full-face air line-supplied breathing apparatus
- 5-minute escape air supply

This equipment is intended for use on an as needed basis, to be determined by an evaluation of on-site conditions. Respiratory protective equipment should not be used arbitrarily by any Jordan personnel.

Selection criteria are presented separately; training is required in the use of <u>each</u> type of equipment prior to drawing from stock.

IV. 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:

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

Information regarding each topic is presented as standard respiratory protection procedures.

V. STANDARD RESPIRATORY PROTECTION PROCEDURES

The following information has been organized and presented by topic as Standard Respiratory Protection Procedures, to be used both in training and as reference material for field operations.

Standard Respiratory Protection Procedure No.	Topic
1	Respiratory Protection Principles
2	Selection of Respirators
3	Fit Testing
4	Inspection/Maintenance/Storage

These procedures are attached.

VI. PROGRAM ADMINISTRATION AND DOCUMENTATION

The administration of Jordan's Respiratory Protection Program is the responsibility of the Health and Safety Supervisor. Administration includes:

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

Written HASPs for each site, and site hazard assessments result in respirator selection in accordance with the decision logic set forth in Standard Respiratory Protection Procedure No. 2.

Fit testing and respirator maintenance is performed by the equipment manager of Jordan's Sample Control and Staging Center under the administration of the HSS.

Major maintenance is performed by manufacturer certified technicians only. Personnel training in respiratory protection is one aspect of the HSS's ongoing personnel training programs.

Program evaluation is a dynamic process, occurring each time a Project HASP is prepared.

Medical supervision of personnel occurs as part of Jordan's Health Monitoring Program, also administered by the HSS. Medical surveillance is required for all personnel assigned to hazardous or potentially hazardous site activities.

Documentation of the various elements of Jordan's Respiratory Protection Program is achieved through several media:

- 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.

- Documentation of fit-testing is maintained on file with the equipment manager of the Sample Control and Staging Center, utilizing the appropriate form. (Exhibit 1)

- 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 for each respirator, SCBA, and escape respirator by the equipment manager. (Exhibit 2)

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

Exhibit 1

Respirator Fit Test Worksheet

RESPIRATOR FIT TEST WORKSHEET

Applicant Name _____

Organization _____

Date of Test _____

Employee Number _____

Equipment Type _____

Manufacturer _____

Model/Size _____

Test Conducted by _____

TEST RESULTS

(1) Negative Pressure Test — Pass ( ) Fail ( ) _____

(2) Positive Pressure Test — Pass ( ) Fail ( ) _____

(3) Isoamyl Acetate Vapor Test.
Initial Odor Recognition — Yes ( ) No ( ) _____
Odor Detected w/ Respirator On — Yes ( ) No ( ) _____

(4) Irritant Smoke Test
Irritant Detected — Yes ( ) No ( ) _____

Employee briefed on fundamental principals of respiratory protection, use, inspection, cleaning, maintenance and storage of equipment
Yes ( ) No ( )

ADDITIONAL INFORMATION

Last Employee Physical Exam Conducted on _____
Stress Test Included Yes ( ) No ( )

At Medical Facility _____

Corrective Lenses Required for Normal Work Tasks Yes ( ) No ( )

Facial Characteristics: Clean Shaven ( ) Beard ( ) Other ( ) _____
Specify

Follow-up Physical Due _____

I hereby certify the subject employee has been fit tested according to procedures specified in RESPIRATORY PROTECTION PROCEDURE NO. 3.

_____ Tester Name

_____ Date

Exhibit 2

Respirator Use & Maintenance Record

RESPIRATOR USE AND MAINTENANCE RECORD

Respirator

ID Number

Respirator Type _____

Manufacturer _____

Model Number _____ Date Place In Service _____

Date	Assigned to Whom or Location of Storage	Inspection/Maintenance and Charging (SCBAs) Information	Serviced By

STANDARD RESPIRATORY PROTECTION PROCEDURE NO. 1
RESPIRATORY PROTECTION PRINCIPLES

1.1 INTRODUCTION

Since the lungs are not completely effective in protecting the body against respirable chemical hazards, they must be artificially protected from toxic gases, vapors, and particulates. In addition, the body must be supplied with enough oxygen to maintain a normal capacity to perform tasks.

1.2 ROUTES OF EXPOSURE

The volume of air inhaled during "normal" activities is approximately 6 ℓ/min. The volume of air inhaled during brisk activity or during periods of stress can go up to 75 ℓ/min (a 12-fold increase).

Air is inhaled through the nose and mouth and travels an extremely turbulent path to the lungs. This turbulency results in the air impinging on many sites, thus allowing the insoluble particulates to become impacted and soluble particulates, vapors, and gases to become absorbed.

The inhaled air passes through the pharynx, the common passageway for both food and air, and enters the trachea at the larynx. The trachea (or windpipe) divides into two bronchi, which lead to the two lungs. All of these organs are collectively called the conducting tubes, since they lead the air to the alveoli, the site of gaseous exchange with the pulmonary capillaries (i.e., the blood).

Toxic substances may be absorbed at any point in the respiratory tract. The conducting tubes are lined with mucus and cilia. Insoluble contaminants caught in the mucus are swept up to the esophagus by the cilia and swallowed, thus causing an ingestion problem.

1.3 OXYGEN DEFICIENCY

1.3.1 Oxygen and the Respiratory Process

The chemical composition of normal air is presented below as Table 1.

Table 1. Atmospheric Composition

Gas	Volume (%)	Partial Pressure (mm Hg at sea level)
Nitrogen	78.9	594
Oxygen	20.95	159
Argon	0.93	7
Carbon dioxide	0.04	0.03

It is not the percentage of oxygen in the air, but rather its partial pressure, that is important in respiration. As one increases in altitude, the percentage of oxygen stays constant, but its partial pressure drops. Additionally, as the percentage of oxygen in the air drops, so does its partial pressure.

The "anatomic dead space volume" of the respiratory tract is about 150 ml. The average breath draws in about 500 ml of air. This air is mixed with the air remaining in the dead space from the previous exhalation, which has been depleted in oxygen due to the normal respiratory process. The overall effect is a lower partial pressure of oxygen in the respiratory tract as compared with the ambient air. The average respirator adds about 100 ml of dead space to the respiratory system, which further lowers the partial pressure of oxygen in the respiratory system, causing a slight oxygen deficiency.

1.3.2 Oxygen Levels/Physiological Effect

The currently accepted National Institute for Occupational Safety and Health (NIOSH) standards specify that if an atmosphere contains less than 19.5 percent by volume oxygen at sea level, then an atmosphere-supplying device must be used.

Note that as altitude increases, the percentage of oxygen stays constant, but the partial pressure drops. There is currently no standard that accounts for the drop in partial pressure with altitude; the problem is currently under study by NIOSH.

The physiological effects of oxygen deficiency are indicated in Table 2.

1.4 PARTICULATE CONTAMINANTS - AEROSOLS

Aerosol is a term used to describe particulates in air without regard to their origin. Particulates are collected on the walls of the respiratory tract depending upon their size as follows:

1. Pharynx - 10-30 µm
2. Trachea - 10 µm
3. Bronchus - 5-10 µm
4. Alveoli - 0.1-1 µm

Particulates less than 0.5 µm may never be deposited in the respiratory tract and may simply be exhaled.

Particulates affect the human body as follows:

1. Nuisances - inert substances that cause no lung damage but inhibit proper functioning of the lungs.

2. Inert pulmonary reaction causing substances - substances that produce nonspecific pulmonary effects.

Table 2. Physiological Effects of Oxygen Deficiency

Oxygen Volume Percentage at Sea Level	Physiological Effect
16-12	Increased breathing volume. Accelerated heartbeat. Impaired attention and thinking. Impaired coordination.
14-10	Very faulty judgment. Very poor muscular coordination. Muscular exertion causes rapid fatigue that may cause permanent heart damage. Intermittent respiration.
10-6	Nausea. Vomiting. Inability to perform vigorous movement, or loss of all movement. Unconsciousness, followed by death.
Less than 6	Spasmatic breathing. Convulsive movements. Death in minutes.

3. Pulmonary fibrosis causing substances - substances that produce effects ranging from nodule production to serious diseases such as asbestosis.

4. Irritants - substances that irritate, inflame, or ulcerate lung tissues.

5. Systemic poisons - substances that cause injury to specific organs and body systems.

6. Allergens - substances that produce hypersensitivity.

1.5 GASEOUS CONTAMINANTS

Gaseous contaminants are "filtered" to a small degree by the respiratory tract before they reach the alveolar spaces. However, if the contaminants are soluble, they can be directly absorbed through the walls of the respiratory tract.

Gaseous contaminants affect the human body as follows:

1. Irritants - corrosive compounds that injure and inflame tissue.

2. Asphyxiants - substances that displace oxygen or prevent the use of oxygen by the body.

3. Anesthetics - substances that depress the central nervous system and cause intoxication or loss of sensation.

4. Systemic poisons - substances that cause diseases.

1.6 EXPRESSING AIR CONTAINMENT CONCENTRATIONS

Any substances that are not normal components of breathing air (oxygen, nitrogen, etc.) are considered to be contaminants. The respiratory threat posed by contaminants is a function of the actual contaminant and its concentration in the air. The concentration is expressed in a variety of ways, as listed below.

1. Particulates

   a. mppcf - millions of particulates per cubic foot.

   b. ppcc - particles per cubic centimeter.

   c. mg/m^3 - milligrams per cubic meter.

2. Gases and Vapors

   a. ppm - volumes per million volumes of air (parts per million).

   b. ppb - volumes per billion volumes of air (parts per billion).

c. mg/m^3 - milligrams of gas per cubic meter.

d. Conversion of units. The following equation converts mg/m^3 to ppm, at 24°C and 760 mm Hg.

$$ppm = \frac{24.45}{\text{molecular weight}} \; mg/m^3,$$

This equation is extremely useful for determining respiratory protection requirements.

1.7 MEASURES OF RESPIRATORY HAZARDS

Every contaminant contained in breathing air has a limit, above which it becomes a threat to human health. These limits are determined either from animal studies or from epidemiological data. Unfortunately, animal studies can only approximate human response and may vary widely for individual chemicals. Epidemiological studies, although capable of providing a more precise forecast of human response, are limited by a lack of accurate records and a lack of controlled studies. Therefore, the "safe" limits of various chemicals must be viewed only as guidelines. Furthermore, these guidelines are primarily designed for the industrial situation where an individual is being exposed to one or two well-defined substances. These guidelines do not address the problems of synergism, potentiation, or allergic response.

The guidelines used in measuring respiratory hazards are listed below.

1. Threshold Limit Value. The threshold limit value (TLV) is recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) and is derived from consensus review. It is a time-weighted average concentration set for a particular substance that represents a level that almost all workers can be exposed to for an 8-hr day (40-hr week) without suffering adverse health effects. It is assumed that following each 8-hr. exposure there will be a 16-hr. recovery period and that after 5 days there will be a 48-hr. recovery period. The TLV lists are revised on a yearly basis.

2. Permissible Exposure Limits. The permissible exposure limits (PELs) are set forth in the Occupational Safety and Health Administration (OSHA) Standards 29 CFR 1910.1000, Tables Z-1, Z-2, and Z-3. These levels were promulgated initially from the ACGIH TLV lists (1968). As part of the law, they represent the legal maximum concentrations for personnel exposure. They are not updated on a yearly basis, as is the TLV list. Therefore, the most current ACGIH TLV is used in determining respiratory protection, rather than the PEL listing.

3. Immediately Dangerous to Life and Health. 30 CFR 11.3 defines conditions that are immediately dangerous to life and health (IDLH) as "conditions that pose an immediate threat to life or health or conditions that pose an immediate threat of severe exposure to contaminants such as radioactive materials, which are likely to have an adverse cumulative or delayed effect on health".

OSHA adds these criteria:

a. The worker must be able to escape without losing his life or suffering permanent health damage within 30 minutes.

b. The worker must be able to escape without severe eye or respiratory irritation or other reactions.

4. Lower Flammable Limit. The lower flammable limit (LFL) is the lowest concentration by volume of a gas or vapor in air that will explode when there is an ignition source.

1.8 RESPIRATORY PROTECTION

When it has been determined that the ambient atmosphere is hazardous, it becomes necessary to protect the individual by:

1. avoiding and/or minimizing exposure;
2. applying engineering controls such as ventilation; and
3. using a respirator to either filter the air or supply air.

The legal requirements for respiratory protection are summarized below.

1. Williams and Steiger Occupational Safety and Health Act of 1970 established standards that state that "approved or accepted respirators shall be used when they are available".

2. 29 CFR 1910.134 gives legal requirements for the selection and use of respiratory equipment as promulgated by OSHA and based on American National Standards Institute (ANSI) Standard Z88.2, "American National Standards Practices for Respiratory Protection". Standard Z88.2 was originally a consensus standard, but now has been cited as a Federal regulation.

3. 30 CFR Part 11 describes tests for permissibility of respiratory protective apparatus and updates or deletes approvals. 30 CFR Part 11 also cites ANSI Z88.2 as the basis for respiratory protection.

STANDARD RESPIRATORY PROTECTION PROCEDURE NO. 2
SELECTION OF RESPIRATORS

2.1 INTRODUCTION

This text is based on "Joint NIOSH/OSHA Standards Completion Program - Respirator Decision Logic". The text is excerpted for the purpose of covering the major points of the respirator decision logic. For the complete text, see John S. Pritchard's, "A Guide to Industrial Respiratory Protection" (U.S. Department of Health, Education, and Welfare, U.S. Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, Cincinnati, Ohio, June 1976). It is not intended to be all-inclusive in content.

The purpose of the respirator decision logic is to provide technical accuracy and uniformity in the selection of respirators and to provide necessary criteria to support this selection. The decision logic is a step-by-step elimination of inappropriate respirators until only those that are acceptable remain. Judgment by persons knowledgeable of inhalation hazards and respiratory protection equipment is essential to ensure appropriate selection of respirators.

The primary technical criteria for what constitutes a permissible respirator are based on the technical requirements of 30 CFR 11. The health standards will allow only respirators approved under 30 CFR 11. Classes of respirators are only included when at least one device has been approved.

Protection factors are criteria used in determining what limiting concentrations are to be permitted for each respirator type that will afford adequate protection to the wearer. The referenced Subparts of 30 CFR 11 give technical descriptions concerning each type or class of respirators referenced in the decision logic; 30 CFR 11 should be used with the decision logic in order to properly understand the criteria for the specification of allowable respirators.

Throughout this text, reference is made to PELs. Prudent, accepted practice dictates the use of current ACGIH TLVs, which are updated each year, in the place of the PEL, which is only periodically updated.

2.2 GENERAL DECISION LOGIC FLOWCHART

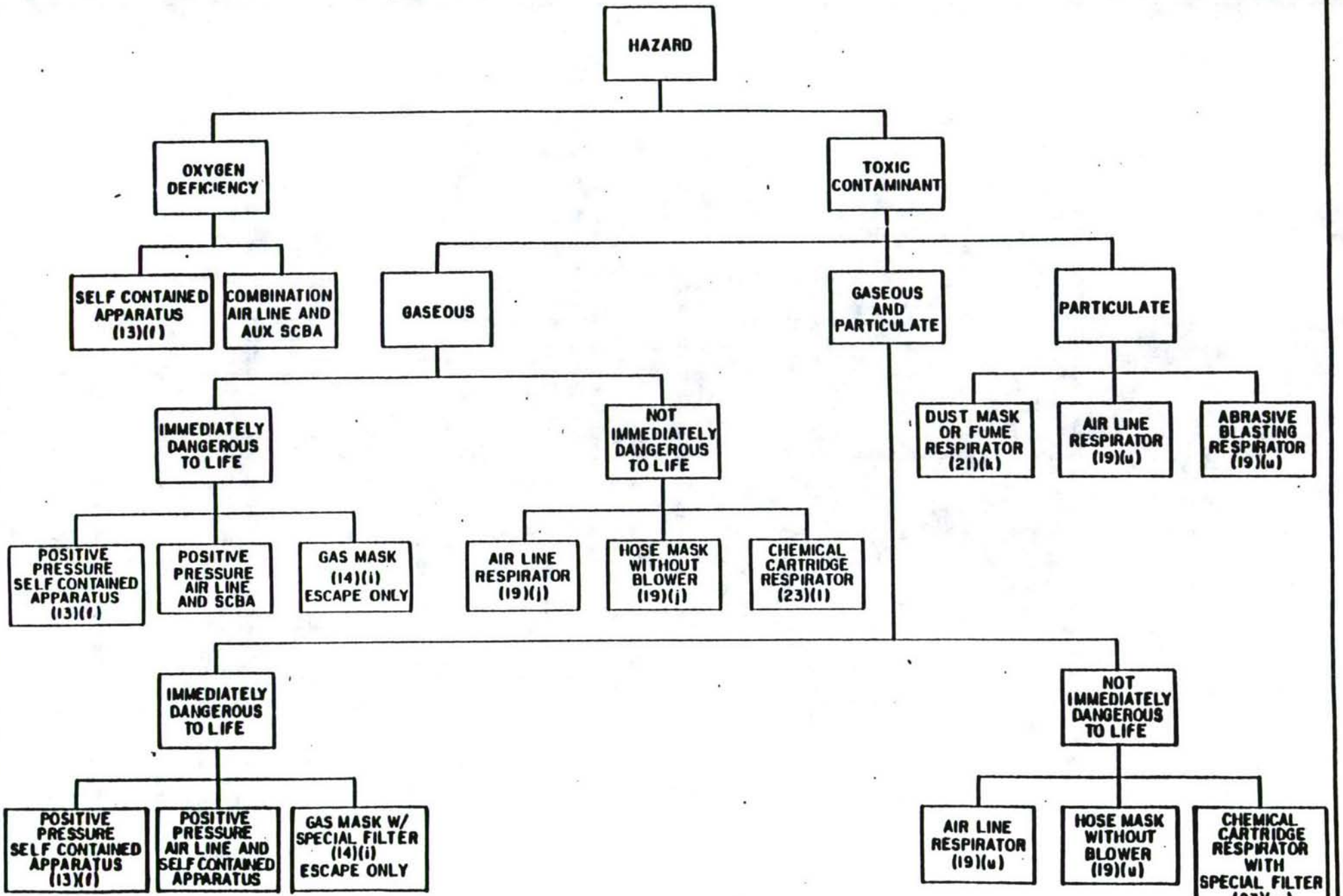
The following material used in concert with the decision logic chart (Figure 1) provides a formalized selection guide for respiratory protection.

1. Step 1 - Assemble Information on Substance. Assemble necessary toxicological, safety, and research information for the particular contaminant. The following are required:

   a. Permissible exposure limits specified in 29 CFR 1910.1000 (Tables Z-1, Z-2, and Z-3).

   b. Warning properties if the substance is a gas or a vapor.

   c. Eye irritation potential of the substance.



BASED ON BUREAU OF MINES INFORMATION CIRCULAR 7792
NUMBERS IN PARENTHESIS REFER TO BUREAU OF MINES SCHEDULES
LETTERS IN PARENTHESIS REFER TO SUBPART OF NIOSH/MESA 30 CFR PART 11

FIGURE 1
SELECTION OF RESPIRATORY EQUIPMENT (LUNDIN, A., 1979)

d. LFL for the substance.

e. IDLH concentration for the substance.

f. Any possibility of poor sorbent efficiency at IDLH concentration and below.

g. Any possibility of systemic injury of death resulting from absorbance of the substance (as a gas or vapor) through the skin.

h. Any possibility of severe skin irritation resulting from contact of the skin with corrosive gases, vapors, or particulates.

i. The vapor pressure of the substance (and equivalent ppm).

j. Any possibility of high heat of reaction with sorbent material in cartridge or canister.

2. Step 2 - Determine Physical State of Substance. Determine the physical state(s) of the substance as it is likely to be encountered in the occupational environment. It will be either (1) gas or vapor; (2) particulate (dust, fume or mist); or (3) combination of (1) and (2).

3. Step 3 - Assemble a Table of Permissible Respiratory Protection for Substance. This is done using the material from Step 1 and the appropriate specific decision logic chart from Section 2.3 below and respirator protection factors. Classes of respirators are only included where at least one device has been approved.

4. IF STEPS 1 THROUGH 3 CANNOT BE COMPLETED, THE ATMOSPHERE IS UNKNOWN AND MUST BE CLASSIFIED IDLH. ONLY POSITIVE PRESSURE SCBA MAY BE SELECTED.

2.3 SPECIFIC DECISION LOGIC CHARTS

A decision logic chart for respiratory protection against gases or vapors and against particulates is shown as Figure 1.

2.4 DECISION LOGIC CRITERIA

2.4.1 Skin Absorption and Irritation

Respirator selection criteria are based primarily on the inhalation hazard of the substance. A supplied-air suit may protect the skin from extremely toxic substances that may be absorbed through the skin or from substances which may cause severe skin irritation or injury.

Supplied-air suits are not covered in 30 CFR 11. Data are not available upon which to make recommendations for supplied-air suits for all types of exposures.

Where information is available indicating systemic injury or death resulting from absorbance of gas or vapor through the skin or where severe skin irritation or injury may occur from exposure to a gas, corrosive vapor, or

particulate, the following statement is included as a footnote to the respirator tables, and both the employee and employer are cautioned in the appendices concerning their use:

> Use of supplied-air suit may be necessary to prevent skin contact and respiratory exposure from airborne concentrations of (specific substance). Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life-endangering characteristics of supplied-air suits. Where supplied-air suits are used above a concentration which may be IDLH (concentration), an auxiliary positive-pressure self-contained breathing apparatus must also be worn.

As a guideline for inclusion of the supplied air-suit statement for substances that are sorbed through the skin, a single skin penetration LD_{50} of 2 g/kg for any species is used.

2.4.2 Poor Warning Properties (Refer to Table 1)

It is important to realize that 30 CFR 11 approvals for air-purifying (organic vapor) devices prohibit use against organic vapors with poor warning properties.

Warning properties include odor, eye irritation, and respiratory irritation. Warning properties relying upon human senses are not foolproof. However, they provide some indication to the wearer of possible sorbent exhaustion or of poor facepiece fit or other respirator malfunction.

Adequate warning properties can be assumed when the substance odor, taste, or irritation effects are detectable and persistent at concentrations at or below the permissible exposure limit.

If the odor or irritation threshold of a substance is more than three times greater than the permissible exposure limit, this substance should be considered to have poor warning properties. If the substance odor or irritation threshold is somewhat above the permissible exposure limit (not in excess of three times the limit) and there is no ceiling limit, consideration is given to whether undetected exposure in this concentration range could cause serious or irreversible health effects. If not, the substance is considered to have adequate warning properties. Some substances have extremely low thresholds of odor and irritation in relation to the permissible exposure limit. Because of this, these substances can be detected by a worker within the facepiece of the respirator even when the respirator is functioning properly. These substances are, therefore, considered to have poor warning properties.

Though 30 CFR 11 does not specifically eliminate air-purifying respirators for pesticides with poor warning properties, prudent practice dictates that a respirator should not be used to protect against any substance with poor warning properties.

TABLE 1. COMPARISON OF ODOR THRESHOLDS AND TLVs FOR SELECTED CHEMICAL COMPOUNDS

Compounds	Odor Threshold (ppm)	TLV (ppm)
Group 1 - Odor Threshold Below or Approximately the Same as the TLV		
Acrolein	0.2	0.1
Carbon tetrachloride	10	5
Carbon disulfide	0.21	10
Cyclohexane	300	300
Cyclohexanol	100	50
Epichlorhydrin	10	2
Ethyl benzene	140	100
Ethylene diamine	11	10
Hydrogen chloride	10	5
Methyl acetate	200	200
Methylamine	10	10
Methyl chloride	25	50
Methyl chloroform	300	350
Nitrogen dioxide	5	3
Propyl alcohol	200	200
Turpentine	200	100
Group 2 - Odor Threshold from 2 to 10 Times the TLV		
Allyl alcohol	7	2
Arsine	0.21	0.05
Crotonaldehyde	7	2
1,2 Dichloroethylene	500	200
Dichloroethyl ether	35	5
Dimethyl acetamide	46	10
Dimethyl formamide	100	10
Hydrogen selenide	0.3	0.05
Isopropyl glycidyl ether (IGE)	300	50
Styrene monomer	200	50
Group 3 - Odor Threshold Equal to or Greater Than 10 Times TLV		
Acrylonitrile	21	2
Bromoform	530	0.5
Camphor (synthetic)	1.6-200	2
Chloroacetophenone	1	0.05
Chloroform	200	10
Chloropicrin	1	0.1
Diglycidyl ether (DGE)	5	0.1

TABLE 1. COMPARISON OF ODOR THRESHOLDS AND TLVs
FOR SELECTED CHEMICAL COMPOUNDS (cont.)

Compounds	Odor Threshold (ppm)	TLV (ppm)
Group 3 - Odor Threshold Equal to or Greater Than 10 Times TLV (cont.)		
Ethylene oxide	500	1
Mercury vapor	(a)	0.05 mg/m³
Methyl bromide	(a)	5
Methyl formate	2000	100
Methanol	2000	200
Methyl cyclohexanol	500	50
Phosgene	1.0	0.1
Phosphine	(a)	0.3
Radioactive gases and vapors	(a)	
Toluene 2,4 diisocyanate (TDI)	2	0.005

(a) Information not Available

2.4.3 Sorbents

There are certain limitations involved with the use of sorbents in cartridge/canister sorbents. When the following conditions occur, a sorbent cartridge is not recommended:

1. Where supporting evidence exists of immediate (less than 3 min.) breakthrough time at the IDLH concentration and below for a cartridge or canister sorbent, air-purifying devices shall not be allowed for any use, escape or otherwise. See Table 2.

2. Where there is reason to suspect that commonly used sorbents (e.g., activated charcoal) do not provide adequate sorption efficiency against a specific contaminant, use of such sorbents shall not be allowed. However, where another sorbent material has been demonstrated to be effective against a specific contaminant, approved respirators using the effective sorbent material shall be allowed.

3. Where there is reason to suspect that a sorbent has a high heat of reaction with a substance, use of that sorbent is not allowed.

4. Where there is reason to suspect that a substance sorbed on a sorbent of a cartridge or canister is shock sensitive, use of air-purifying respirators is disallowed.

2.4.4 Eye Irritation

In addition to respiratory protection, it is important to consider a chemical's potential for producing eye irritation or damage. The following guidelines deal with eye protection:

1. For routine work operations, any perceptible eye irritation is considered unacceptable. Therefore, only full facepiece respirators are permissible in contaminant concentrations that produce eye irritation. Protection may be required in certain concentrations of gases and vapors. For escape, some eye irritation is permissible if it is determined that such irritation would not inhibit escape and such irritation is reversible.

2. Where quantitative eye irritation data cannot be found in literature references, and theoretical considerations indicate that substance should not be an eye irritant, half-facepiece respirators are allowed.

3. Where a review of the literature indicates a substance causes eye irritation but no eye irritation threshold is specified, the data will be evaluated to determine whether quarter- or half-facepiece respirators can be used.

2.4.5 IDLH

The definition of IDLH provided in 30 CFR 11.3(t) is as follows:

TABLE 2. EFFECT OF SOLVENT VAPOR ON RESPIRATOR CARTRIDGE EFFICIENCY[a]

Solvent	Time to Reach 1 Percent Breakthrough (10 ppm) (Min)
Aromatics	
Benzene	73
Toluene	94
Ethyl benzene	84
m-Xylene	99
Cumene	81
Mesitylene	86
Alcohols	
Methanol	0.2
Ethanol	28
Isopropanol	54
Allyl alcohol	66
n-Propanol	70
Sec-Butanol	96
Butanol	115
2-Methoxyethanol	116
Isoamyl alcohol	97
4-Methyl-2-pentanol	75
2-Ethoxyethanol	77
Amyl alcohol	102
2-Ethyl-1-butanol	76.5
Monochlorides	
Methyl chloride	0.05
Vinyl chloride	3.8
Ethyl chloride	5.6
Allyl chloride	31
1-Chloropropane	25
1-Chlorobutane	72
Chlorocyclopentane	78
Chlorobenzene	107
1-Chlorohexane	77
o-Chlorotoluene	102
1-Chloroheptane	82
3-Chloromethyl heptane	63

TABLE 2. EFFECT OF SOLVENT VAPOR ON RESPIRATOR CARTRIDGE EFFICIENCY[a] (cont.)

Solvent	Time to Reach 1 Percent Breakthrough (10 ppm) (Min)
Dichlorides	
Dichloromethane	10
Trans-1,2-dichloroethylene	33
1,1-Dichloroethane	23
cis-1,2-Dichloroethylene	30
1,2-Dichloroethane	54
1,2-Dichloropropane	65
1,4-Dichlorobutane	108
o-Dichlorobenzene	109
Trichlorides	
Chloroform	33
Methyl chloroform	40
Trichloroethylene	55
1,1,2-Trichloroethane	72
1,2,3-Trichloropropane	111
Tetra- and Pentachlorides	
Carbon tetrachloride	77
Perchloroethylene	107
1,1,2,2-Tetrachloroethane	104
Pentachloroethane	93
Acetates	
Methyl acetate	33
Vinyl acetate	55
Ethyl acetate	67
Isopropyl acetate	65
Isopropenyl acetate	83
Propyl acetate	79
Allyl acetate	76
sec-Butyl acetate	83
Butyl acetate	77
Isopentyl acetate	71
2-Methoxyethyl acetate	93
1,3-Dimethylbutyl acetate	61
Amyl acetate	73
2-Ethoxylethyl acetate	80
Hexyl acetate	67

TABLE 2. EFFECT OF SOLVENT VAPOR ON RESPIRATOR CARTRIDGE EFFICIENCY[a] (cont.)

Solvent	Time to Reach 1 Percent Breakthrough (10 ppm) (Min)
Ketones	
Acetone	37
2-Butanone	82
2-Pentanone	104
3-Pentanone	94
4-Methyl-2-pentanone	96
Mesityl oxide	122
Cyclopentanone	141
3-Heptanone	91
2-Heptanone	101
Cyclohexanone	126
5-Methyl-3-heptanone	86
3-Methylcyclohexanone	101
Diisobutyl ketone	71
4-Methylcyclohexanone	111
Alkanes	
Pentane	61
Hexane	52
Methylcyclopentane	62
Cyclohexane	69
Cyclohexene	86
2,2,4-Trimethylpentane	68
Heptane	78
Methycyclohexane	69
5-Ethylidene-2-norbornene	87
Nonane	76
Decane	71
Amines	
Methyl amine	12
Ethyl amine	40
Isopropyl amine	66
Propyl amine	90
Diethyl amine	88
Butyl amine	110
Triethyl amine	81
Dipropyl amine	93
Diisopropyl amine	77
Cyclohexyl amine	112
Dibutyl amine	76

TABLE 2. EFFECT OF SOLVENT VAPOR ON RESPIRATOR CARTRIDGE EFFICIENCY[a] (cont.)

Solvent	Time to Reach 1 Percent Breakthrough (10 ppm) (Min)
Miscellaneous Materials	
Acrylonitrile	49
Pyridine	119
1-Nitropropane	143
Methyl iodide	12
Dibromomethane	82
1,2-Dibromoethane	141
Acetic anhydride	124
Bromobenzene	142

[a] The above cartridge pairs were tested at 1000 ppm, 50 percent relative humidity, 22°C, and 53.3 1/min. (equivalent to a moderately heavy work rate). The time to achieve a 1 percent breakthrough is noted for each cartridge pair. Cartridges were preconditioned at room temperature and 50 percent relative humidity for at least 24 hours prior to testing.

"Immediately dangerous to life or health" means conditions that pose an immediate threat to life or health or conditions that pose an immediate threat of severe exposure to contaminants, such as radioactive materials, which are likely to have adverse cumulative or delayed effects on health.

The purpose of establishing an IDLH exposure concentration is to ensure that the worker can escape without injury or irreversible health effects from an IDLH concentration in the event of failure of the respiratory protective equipment. The IDLH is considered a maximum concentration above which only highly reliable breathing apparatus providing maximum worker protection is permitted. Since IDLH values are conservatively set, any approved respirator may be used up to its maximum use concentration below the IDLH.

In establishing the IDLH concentration the following factors are considered:

1. Escape without loss of life or irreversible health effects. Thirty minutes is considered the maximum permissible exposure time for escape.

2. Severe eye or respiratory irritation or other reactions that would prevent escape without injury.

IDLH should be determined from the following sources:

1. Specific IDLH provided in the literature, such as the AIHA Hygienic Guides.

2. Human exposure data.

3. Acute animal exposure data.

Where such data are lacking, acute toxicological data from analogous substances may be considered.

The following guidelines should be used to interpret toxicological data reported in the literature for animal species:

1. Where acute animal exposure data are available (30 min. to 4-hr. exposures), the lowest exposure concentration causing death or irreversible health effects in any species is determined to be the IDLH concentration.

2. Chronic exposure data may have no relevance to the acute effects and should be used in determining the IDLH concentration only upon competent toxicologic judgment.

3. Where there is no toxicologic evidence of an IDLH concentration, 500 times the permissible exposure limit shall determine the upper limit above which only highly reliable breathing apparatus providing maximum worker protection is used.

2.4.6 Lower Flammable Limit

In addition to toxic chemicals and irritants, it is necessary to consider flammable substances. In any atmosphere where there is a likelihood of a chemical fire, there is the risk of creating toxic vapors in the fire or of

asphyxiation cause by reduction of the oxygen content by the products of combustion.

Contaminant concentrations in excess of the LFL are considered to be IDLH. At or above the LFL, the use of respirators is limited to those devices that provide the maximum protection (i.e., positive pressure self-contained breathing apparatus (SCBA) and the combination positive pressure supplied-air respirators with auxiliary positive pressure SCBA).

2.4.7 Protection Factors

The protection factors of respiratory protection devices are a useful numerical tool to assist in the choice of a protective system. Protection factors are a measure of the overall effectiveness of a respirator. Filtering efficiency is a part of the protection factor and becomes a significant consideration for less efficient air-purifying respirators.

The protection factor of a given respirator for a specific user times the PEL (or TLV) for a given substance is the maximum allowable concentration for that substance for which the respirator may be used. For example, say the protection factor for a full-face mask respirator will provide protection up to 1000 ppm. Note that there is a difference between "quantitative" protection factors and "qualitative" protection factors.. The correct protection factor must be used in determining the maximum allowable concentration.

2.4.8 Escape

Jordan provides and requires employees to carry an escape respirator where exposure may occur to extremely toxic substances. This escape respirator provides a 5-minute self-contained air supply. (An extremely toxic substance is defined as a gas or vapor having an LC_{50} of less than 10 ppm.)

STANDARD RESPIRATORY PROTECTION PROCEDURE NO. 3
RESPIRATOR FIT TESTING - QUALITATIVE

3.1 RESPIRATOR QUALITATIVE FITTING METHODS

Despite the care that goes into respirator design and manufacture to give maximum protection, efficiency will be lost if there is an improper match between the facepiece and the user, or other improper wearing practices. The problem is twofold. Since more than one brand of particular type of facepiece is available, the first problem is to determine which fits best. The second problem is whether the user knows when the respirator fits properly. Both problems can be solved by the use of a fitting test, which is in fact an OSHA requirement. A number of tests and fitting procedures can be performed easily, as outlined below.

Note: During any fitting test, the respirator head straps must be as comfortable as possible. Tightening the straps will sometimes reduce the facepiece leakage, but the user may be unable to tolerate the respirator for any length of time.

3.1.1 Test 1 - Negative Pressure Test

The user will perform this test alone in the field. It consists of merely closing off the inlets of the canister, cartridge(s), or filter(s) by covering with the palm(s) or replacing the seals over the canister or cartridge inlets, or by squeezing breathing tubes so that air cannot pass; inhaling gently so the facepiece collapses slightly; and holding the breath for ten seconds. If the facepiece remains slightly collapsed and no inward leakage is detected, the respirator is probably tight enough.

Although this test is simple, it has several major drawbacks, primarily that the user must handle the respirator after it has supposedly been positioned on the face. Handling can modify the facepiece-to-face seal. When the respirator is to be used in a relatively toxic atmosphere, this test should be used only as a very gross determination of fit. The user will perform this test just before entering any toxic atmosphere.

3.1.2 Test 2 - Positive Pressure Test

This test is very much like the negative pressure test; it has the same advantages and limitations. It is conducted by closing off the exhalation valve and exhaling gently into the facepiece. The fit is considered satisfactory if slight positive pressure can be built up inside the facepiece without any evidence of outward leakage. For some respirators, this method requires the user to remove the exhalation valve cover and then carefully replace it after the test, often a most difficult task which can disturb the respirator fit even more than does the negative pressure test. If removing and replacing the valve cover is required, this test should be used sparingly. For respirators whose valve covers have a single small port that can be covered by the palm or finger, this test is easy. Where applicable, this test will be performed just before entering any hazardous atmosphere.

3.1.3 Test 3 - Isoamyl Acetate Vapor (Banana Oil) Test

The chemical isoamyl acetate has a pleasant, easily detectable odor, so it is used widely in checking respirator fit.

The test gives the user the required opportunity to wear the respirator in a test atmosphere. Generally, it consists of creating an atmosphere containing banana oil around the user of an atmosphere-supplying or air-purifying respirator with an organic vapor removing cartridge(s) or canister. If the hazard is particulate matter or a non-organic vapor or gas, the organic vapor cartridge(s) or canister must be replaced with a particulate filter(s) or proper cartridge(s) or canister after this test. Thus, this test can be used for any facepiece that has the capability of accepting chemical cartridges and particulate filters. It must be emphasized, however, that the correct cartridge, canister or filter must be replaced on the facepiece before the user enters the specific exposure area.

The isoamyl acetate test is performed with single use capsules, or may be performed by saturating a piece of cotton or cloth with the liquid and passing it close to the respirator near the sealing surface, taking care to avoid skin contact.

In general, the isoamyl acetate fitting test will be performed as follows:

1. The user puts on the respirator in a normal manner in an area where he/she cannot smell banana oil and thus not be influenced by the odor while performing the fitting test. If it is an air-purifying device, it must be equipped with a cartridge(s) or canister specifically designed for protection against organic vapors.

2. The capsule or saturated cloth is passed close to the respirator sealing surfaces.

3. If the user smells banana oil, he readjusts the facepiece and/or adjusts the head straps without unduly tightening them.

4. The user repeats step 2. If banana oil is not smelled, there is assumed to be a satisfactory seal. If the wearer smells the vapor, an attempt should be made to find the leakage point. If the leak cannot be located, another respirator of the same type and brand should be tried. If this leaks, another brand of respirator with a facepiece of the same type but slightly different shape or size should be tried.

5. After a fit is obtained, if the respirator is an air-purifying device, it must be equipped with the correct filter(s), cartridge(s) or canister for the anticipated hazard.

During the test, the subject must make movements that approximate a normal workng situation. These will include, but not necessarily be limited to, the following:

1. Normal breathing.

2. Deep breathing like during a heavy exertion period: this should not be done long enough to cause hyper ventilation.

3. Slowly performing side-to-side and up-and-down head movements: these movements should be exaggerated, but should approximate those that take place on the job.

4. Talking: this is most easily accomplished by reading prepared text loudly enough to be understood by someone standing nearby.

5. Other exercises may be added depending upon the situation: for example, if users are going to spend a significant part of their time bent over at some task, it will include an exercise approximating this bending.

When the test is used in training workers and selecting the respirators that fit best, they will perform the complete set of exercises. However, the number of exercises may be reduced when the test is used as a quick field check before routine entry into a contaminated atmosphere.

3.1.4 Test 4 - Irritant Smoke Test

This test is similar to the isoamyl acetate test in concept. It involves exposing the respirator wearer to an irritating aerosol produced by stannic chloride or titanium tetrachloride smoke tubes normally used to check the quality of ventilation systems. (Note: Other types of smoke tubes such as acetic acid are available, but should not be used for respirator fitting.) When the tube ends are broken and air is passed through it, the material inside reacts with the moisture in the air to produce a dense, highly irritating smoke, consisting of hydrochloric acid absorbed in small solid particles. As a qualitative means of determining respirator fit, this test has a distinct advantage in that the user usually reacts involuntarily to leakage by coughing or sneezing. The likelihood of this giving a false indication of proper fit is reduced. On the other hand, the aerosol is very irritating and must be used carefully to avoid injury.

This test can be used for both air-purifying and atmosphere-supplying respirators, but air-purifying respirators must have a high-efficiency filter(s). After the test, it may be necessary to replace the high-efficiency filter(s) on the air-purifying respirator with another type of air-purifying element(s) depending upon the hazard to which the respirator user is to be exposed. This test can be used for worker training or respirator selection.

The irritant smoke test must be performed with proper safeguards because the aerosol is highly irritating. The procedure is as follows:

1. The user puts on the respirator normally, taking care not to tighten the headstrap uncomfortably and stands with his/her back to a source of exhaust ventilation.

2. The tester tells the user to close his/her eyes, even if wearing a full facepiece respirator, and to keep them closed until told to open them.

3. The tester lightly puffs smoke over the respirator, holding the smoke tube at least two feet from it. At this time, the test should keep the amount of smoke minimal and pause between puffs to note the user's reaction.

4. If the user detects no leakage, the tester will increase the smoke density and move the smoke tube progressively closer to the subject, still remaining alert to any reactions.

5. When the smoke tube has been brought to within about 6 inches of the respirator with no leakage detected, the tester will start to direct smoke specifically at potential sources of leakage, around the sealing surfaces and exhalation valve, while the subject's head is still.

6. At this point, if no leakage has been detected, the user may cautiously begin the head movements described in the isoamyl acetate test. The tester should remain especially alert and be prepared to stop producing smoke immediately.

7. If leakage is detected at any time, the tester should stop the smoke and let the user readjust the facepiece or head strap tension. The tester should then start the test at step 2.

STANDARD RESPIRATORY PROTECTION PROCEDURE NO. 4
INSPECTION/MAINTENANCE/STORAGE

4.1 INTRODUCTION

Respirator maintenance is an integral part of the overall respirator program. Wearing a poorly maintained or malfunctioning respirator is, in one sense, more dangerous than not wearing a respirator at all. Personnel wearing defective devices think they are protected when, in reality, they are not. Emergency escape and rescue devices are particularly vulnerable to poor maintenance as 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 emergency escape or rescue.

This program includes:

1. Inspection for defects (including a leak check).
2. Cleaning and disinfecting.
3. Repair as required.
4. Proper and sanitary storage of equipment.

4.2 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.
2. While it is being cleaned.

Since the use and cleaning will, to a large extent, be performed by the same personnel, these inspections may become concurrent.

4.3 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 montly..." Obviously, emergency escape and rescue devices do not require inspection before each use. Records of inspections are kept on forms presented in Section VI-Program Administration and Documentation.

4.4 INSPECTION PROCEDURES

Respirator inspection shall include checking of:

1. Tightness of the connections.
2. Facepiece.
3. Valves.

4. Connecting tubes.
5. Canisters, filters, or cartridges.

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

4.5 FIELD INSPECTION OF AIR-PURIFYING RESPIRATORS

Routinely used air-purifying respirators will be checked as follows before and after each use:

1. Examine the facepiece for:

    a. Excessive dirt.

    b. Cracks, tears, holes or physical distortion of shape from improper storage.

    c. Inflexibility of rubber facepiece (stretch and knead to restore flexibility).

    d. Cracked or badly scratched lenses in full facepieces.

    e. Incorrectly mounted full facepiece lenses, or broken or missing mounting clips.

    f. Cracked or broken air-purifying element holder(s), badly worn threads or missing gasket(s).

2. Examine the head straps or head harness for:

    a. Breaks.
    b. Loss of elasticity.
    c. Broken or malfunctioning buckles and attachments.
    d. Excessively worn serrations on head harness, which might permit slippage (full facepieces only).

3. Examine the exhalation valve for the following after removing its cover:

    a. Foreign material, such as detergent residue, dust particles or human hair under valve seat.

    b. Cracks, tears or distortion in the valve material.

    c. Improper insertion of the valve body in the facepiece.

    d. Cracks, breaks or chips in the valve body, particularly the sealing surface.

    e. Missing or defective valve cover.

    f. Improper installation of the valve in the valve body.

4. Examine the air-purifying element(s) for:

a. Incorrect cartridge, canister or filter for the hazard.

b. Incorrect installation, loose connections, missing or worn gasket or cross threading in the holder.

c. Expired shelf-life date on the cartridge or canister.

d. Cracks or dents in the outside case of the filter, cartridge or canister, indicated by the absence of sealing material, tape, foil, etc. over the inlet.

e. Identical cartridges if more than one are used.

4.6 CARE AND CLEANING OF SELF-CONTAINED BREATHING APPARATUS (SCBA)

The proper care of SCBAs involves:

1. Inspection for defects.
2. Cleaning and disinfecting.
3. Repair.
4. Storage.

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

1. Preliminary inspection. Check to ensure that:

   a. High-pressure hose connector is tight on cylinder fitting.
   b. Bypass valve is closed.
   c. Mainline valve is closed.
   d. There is no cover or obstruction on regulator outlet.
   e. Pressure in the tank is at least 1800 psi.

2. Backpack and harness assembly.

   a. Straps

      1. Visually inspect for complete set.
      2. Visually inspect for frayed or damaged straps that may break during use.

   b. Buckles

      1. Visually inspect for mating ends.
      2. Check locking function.

   c. Backplate and cylinder lock

      1. Visually inspect backplate for cracks and for missing rivets or screws.
      2. 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

   a. Cylinder

      1. Physically check cylinder to ensure that it is tightly fastened to backplate.

      2. Check hydrostatic test date to ensure that it is current.[1]

      3. Visually inspect cylinder for large dents or gouges in metal.

   b. Head and valve assembly

      1. Visually inspect cylinder valve lock for presence.

      2. Visually inspect cylinder gauge for condition of face, needle, and lens.

      3. 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

   a. 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.)

   b. Regulator and low-pressure alarm

      1. Cover outlet of regulator with palm of hand. Open mainline valve and read regulator gauge (must read at least 1800 psi and not more than rated cylinder pressure).

      2. 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.

      3. 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, establsih a slight negative pressure in regulator and hold for 5 to 10 sec. 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.

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[1] Monthly inspection only.

4. Open cylinder valve.

5. 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.

6. 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. Facepiece and corrugated breathing tube.

a. Facepiece

1. Visually inspect head harness for damaged serrations and deteriorated rubber. Visually inspect rubber facepiece body for signs of deterioration or extreme distortion.

2. Visually inspect lens for proper seal in rubber facepiece, retaining clamp properly in place, and cracks or large scratches.

3. Visually inspect exhalation valve for visible deterioration or foreign materials buildup.

b. Breathing tube and connector

1. Stretch breathing tube and visually inspect for deterioration and holes.

(2) Visually inspect connector to ensure good condition of threads and for presence and proper condition of "O" ring or rubber gasket seal.

(3) Negative pressure test on facepiece.[2]

(a) Don backpack and facepiece.

(b) With facepiece held tightly to face or facepiece 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 sec. If negative pressure leaks down, the facepiece assembly is not adequate and should not be worn.

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[2]For regular monthly inspection, only steps (b) and (c) of procedure are necessary.

6. Storage of units. Check that:

   a. Cylinder is refilled as necessary and unit is cleaned and inspected.

   b. Cylinder valve is closed.

   c. High-pressure hose connector is tight on cylinder.

   d. Pressure is bled off high-pressure hose and regulator.

   e. Bypass valve is closed.

   f. Mainline valve is closed.

   g. All straps are completely loosened and laid straight.

   h. Facepiece is properly stored to protect against dust, sunlight, heat, extreme cold, excess moisture, and damaging chemicals.

4.7 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 may be made from readily available household solutions, including:

1. Hypochlorite solution (50 ppm of chlorine) made by adding approximately two milliliters of bleach (such as Clorox) to one liter of water, or two tablespoons of bleach per gallon of water. A two-minute immersion disinfects the respirators.

2. Aqueous solution of iodine (50 ppm of iodine) made by adding approximately 0.8 milliliters of tincture of iodine per liter of water, or one teaspoon of tincture of iodine per gallon of water. Again, a two-minute immersion is sufficient.

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

4.8 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 very important for preventing dermatitis.

4.9 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, but care must be taken not to damage or distort the facepieces.

4.10 REASSEMBLY AND INSPECTION

The clean, dry respirator facepieces should be reassembled and inspected in an area separate from the disassembly area to avoid contamination. The inspection procedures have been discussed; 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 facepiece should be combined with the tested regulator and the fully charged cylinder, and an operational check performed.

4.11 MAINTENANCE AND REPAIR

Replacement or repair shall be done only by trained, experienced persons with 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.

4.12 RESPIRATOR STORAGE

Respirators must be stored to protect against:

1. Dust.
2. Sunlight.
3. Heat.
4. Extreme cold.
5. Excessive moisture.
6. Damaging chemicals.
7. Mechanical damage.

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

Freshly cleaned respirators should be placed in reusable plastic bags until reissue. They should be stored in a clean, dry location away from direct sunlight. They should be placed in a single layer with the facepiece and exhalation valve in an undistorted position to prevent rubber or plastic from taking a permanent distorted "set".

APPENDIX E

EMERGENCY INFORMATION

EMERGENCY TELEPHONE NUMBERS

POST IN OFFICE, STAGING AREA (NEAR PHONE), AND SAMPLING VANS

HAA Security: Larry Gallagher	(415) 561-5849
Off-site Emergency Services	911 or
Novato Fire	(415) 892-1513
Novato Police	(415) 897-4361
Novato Community Hospital	(415) 897-3111
Kalser Permanente Medical Center	(415) 499-2400
National Poison Control Center	(800) 492-2414
California Poison Control Center	(415) 476-6600
National Response Center	(800) 424-8802
Chemical Manufacturer's Association (CMA) Chemical Referral Center	(800) 262-8200
Site HSO:	
Site FOL:	
Contractor's HSS:	
Contractor's HSM:	
USATHAMA Safety Office:	(301) 671-4811

ROUTES TO EMERGENCY MEDICAL FACILITIES

POST IN OFFICE, STAGING AREA, AND SAMPLING VANS

The primary source of emergency medical assistance for HAA is:

Novato Community Hospital
1625 Hill Road
Novato
(415) 897-3111

Directions to the Novato Community Hospital:

From either HAA Main Entrance Road or State Access Road, turn right (north) onto Nave Drive. Follow approximately one mile and enter U.S. Rt. 100 North. Follow U.S. Rt 100 north for about two miles and exit at DeLong Avenue. Turn left (west) on DeLong Avenue which becomes Diablo Avenue in about ½ mile. At end of Diablo Avenue, turn right onto Hill Road. Hospital is on the left near intersection of Del Mar Avenue.

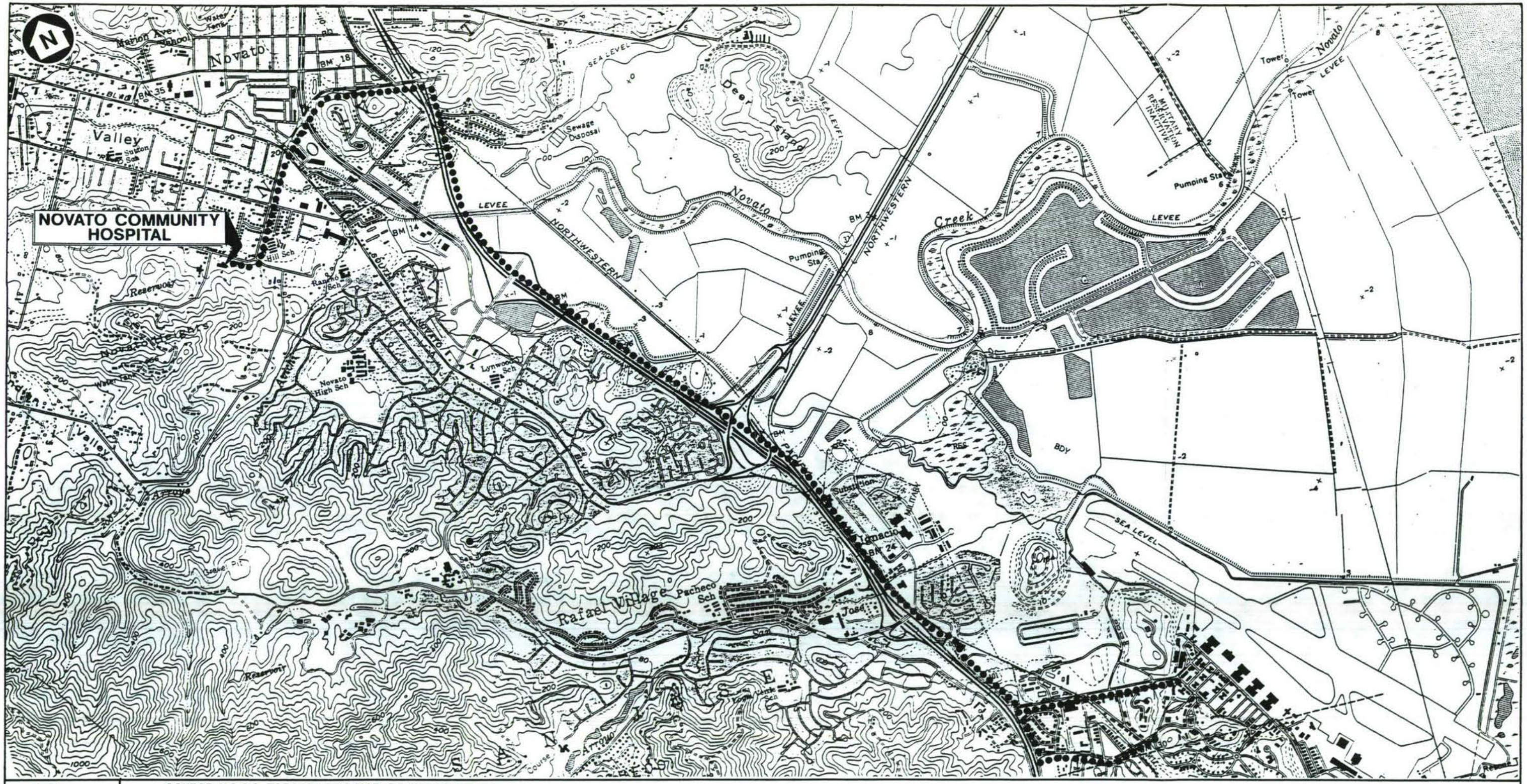
The secondary source of medical assistance for HAA is:

Kaiser Permanente Medical Center
99 Monticillo Road
San Rafael
(415) 499-2400

Directions to Kaiser Permanente Medical Center:

From either HAA Main Entrance Road or State Access Road, turn left (south) onto Nave Drive. In about ½ mile, enter U.S. Rt. 101 south. Follow Rt. 101 for about 2½ miles and exit at Manuel T. Freitas Parkway (west). Exit parkway left at Las Gallinas Avenue. Bear right at fork onto Nova Albion Way. Bear right onto Montecillo Road. Kaiser Permanente is on the left.

Directions to both medical facilities are shown on Figure E-1 and E-2.



SOURCE: U.S.G.S. TOPOGRAPHIC MAP 7.5 MINUTE SERIES
NOVATO, CALIFORNIA, 1954,
PHOTOREVISED, 1980.

QUADRANGLE LOCATION

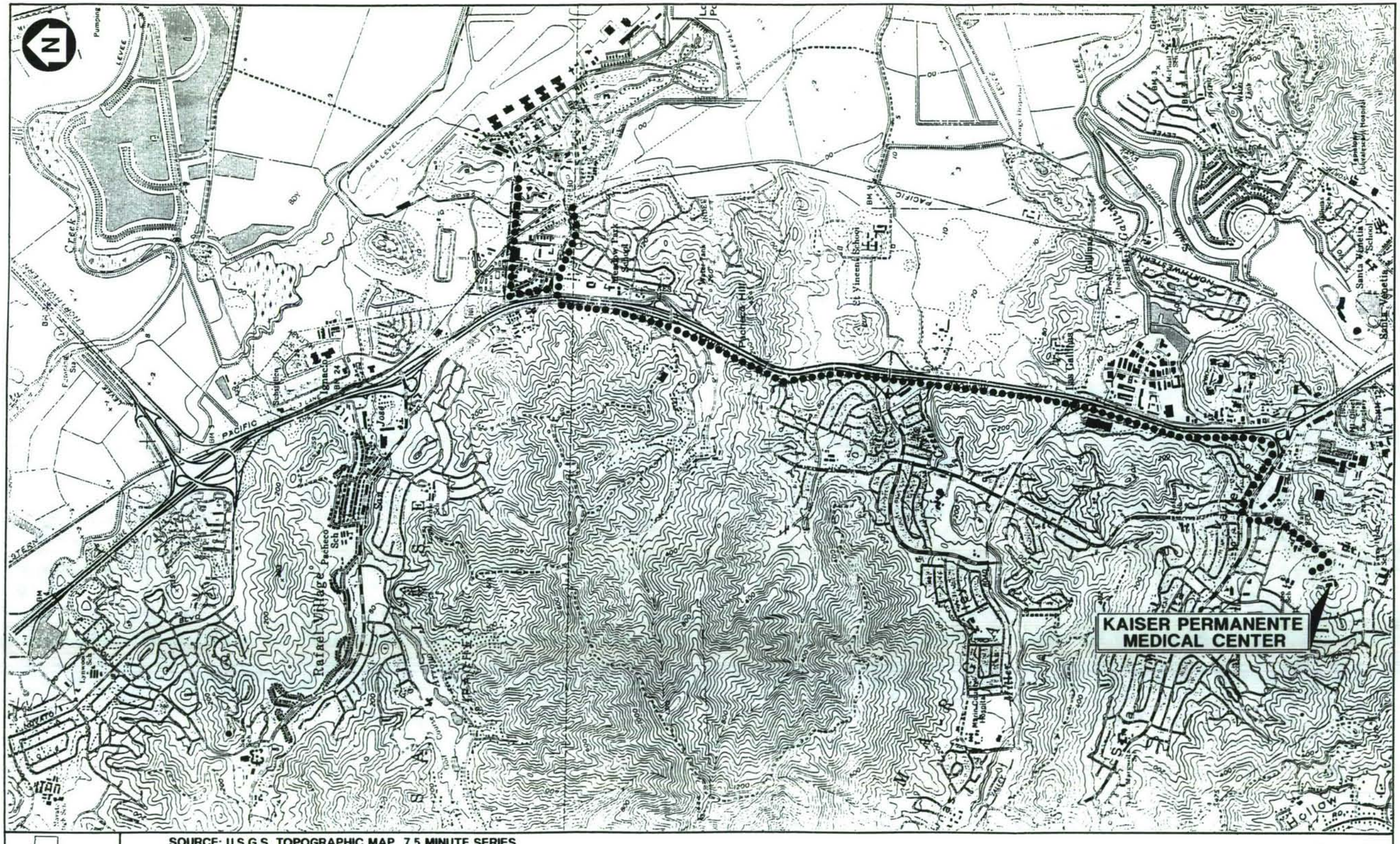
SCALE IN FEET

0 2000 4000

6259-04

FIGURE E-1
PRIMARY HOSPITAL LOCATION
HEALTH AND SAFETY PLAN
HAMILTON ARMY AIRFIELD

E.C. JORDAN CO.



SOURCE: U.S.G.S. TOPOGRAPHIC MAP 7.5 MINUTE SERIES
NOVATO, CALIFORNIA, 1954,
PHOTOREVISED, 1980.

SCALE IN FEET
0 2000 4000

FIGURE E-2
SECONDARY HOSPITAL LOCATION
HEALTH AND SAFETY PLAN
HAMILTON ARMY AIRFIELD

E.C.JORDAN CO.

6259-04

EMERGENCY SIGNALS

POST IN TRAILER

Field personnel will be carrying portable radios for communications. If this is the case, a transmission that indicates it is of an emergency nature will take priority over all other transmissions. All other site radios will yield the frequency to the emergency transmissions.

Where radio communication is not available, the following air horn signals will be employed:

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

APPENDIX F

OSHA JOB SAFETY AND HEALTH PROTECTION POSTER

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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 to 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 that 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 discrimination.

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 penalties against employers of up to $1,000 for each serious violation and for optional penalties of up to $1,000 for each nonserious violation. Penalties of up to $1,000 per day may be proposed for failure to correct violations within the proposed time period. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to $10,000 for each such violation.

Criminal penalties are also provided for in the Act. Any willful violation resulting in death of an employee, upon conviction, is punishable by a fine of not more than $10,000, or by imprisonment for not more than six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

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.

Such voluntary action should initially focus on the identification and elimination of hazards that could cause death, injury, or illness to employees and supervisors. 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 help such as training.

Consultation

Free consultative assistance, without citation or penalty, is available to employers, on request, through OSHA supported programs in most State departments of labor or health.

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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 location:

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

Telephone numbers for these offices, and additional area office locations, are listed in the telephone directory under the United States Department of Labor in the United States Government listing.

Washington, D.C.
1985
OSHA 2203

William E. Brock, Secretary of Labor

U.S. Department of Labor

Occupational Safety and Health Administration