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FINAL

PLAN OF ACTION

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

PREPARED FOR:

NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
PHILADELPHIA, PENNSYLVANIA

APRIL 1989

ATLANTIC PROJECT NO. 1256-03-01
NAVY CONTRACT NO. N62472-88-C-1294

ATLANTIC
ENVIRONMENTAL SERVICES, INC. 188 NORWICH AVENUE COLCHESTER, CONNECTICUT 06415 (203) 537-0751

FINAL

FIELD SAMPLING PLAN

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Appendix A: Atlantic Technical Procedures
Appendix B: Monitoring Well Details

1.0 INTRODUCTION

The Naval Submarine Base (Subase), New London-Groton, is located in Southeastern Connecticut. The Subase, which is being investigated as part of this program, is located on the east bank of the Thames River approximately six miles north of Long Island Sound. A vicinity map is shown in Figure 1-1.

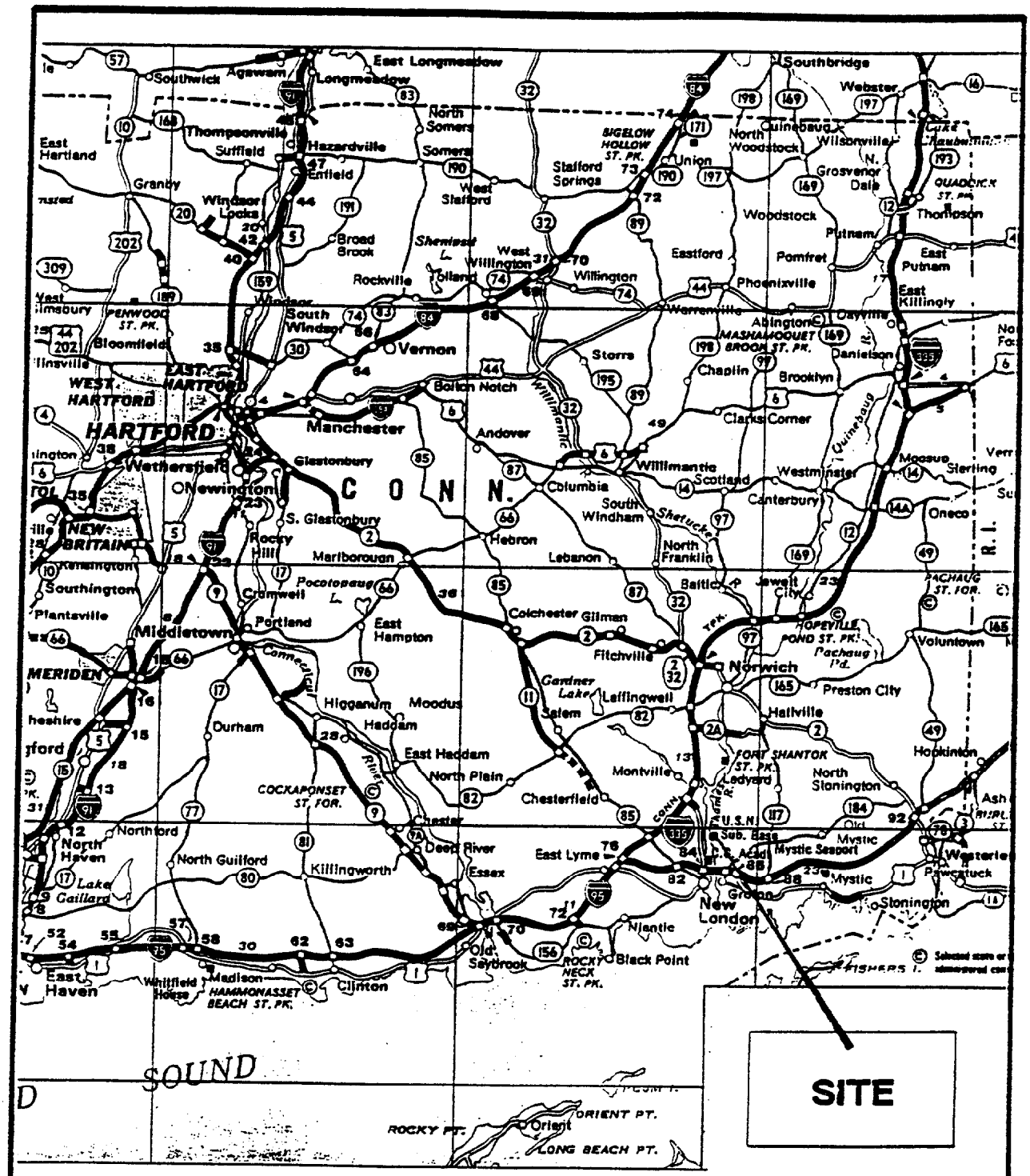
The Subase is located in the Towns of Ledyard and Groton, Connecticut and consists of approximately 547 acres of land. The site location is shown on Figure 1-2.

Envirodyne Engineers, Inc. (Envirodyne) performed an Initial Assessment Study (IAS) for the Subase in 1982 as part of the Navy Assessment and Control of Installation Pollutants (NACIP) and recommended sites for further study based on past records of waste disposal and potential impacts to health and the environment. The sites ultimately included for study as part of this project have been added and modified from the IAS recommendations based on further information and Navy deliberations.

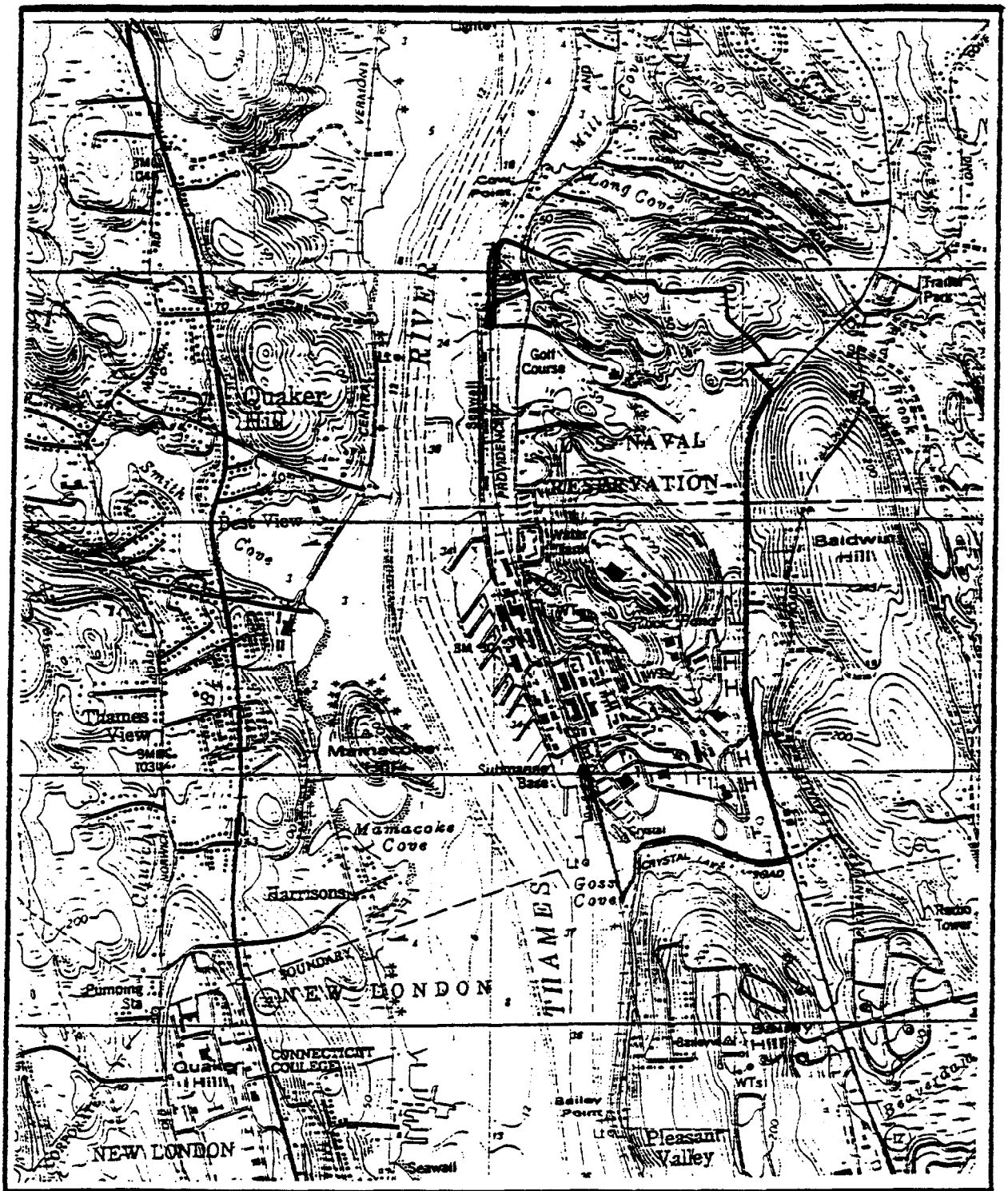
Wehran Engineering Corporation (Wehran) completed a Verification Step 1A Study of three sites at the Subase in March 1988. Wehran evaluated the DPDO, Area A Landfill, and Over Bank Disposal Site, and based on collected analytical data, recommended further investigation to fully assess risks and potential remediation alternatives.

This field sampling plan describes the recommended field investigation program which will be performed by Atlantic Environmental Services, Inc. (Atlantic) as part of the Naval Installation Restoration (IR) Program (formerly NACIP). The program consists of two levels of investigation and evaluation. The Step I Site Inspection phase is applicable to five of the nine identified sites. The objectives of the site inspection (Step I) are to determine the presence or absence, as well as the order of magnitude, of specific toxic or hazardous contaminants identified or other contaminants which may be present in concentrations considered to be an environmental risk. Step I includes an initial field sampling program to identify if contamination is present onsite and warrants a Step II remedial investigation. The Step I sites to be investigated include:

1. CBC Drum Area (Site No. 1)
2. Rubble Fill at Bunker A-86 (Site No. 4)
3. Torpedo Shops (Site No. 7)
4. Goss Cove Landfill (Site No. 8)
5. Over Bank Disposal Area Northeast (OBDANE) (Site No. 14)
6. Spent Acid Storage and Disposal Area (Site No. 15)
7. Former Gasoline Station (Site No. 18)



INSTALLATION RESTORATION STUDY **NAVAL SUBMARINE BASE** **NEW LONDON** **GROTON, CT**	SOURCE: R.R. Donnelley & Sons Co. 1985 N	**FIGURE 1-1** **VICINITY MAP** ATLANTIC ENVIRONMENTAL SERVICES, INC.



INSTALLATION RESTORATION STUDY **NAVAL SUBMARINE BASE** **NEW LONDON** **GROTON, CT**	SOURCE: Uncasville, CT U.S.G.S. Topographic Map 1984 N	**FIGURE 1-2** **SUBASE LOCATION** ATLANTIC ENVIRONMENTAL SERVICES, INC.

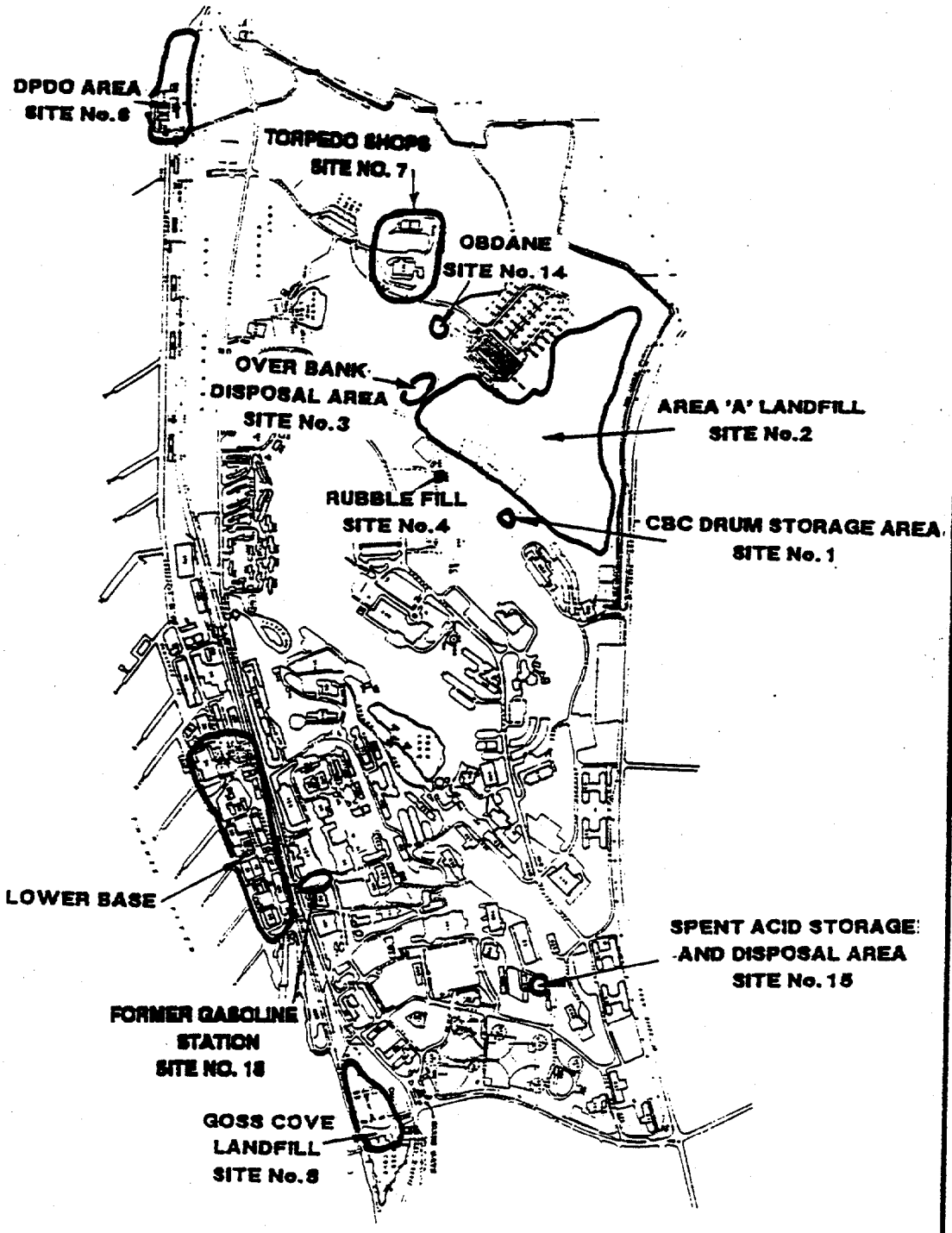
The site numbers correspond to those assigned in the Envirodyne Report.

The Step II Remedial Investigation/Feasibility Study (RI/FS) is applicable to the remaining four sites, where onsite contamination was identified by earlier investigations. It involves comprehensive onsite investigations in order to determine the extent of contamination, assess health and environmental risks and evaluate remediation alternatives. The Step II sites to be investigated include:

1. Area A Landfill (Site No. 2)
2. Over Bank Disposal Area (Site No. 3)
3. DPDO Area (Site No.6)
4. Lower Subase

The Step I and Step II site locations on the Subase are illustrated on Figure 1-3.

Atlantic's point of contact (POC) at the Subase for this project is Mr. William Mansfield. Ms. Adrienne Townsel is the Engineer-In-Charge (EIC) representing the Northern Division of the Naval Facilities Engineering Command, Philadelphia, Pennsylvania.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	Source: Naval Submarine Base Existing Conditions April 1985 Loureiro Engineering Associates	FIGURE 1-3 INSTALLATION RESTORATION STUDY SITES
		ATLANTIC ENVIRONMENTAL SERVICES, INC.

2.0 SITE BACKGROUND

This section includes general Subase history, an overview of the Subase's site geology and hydrology, specific site historical information, available chemical data, site inspection observations, and a summary of actual and potential onsite and offsite health and environmental effects for each site to be investigated.

2.1 Historical Setting

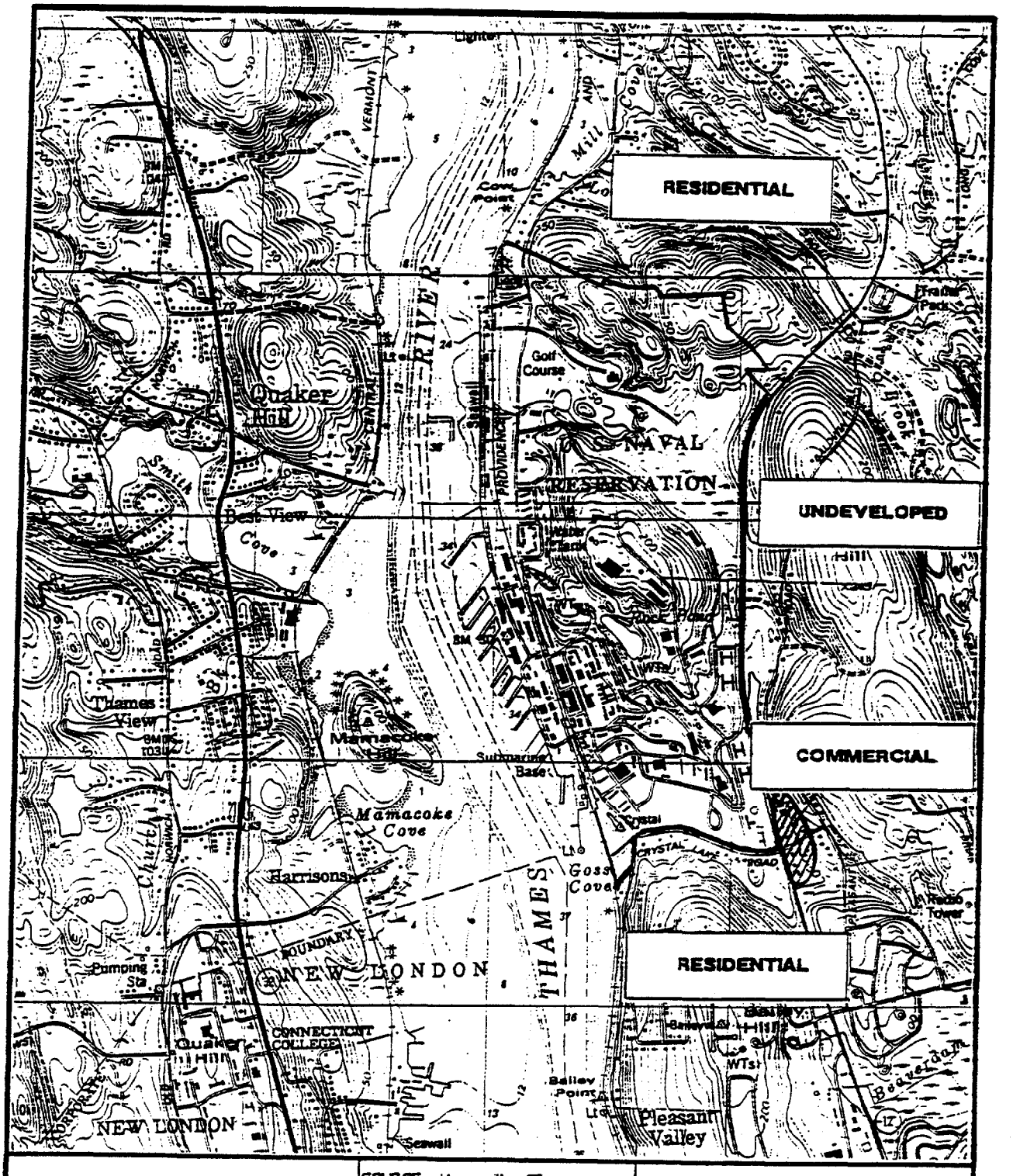
The Subase was established as an official Navy Yard in July 1886. The site initially moored small craft and obsolete warships and was used as a coaling station for the Atlantic Fleet. The property was officially established as a permanent submarine base in 1916. The overall base facilities were expanded and a Submarine School training facility was established in 1917, and the Submarine Medical Center was established in 1918. During World Wars I and II, the Subase expanded greatly in size and the number of buildings to support the Submarine fleet.

The Subase currently provides a base command for naval submarine fleet activities in the Atlantic Ocean. Additionally, the Subase consists of naval housing, submarine training facilities, military offices, medical facilities, and facilities designed for the maintenance, repair, and overhaul of submarines.

2.2 Adjacent Land Use

The area immediately adjacent to the Subase is generally residential and commercial.

To the north, in the Gales Ferry section of Ledyard, there is residential development. This includes residential development along Military Highway and Long Cove Road immediately north of the north gate entrance of the Subase. The eastern boundary of the Subase is Route 12, a state highway. Several homes are located along Route 12 and it transitions to a commercial area near the intersection of Crystal Lake Road which forms the southern boundary of the Subase. The commercial development in this area includes a church, car sales, restaurants, and gas station. On the south side of Crystal Lake Road are several residential homes; further south is naval housing. The western boundary of the Subase is the Thames River. The area land use is shown on Figure 2-1.



INSTALLATION RESTORATION STUDY **NAVAL SUBMARINE BASE** **NEW LONDON** **GROTON, CT**	SOURCE: Uncasville, CT U.S.G.S. Topographic Map 1984	**FIGURE 2-1** **AREA LAND USE**
		ATLANTIC ENVIRONMENTAL SERVICES, INC.

2.3 Site Geology and Hydrology

2.3.1 General

Information regarding site geology and hydrology are based on US Geological Service (USGS) published data supplemented with field observations.

The Subase site is located in the Northern Appalachian Mountain Belt of the New England Physiographic Province. The present topography is a result of glaciation. The site is situated in the Eastern Uplands area of Connecticut which consists of irregular, hilly areas with many swamps, exposed rock ledges and poorly drained, uneven valleys. The upland area is bordered to the west by the tidal estuary of the Thames River. The western area of the Subase (Lower Subase area) is located on a terrace of the Thames River. Sites within this terrace flat area include the DPDO, Goss Cove Landfill, and the Lower Subase. The Area A Landfill, Over Bank Disposal Area, CBC Drum Area, Rubble Fill at Bunker 86, Spent Acid Storage and Disposal Area and OBDANE areas are located in upland areas to the east of the river terrace.

2.3.2 Bedrock Geology

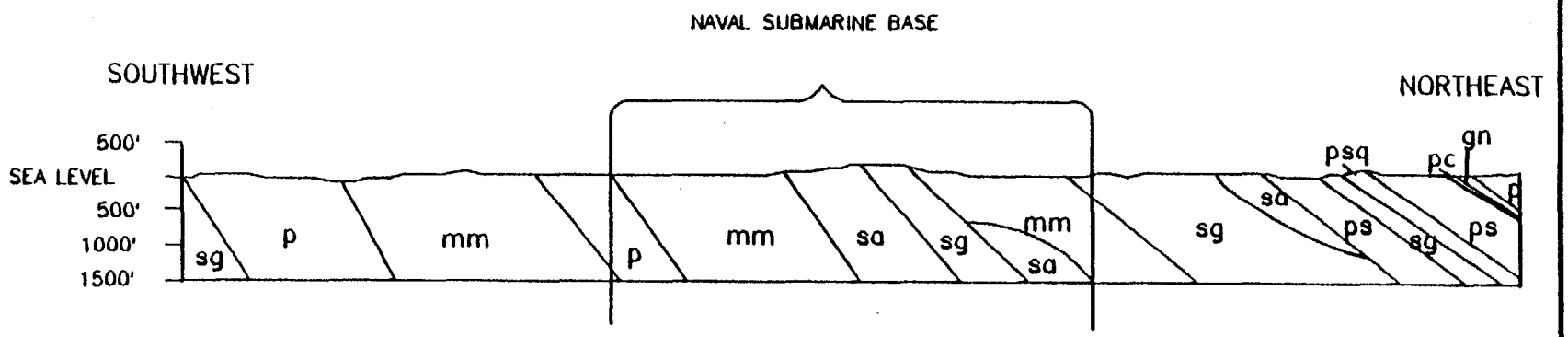
The USGS Bedrock Geologic Map of the Uncasville Quadrangle (Richard Goldsmith, 1967) identifies the bedrock in southeastern Connecticut as hard, dense, metamorphosed sedimentary and crystalline rock. The bedrock is divided into two age groups, Pre-Silurian and Pre-Pennsylvanian. The local bedrock contains a complex series of folds, faults, anticlines, and synclines. The bedrock geology is shown on Figure 2-2. A general cross-section of the geology is presented in Figure 2-3.

During the Pre-Silurian period, sand, silt, and clay sediments were deposited in this area of southeastern Connecticut. Regional uplifting forces resulted in the metamorphism of these sediment layers. These metamorphic rocks form the base of the Appalachian Mountains of southern New England.

Increased tectonic activity occurred during the Pre-Pennsylvanian and produced magmatic plutons which intruded between the older sedimentary layers. The intrusions are parallel to the older sedimentary beds. A slow cooling rate of the intrusive layers resulted in the segregation of minerals within the bedrock. Granitic gneisses and schistose quartzites were produced due to intense deformation forces on the bedrock material.

Pre-Pennsylvanian rocks located onsite are members of the Sterling Plutonic Group and consist of igneous intrusives which have been metamorphosed to granitic gneisses. This group is further divided into the Alaskite Gneiss and Granite Gneiss.

INSTALLATION RESTORATION STUDY **NAVAL SUBMARINE BASE** **NEW LONDON** **GROTON, CT**	SOURCE: U.S.G.S. Surficial Geology Map of the Uncasville Quadrangle N **LEGEND** Refer to Figure 2-3	**FIGURE 2-2** **BEDROCK GEOLOGY** ATLANTIC ENVIRONMENTAL SERVICES, INC.



Alaskite gneiss

sa – orange-pink to light-grey, fine- to medium-grained, equigranular gneissic granite composed of about equal amounts of quartz, microcline, and albite to sodic oligoclase, and about 1 percent magnetite or as much as 2 percent magnetite and biotite.

Granite gneiss

sg – orange-pink to light-grey, medium-grained, gneissic biotite granite, main constituents quartz = microcline oligoclase with 2-7 percent biotite and iron oxides. Locally contains muscovite and garnet; somewhat uneven in mineral distribution. Foliation typically marked by parallelism of alternate flat lenses of quartz and feldspars, and parallelism of biotite flakes. Biotite tends to be concentrated on surfaces between lenses. Some masses have slightly coarser grained streaks rich in orange-pink microcline in finer grained gray quartz-microcline-plagioclase rock. Locally mafic-poor similar to biotitic phases of the alaskite gneiss (sab).

Mamacoke Formation

mam – indistinctly layered light- to dark-gray, biotite-, quartz-feldspar gneiss, and minor hornblende-biotite-quartz-feldspar gneiss; locally granitoid and migmatic. Thin layers of amphibolite and quartzite. Biotite flakes typically small and mostly evenly distributed.

Plainfield Formation

p – dark-green hornblende-biotite-quartz-plagioclase gneiss, in part diopsidic; dark biotite-quartz-plagioclase gneiss with variable amounts of microcline; garnet-biotite-quartz-feldspar schist and gneiss; amphibolite; light-gray sugary textured biotite-feldspar-quartz gneiss; thin gray quartzite, rare thick white quartzite.

pc – calc-silicate quartzite and gneiss.

ps – garnet-sillimanite-biotite-quartz-feldspar schist and gneiss; garnet-biotite-quartz-feldspar gneiss; biotite-quartz-feldspar gneiss; minor biotite-quartz-andesine gneiss with diopside and colorless amphibole; thin-bedded quartzite, locally pyritic.

psq – thick- to thin-bedded, white or tan, to light-gray, rarely greenish quartzite; thin-bedded micaceous quartzite, locally graphitic; thin interlayers of garnet and sillimanite-bearing schist and gneiss.

Source: Bedrock Geologic Map of Uncasville Quadrangle, USGS Goldsmith, 1967

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

FIGURE 2-3

GENERAL GEOLOGIC CROSS-SECTION

ATLANTIC ENVIRONMENTAL SERVICES, INC.

The Alaskite Gneiss is a orange-pink to light-gray, fine to medium grained, equigranular gneissic granite composed of equal amounts of quartz, microcline, and albite to sodic oligoclase and small amounts of magnetite (1-2%) and biotite (2%).

The Granite Gneiss is an orange-pink to light-gray, medium grained, gneissic biotite granite. The main constituents are equal amounts of quartz and microcline, oligoclase with two to seven percent biotite and iron oxides. Local areas contain muscovite and garnet. Foliation is typically marked by parallelism of lenses of quartz and feldspar. This bedrock unit is mapped as underlying the CBC Drum Area, the Rubble Fill at Bunker A-86, and the southern portion of the Goss Cove Landfill.

The majority of the Pre-Silurian rocks located onsite are members of the Mamacoke Formation. They are composed of indistinctly layered light-to-dark gray biotite-quartz-feldspar gneiss and contain minor layers of hornblende-biotite-quartz-feldspar gneiss; the members are locally granitoid and migmatic. Thin layers of amphibolite and quartzite occur in the formation. This bedrock unit is mapped as underlying the DPDO Area, Area A Landfill, OBDANE, Over Bank Disposal Area, Lower Subase, Spent Acid Storage and Disposal Area, and the northern portion of the Goss Cove Landfill.

One other Pre-Silurian unit which underlies the northeast corner of the Subase is a member of the Plainfield Formation. The member is composed of dark-green hornblende biotite-quartz plagioclase gneiss.

2.3.3 Surficial Geology

Information regarding the surficial geology present at the Subase was obtained from the USGS Surficial Geology of the Uncasville Quadrangle Map (Richard Goldsmith, 1960). The surficial geology of the site is shown on Figure 2-4. Most of the surficial deposits which overlie the bedrock are unconsolidated glacial materials deposited during the Pleistocene Age. The remainder of the surficial deposits are products of postglacial geologic processes and man-made modifications. The glacial deposits are divided into two types: nonstratified drift, or till (also known as ground moraine), and stratified drift. The nonstratified rock material was laid down directly by the glaciers. Stratified drift was deposited by meltwater streams from a near or distant ice mass.

Most of the bedrock is mantled by a thin layer of till which is generally a dense heterogeneous mixture of clay, silt, sand, and rock fragments ranging from cobbles to boulders. The majority of the material is unstratified, but locally contains small pockets or lenses of stratified sand and gravel. Till is exposed on most of the upland surface and probably underlies outwash materials in the valleys. It varies considerably in thickness and in many places is absent, but averages less than 10 feet thick. The till is thickest

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

SOURCE: U.S.G.S. Surficial Geology Map of the Uncasville Quadrangle

N

LEGEND
af— Artificial Fill
Qvt— Stratified Drift, Higher Terrace Deposits
Qgm— Till, Ground Moraine Deposits

FIGURE 2-4
SURFICIAL GEOLOGY

ATLANTIC ENVIRONMENTAL SERVICES, INC.

on the north slopes of hills and thins to absent on the summit and south sides. The till on the Subase is either compact, locally fissile, bouldery, and predominantly sand, or a fissile, bouldery and predominantly silt and clay till. The type of till varies based upon the bedrock source. Till has been mapped at the Area A Landfill, OBDANE, Over Bank Disposal Area, CBC Drum Area, and the Rubble Fill at Bunker A-86. The site Area A Landfill borders alluvium and swamp deposits which are mapped in the Area A Wetland and along the streams discharging from the wetland.

Stratified drift, which was deposited by glacial meltwaters, is stratified silt, sand and gravel. As the ice melted and local base levels of streams were lowered, the stratified deposits were left as ridges, mounds, terraces and pitted valley floors. Stratified drift deposits are mapped on the Subase in the area of the golf course and north of the ball fields at the southern portion of the base. The Spent Acid Storage and Disposal Area is mapped on the border of the stratified drift and the artificial fill placed in the former pond located where the ball field currently exists.

Artificial fill is mapped in the areas of the Goss Cove Landfill, DPDO, and the majority of the Lower Subase.

Extensive bedrock outcrops are mapped and were observed throughout most of the base. Extensive bedrock outcrops were observed at or adjacent to all sites except the Lower Subase.

2.4 Site Hydrology

The Subase site is located along the eastern bank of the Thames River, within the Thames River watershed. This basin drains approximately 1,400 square miles of eastern Connecticut, western Rhode Island, and south central Massachusetts. The Thames River originates in Norwich and is formed by the Shetucket and Quinebaug Rivers. The Yantic River also enters the Thames in Norwich. The Thames eventually discharges into Long Island Sound, approximately six miles south of the Subase. The Thames River estuary extends from Long Island Sound north 16 miles to Norwich. Widths of the river vary from 1.5 miles at New London harbor to about 400 to 500 feet wide at Norwich.

The surface drainage from the site discharges to the west towards the Thames River. Several streams and ponds are located in the north/central section of the Subase. Four major discharge points are located onsite. Two discharge points are located near the DPDO area. Another discharge point is situated near Pier 26. A major discharge point is located near Goss Cove Landfill.

The watershed areas for the Subase are shown on Figure 2-5. The offbase contributing watershed to the east of Route 12 is a sparsely residential developed area with some limited commercial development on Route 12 to the south.

2.5 Water Quality Classification

2.5.1 Water Quality Classification and Water Supply

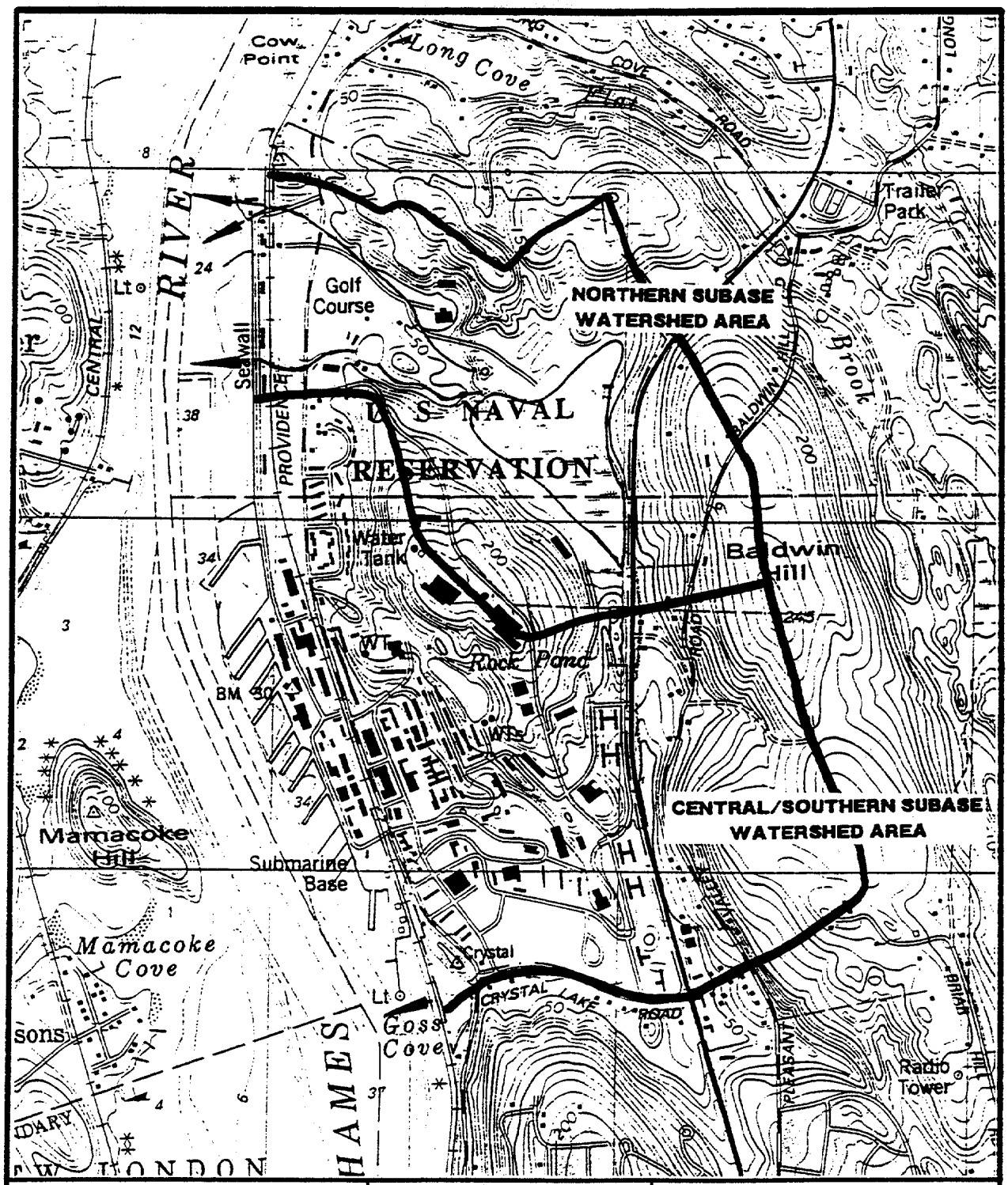
The State of Connecticut Department of Environmental Protection (CTDEP) has classified the Thames River water quality as SC/SB. This classification is described as being suitable for fish, shellfish, and wildlife habitat; good aesthetic value; suitable for industrial cooling; and suitable for recreational boating and, in some places, bathing. The classification is further described as presently not meeting water quality criteria or one or more designated uses due to pollution.

The CTDEP has classified the ground water beneath the central and southern Subase as GB/GA. This classification is described as ground water which may not be suitable for direct human consumption without need for treatment due to waste discharges, spills, or leaks of chemicals or land use impacts, but may be suitable for industrial process water and cooling waters. The immediate goal, where appropriate, is to maintain the water at Class B condition; the long term goal is to restore the ground water to drinking water quality. The CTDEP has classified the ground water on the north portion of the Subase as GA including the Area A Landfill and adjacent sites, and the DPDO site. This classification is described as presumed suitable for direct human consumption without need for treatment. The goal is to maintain drinking water quality.

2.5.2 Water Supply

Potable water supply to the Subase is provided by the Groton Water Department. The Groton water supply is provided principally by reservoirs and supplemented with wells. The water supplies are located within the Poquonock River watershed located east of the Subase; the Subase is not located within this water supply watershed.

The homes located on Route 12 adjacent to the northeast portion of the Subase have individual onsite wells, as do homes along Military Highway and Long Cove Road north of the Subase. Several trailer parks located near the Subase have wells classified as public water supplies. The Colonel Ledyard Mobil Home Park, located adjacent to the north gate, has a well supply and Grandview Trailer Park, located at the intersection of Long Cove Road and Route 12, has two wells for water supply.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND Major Surface Water Discharge Points N SOURCE: Uncasville, CT U.S.G.S. Topographic Map 1984	FIGURE 2-6 WATERSHED AREAS ATLANTIC ENVIRONMENTAL SERVICES, INC.

2.6 Step I Sites: Site Background and Nature of Problem

The Step I sites which are included in the IR Study consist of the following:

- CBC Drum Area,
- Rubble Fill at Bunker A-86,
- Torpedo Shops
- Goss Cove Landfill,
- Over Bank Disposal Area Northeast (OBDANE).
- Spent Acid Storage and Disposal Area
- Former Gasoline Station

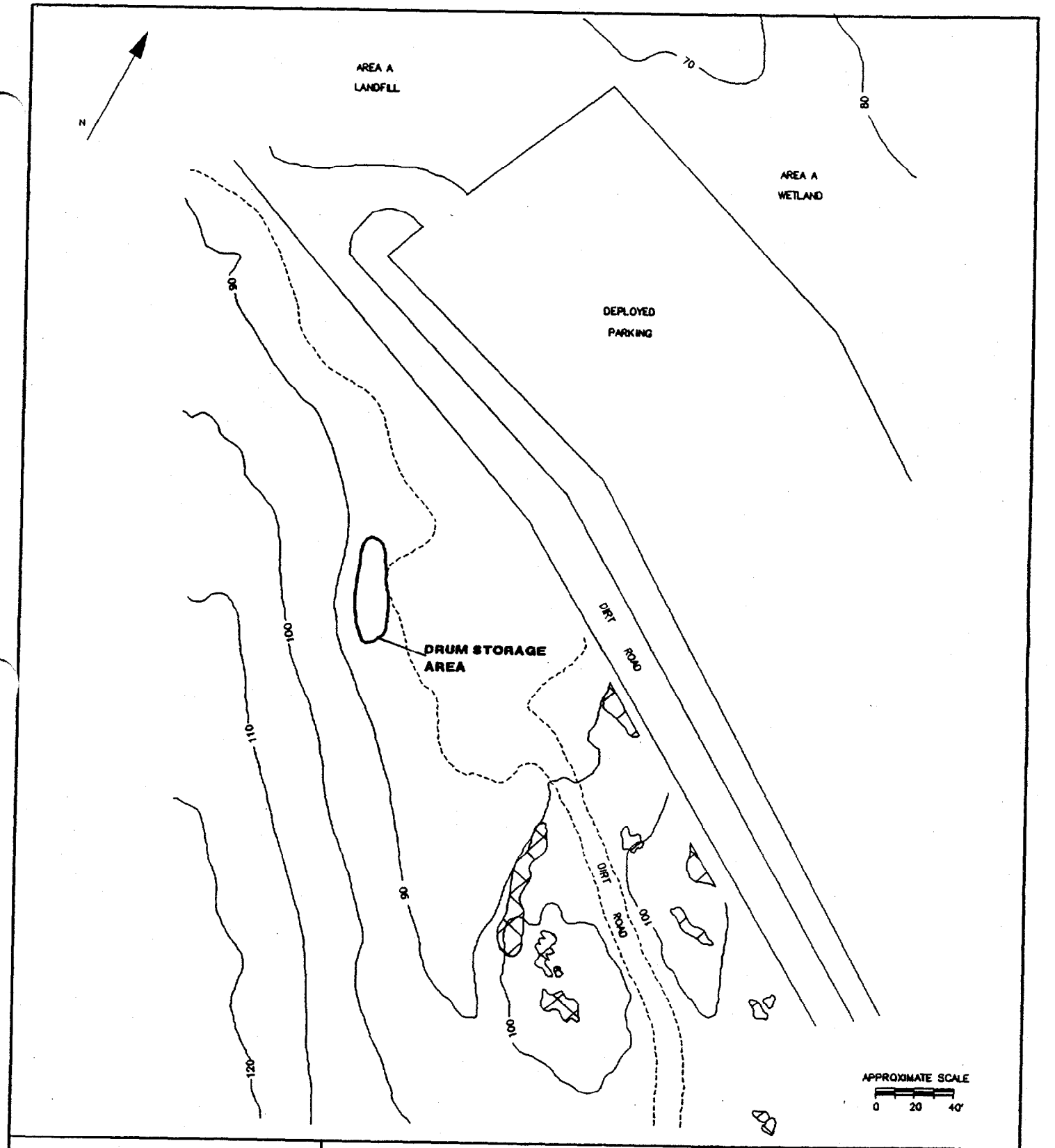
These sites have been determined to require further study based on the IAS report. The purpose of the Step I evaluation is to conduct a screening level field investigation to assess if contamination is present and to assess potential health and environmental risks. If contamination is identified which could have health or environmental effects, subsequent investigation under Step II of the IR Program may be required to fully define the extent of contamination and to evaluate remedial measure as appropriate. A summary of the site background information has been made based on the IAS report, the Wehran report, and further information developed by Atlantic. Site background information also includes site history, available chemical data, site inspection observations, and a general discussion of potential onsite and offsite health and environmental risks.

2.6.1 CBC Drum Storage Area (Site No. 1)

This site is located in the northern section of the Subase, adjacent to the deployed personnel parking area and Area A landfill. A site plan showing site topography, drainage features, and utility information is shown on Figure 2-6. The topography slopes toward the site from the south at a 25 to 30 percent grade. The site area is unpaved and generally flat. Surface drainage from this site flows northeast and across the unpaved deployed personnel parking lot and into the Area A Wetland. The site is unpaved and is at the edge of a wooded area.

The IAS identified twenty-six 55-gallon drums of waste oil, lube oil, and paint materials. Some of the drums were observed leaking at that time. Based on the site vegetation and the amount of petroleum on the ground, the IAS concluded that the site had not been used within the last two years of their field observations (1982).

Atlantic performed a inspection of this site on October 20, 1988. Two 55-gallon drums labelled as engine oil were observed. No surface soil staining or stressed vegetation was evident. According to Mr. William Mansfield (POC), the drums at this site were removed and properly disposed by the Navy.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 2-6 SITE PLAN CBC DRUM STORAGE AREA
	PROPOSED	EXISTING	
		—95— Existing Grade Exposed Bedrock	
			ATLANTIC ENVIRONMENTAL SERVICES, INC.

There has been no characterization of the surface soils in the CBC Drum Area. Chemicals associated with waste oil include petroleum hydrocarbons and metals. The hydrocarbons contain many compounds which pose no serious risk to the environment, but do contain volatile organic compounds, some of which may pose a significant risk to the environment. The most typical metals associated with waste oil are lead and cadmium, both of which may pose a significant risk to the environment.

2.6.2 Rubble Fill at Bunker A-86 (Site No. 4)

The site is located adjacent to a dirt access road to Bunker A-86 off of Wahoo Avenue in the north central section of the Subase. The rubble area is located adjacent to and north of the dirt road and west of Bunker A-86. A site plan showing site topography, drainage features, and utility information is shown on Figure 2-7. The topography at the site slopes 30 percent to the north-northeast down to the Area A Landfill and Wetland. The site is wooded adjacent to the dirt road. Surface drainage from this site flows to the north-northeast, across the Area A Landfill into the Area A Wetland.

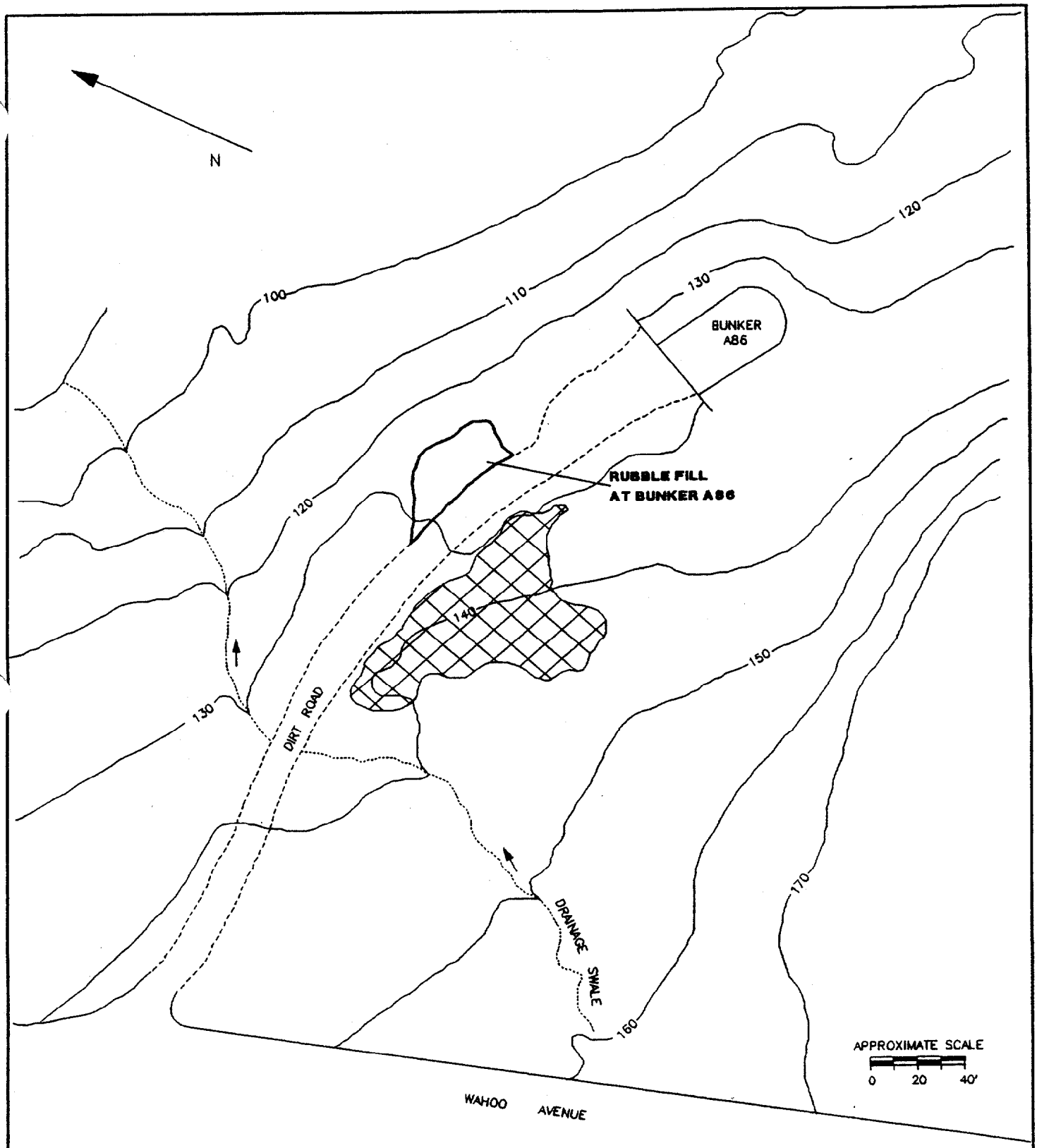
The IAS report identified construction materials disposed at this site including concrete, asphalt, an electric motor, tar buckets, wood, and gravel. They concluded that the disposal of materials had not been going on for more than 10 years at the site prior to their study (1982).

Atlantic's inspection on October 20, 1988, noted that the majority of the disposed materials consisted of construction debris (wood and concrete products). An inventory of chemical containers observed at the base of the fill during Atlantic's inspection included an empty 5-gallon container of monothanolanine (labeled as corrosive product), an empty 5-gallon container of thorite (labeled as non-shrinking compound for patching concrete) and a 55-gallon drum of lube oil (10% full).

There has been no characterization of the surface soils at this site. Due to the principally inert construction debris disposed at this site, the potential risks to environmental concerns and health is low. Petroleum compounds in lube oil, depending upon concentration and exposure can pose environmental and health risks.

2.6.3 Torpedo Shops (Site No. 7)

This site is located in the northern section of the Subase near the North Lake recreation area. A site plan showing the site topography, drainage features and utility information is shown on Figure 2-8. The site was formerly a quarry and the topography is sloped to the southwest with a 60 foot bedrock face to the north and east. Surface runoff is to the southwest into storm sewers located



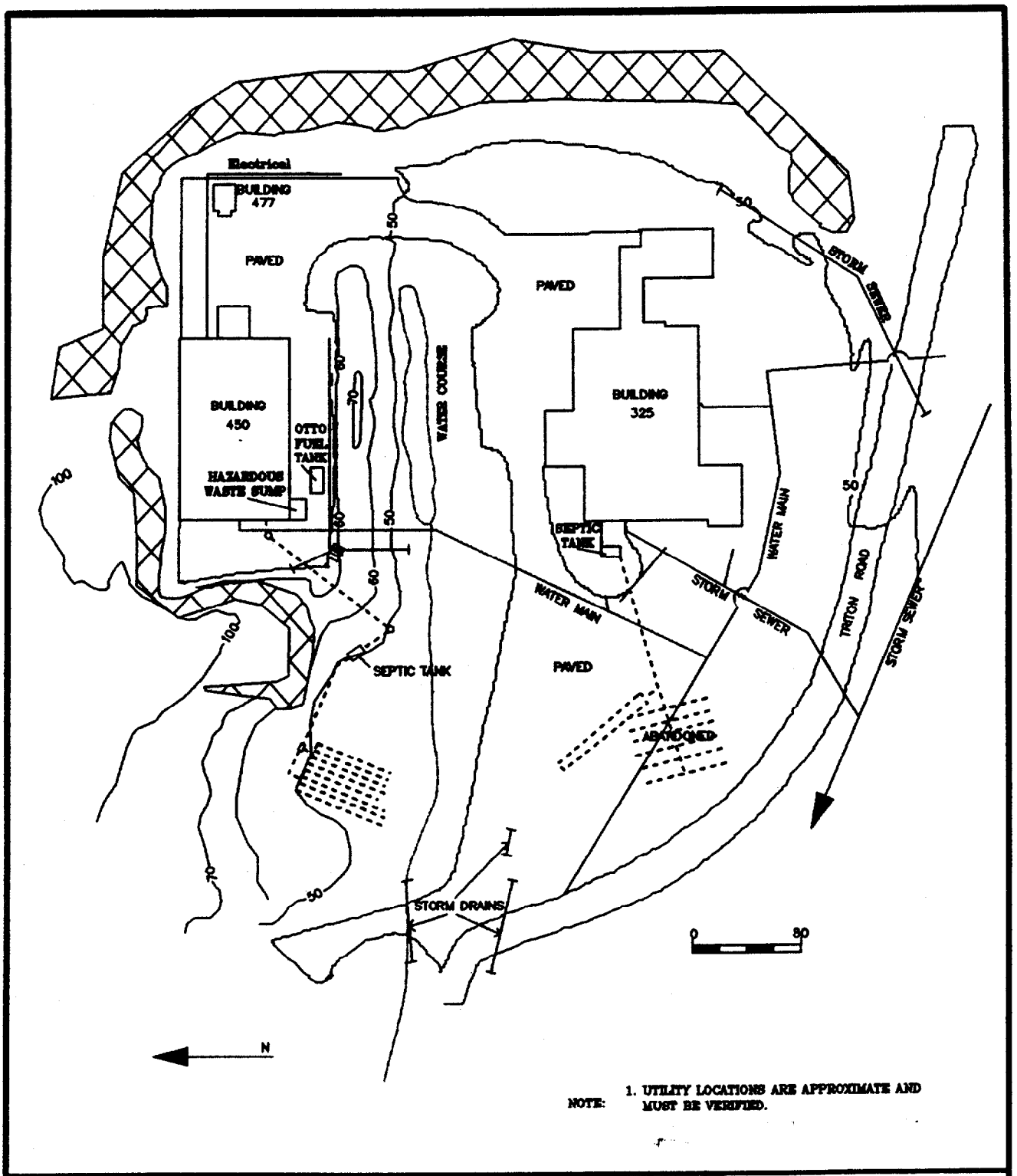
INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 2-7 SITE PLAN RUBBLE FILL AT BUNKER A86
	PROPOSED	EXISTING	
		— 95 — Existing Grade Exposed Bedrock	ATLANTIC ENVIRONMENTAL SERVICES, INC.

on the south side of Buildings 325 and 450. An earth berm is located along the base of the exposed rock face to the east. Runoff from within the berm, as well as the storm sewer system, drains through culverts under Triton Road into the Area A downstream watercourses (see Sec. 4.3.1.3) and into the Thames River at the DPDO area (see Sec. 4.3.3).

Building 325 was built in 1955 and had an onsite septic system until 1983, when all plumbing facilities were connected to sanitary sewers. This building is currently used as administration and quality assurance offices for undersea weapons, but was previously used as a torpedo overhaul facility.

Atlantic performed a visual inspection of the torpedo shops on March 20, 1989. Various fuels, solvents, and petroleum products have been used in the building according to interviews with onsite personnel. Fuels such as Otto fuel (a nitrated ester which produces hydrogen cyanide when burned), high octane alcohol (190 proof), and TH-Dimer (jet rocket fuel) were commonly encountered in maintenance areas. Additionally, solvents such as mineral spirits, alcohol, and 1,1,1-Trichloroethane were also used. Petroleum products such as motor oil and grease were used frequently during weapon overhauls. A sink in one area has been used previously for film development and another sink served a high alkaline battery overhaul area. This plumbing was previously connected to the onsite septic system/leaching field. The maintenance area has a shallow sump covered with a steel grating flush with the floor. This was previously a washdown/blowdown area for ordnance and it is uncertain as to where this shallow sump drains. A smaller building to the east serves as a paint shop. It was previously used as an assembly shop for torpedos. A storage closet in this segment has containers of 1,1,1-Trichloroethane and methyl ethyl ketone (MEK) stored in it. Outside the building to the east, hazardous waste drums are stored. The contents consist primarily of spent aerosol, paint cans and paint residuals. The drums are marked as containing propane, isobutane, MEK, xylot, methylene chloride, propellant, and zinc chromate. To the south of the building is an 8,000 gallon underground fuel oil storage tank.

The original septic field for Building 325 is located to the southwest of the building, adjacent to Triton Road. This leachfield became clogged in 1975 and was abandoned because it could not be cleared. A new leachfield was constructed next to the original distribution box and was in service until 1983 when sanitary sewers were installed. It is depicted as the two parallel lines on Figure 2-8. The various fuels, solvents and petroleum products used frequently in this building, may have been inadvertently discharged to the septic field via the internal building plumbing described herein.



NOTE: 1. UTILITY LOCATIONS ARE APPROXIMATE AND MUST BE VERIFIED.

INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 2-8 SITE PLAN TORPEDO SHOPS
	PROPOSED	EXISTING	
		—95— Existing Grade Exposed Bedrock Face ----- Former Septic System	ATLANTIC ENVIRONMENTAL SERVICES, INC.

Building 450 was built in 1974 and was also served by its own septic system until 1983 when it was connected to sanitary sewers. This building presently serves as the primary MK-48 torpedo overhaul/assembly facility. Fuels, solvents and petroleum products from torpedo overhaul operations are generated as waste products. An Otto fuel-seawater mixture is drained from expired weapons then replaced with fresh Otto fuel. The IAS reported that Building 450 generates 2,950 gallons of Otto fuel contaminated wastewater each month. Interviews with onsite personnel also indicate that solvents such as 1,1,1-trichloroethane, trichloroethylene, toluene, mineral spirits, alcohols and bulk freon are, or have been used at this facility. Petroleum products, specifically TL-250 motor oil and hydraulic fluid are also used in torpedo maintenance.

Building 450 was built with a waste collection system which collected spillings or other waste products via floor drains and sent them to a 2,000 gallon underground waste tank. Reportedly only domestic wastewater from toilet facilities, lavatories and showers was directed to the septic field. The waste tank was pumped periodically and the contents were hauled away for off base disposal. It is possible that accidental discharges of hazardous waste material may have been introduced to the septic system via the bathroom fixtures.

Atlantic performed a visual inspection of Building 450 on March 20, 1989. The septic leachfield is located southwest of this building in a flat elevated area just east of Ammunition Bunker No. A-91. The hazardous waste sump was deactivated in 1987 and has been replaced with three 1,000 gallon above ground tanks located to the south of the building. The floor drains have been sealed and a system for pumping waste products to the new tanks is in place. A 4,000 gallon above ground storage tank for Otto fuel is also to the south of the building.

Inspection of the torpedo shops area and former septic fields revealed no visible surface staining or discharge points. Hazardous material storage areas were clean, well marked and showed no indication of leakage or mismanagement.

There has been no characterization of the subsurface soils, sediments or ground water in the torpedo shop area. Chemicals associated with this area include Otto fuel, alcohol, jet fuel, mineral spirits, 1,1,1-trichloroethane, trichloroethylene, toluene bulk freon, motor oil and hydraulic fluid. Depending on concentration and exposure, these chemicals can pose risks to environmental receptors and human health. Potential risks include:

- Effects upon aquatic/estuarine biota due to transport of chemicals to the Thames River via surface drainage systems and/or ground water.

- Human health effects associated with direct contact with chemicals transported by ground water inflow to the North Lake swimming area.

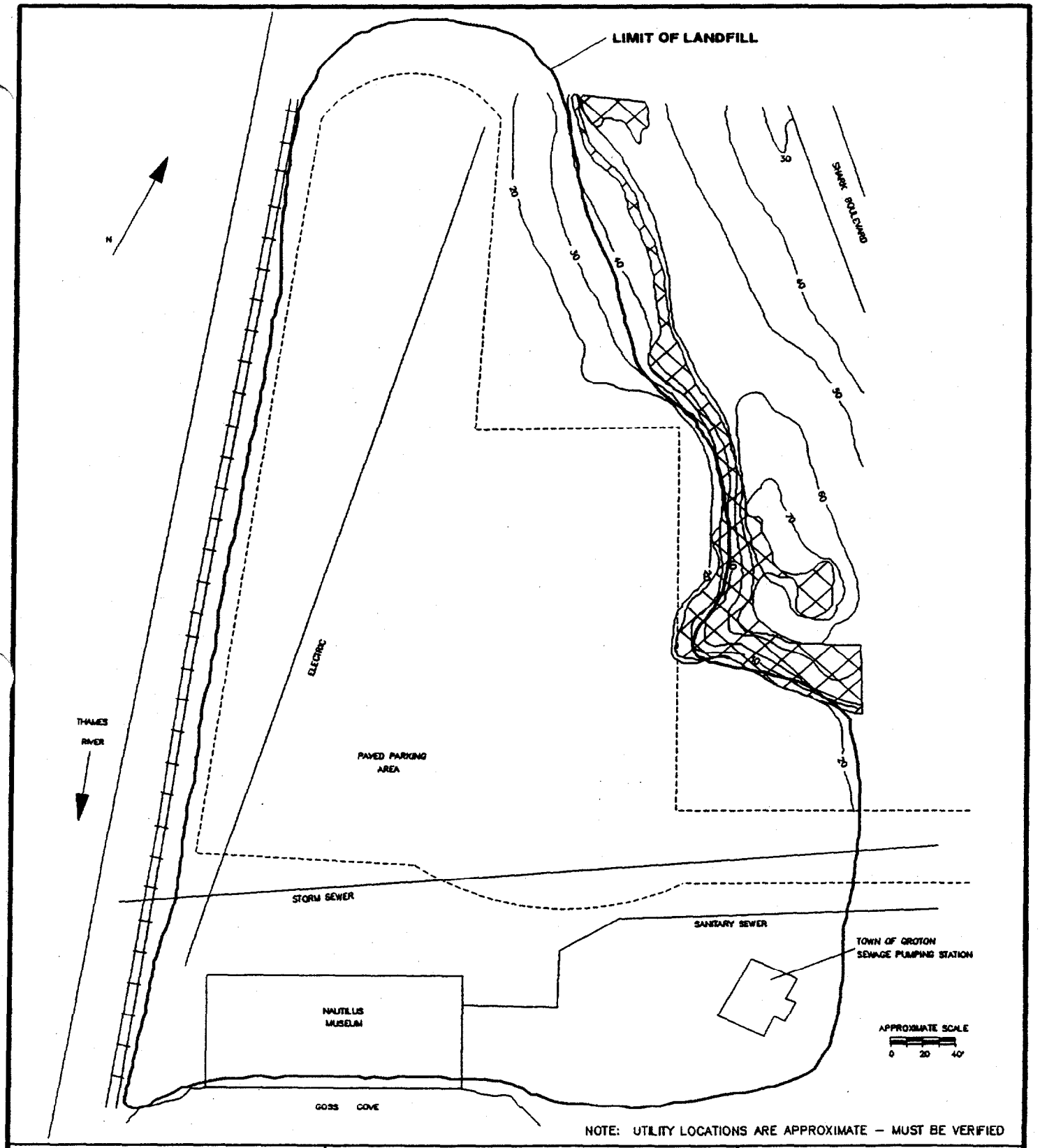
2.6.4 Goss Cove Landfill (Site No. 8)

The Goss Cove Landfill site is located off Military Highway in the southwestern portion of the Subase. A site plan showing current site development, drainage features, and utility information is shown on Figure 2-9. The site is directly adjacent to the Thames River and Goss Cove. The Nautilus Museum and associated parking lot are directly over the site.

The IAS indicated a landfill operated onsite from 1946 until 1957 at which time Area A Landfill was opened. The disposed material was reported to consist of only incinerator ash and inert rubble and was placed within the northern portion of the former Goss Cove. William Mansfield (POC) stated that several large gas cylinders were excavated during the construction of a utility trench located north of the museum. One tank was leaking propane. The contents of the additional tanks which were removed are not known. Based on the finding of gas cylinders in the landfill, and the fact that it served as the landfill for the Subase for ten years from 1946-1957, the exact nature of the disposed material is not defined.

Atlantic reviewed archive photographs for the Goss Cove Area available at the Connecticut State Library. The 1934 photograph showed the entire original area of Goss Cove to be open water with no filling. The railroad did separate the cove from the Thames River in its current location. A 1951 aerial photograph showed the fill extending to the approximately location of the current access driveway to the museum. By 1965, aerial photographs show the landfill extending to the current limits of encroachment on Goss Cove. The 1965-1980 aerial photographs show the landfill surface being used for vehicle parking. By the 1986 aerial photographs, the Nautilus museum has been built on the southern limits of the landfill. The paved parking area extends over the remaining limit of the landfill to the north.

Boring logs for the Nautilus Museum construction were reviewed. The boring logs indicated fill material consisting of cinders, metal, brick, glass, and sand/gravel to a approximate depth of 15 feet. The fill is over an organic silt layer approximately 10-15 feet thick which likely represents the base of the former Goss Cove. The silt is underlain by fine sand to refusal at depths ranging from 25 to 100 feet. The further away from the rock face outcrop along the east side of the parking lot, the deeper it was to refusal.



NOTE: UTILITY LOCATIONS ARE APPROXIMATE – MUST BE VERIFIED

INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 2-9 SITE PLAN GOSS COVE LANDFILL
	PROPOSED	EXISTING	
		— 95 — Existing Grade Exposed Bedrock ○ TB-1 – Test Boring	ATLANTIC ENVIRONMENTAL SERVICES, INC.

Exposure pathways to be considered at this site include the possibility of ground water contamination, ground water contamination discharges to the Thames River, and the release and transport of hazardous volatiles. There are buildings overlying the landfill and these could be potential receptors if the volatiles being released migrate into the buildings.

2.6.5 Over Bank Disposal Area Northeast (OBDANE) (Site No. 14)

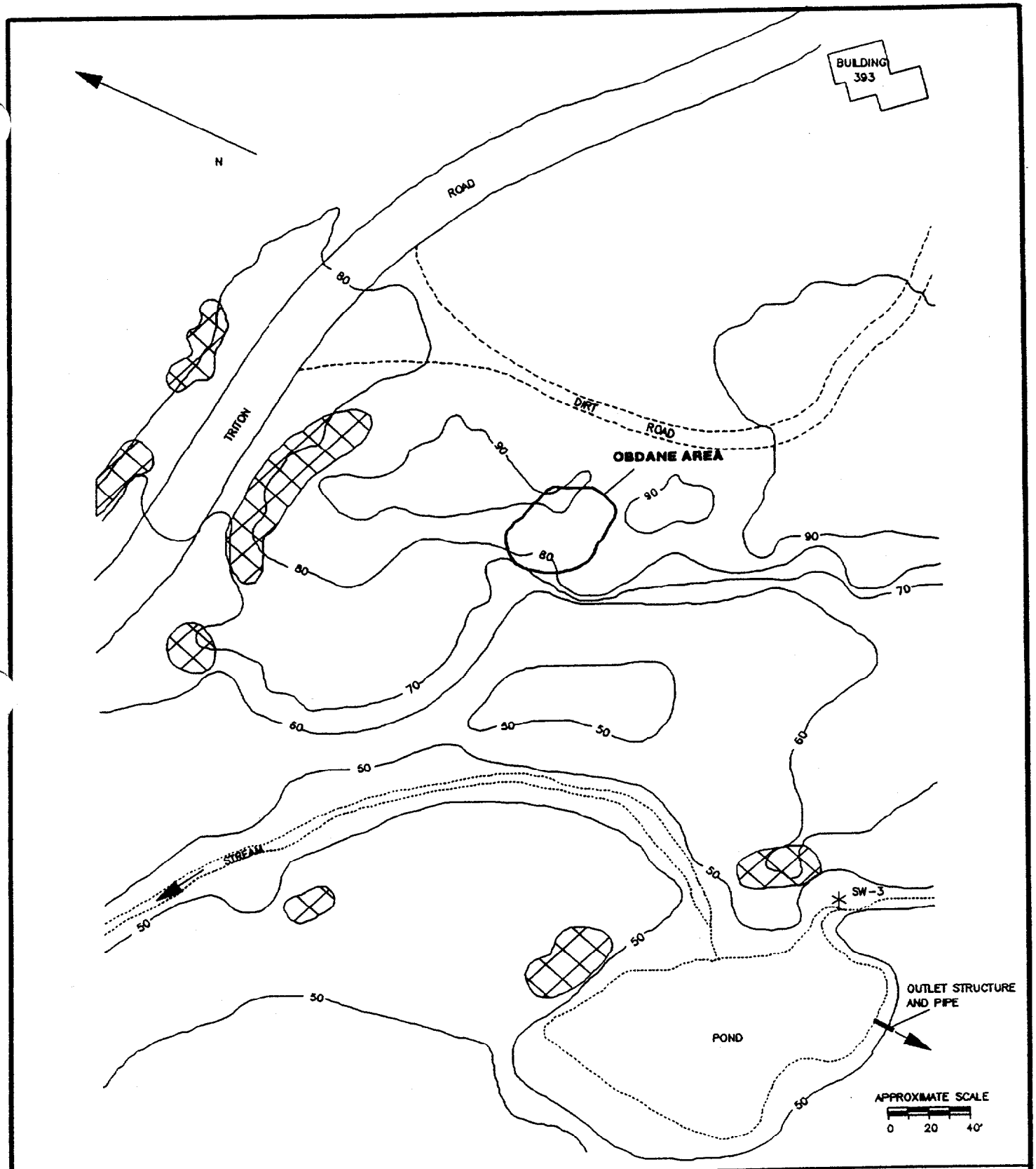
The site is located in a heavily wooded area on the edge of a ravine northwest of Area A Landfill; a dirt road provides limited access to the property. A site plan showing site topography, drainage features, and utility information is shown on Figure 2-10. The topography at the site is sloped to the southwest with a steep 20-foot bedrock face at the edge of the site. Surface runoff is to the southwest into a stream which drains from the Area A Landfill site. The stream flows into a surface drainage system that follows along Triton Road and ultimately discharges into the Thames River at the south end of the DPDO site. The IAS report states the site vegetation indicates that no disposal had occurred within the last 10 years of their investigation (1982). Atlantic inspected the site on September 30, 1988 and verified the presence of several fiber drums. No visual soil staining or stressed vegetation was observed.

The risks associated with any potential contents of the fiber drums are unknown, and will be evaluated based on the collected analytical data for this site and the data collected from the streams which flow from the Area A Landfill near the site.

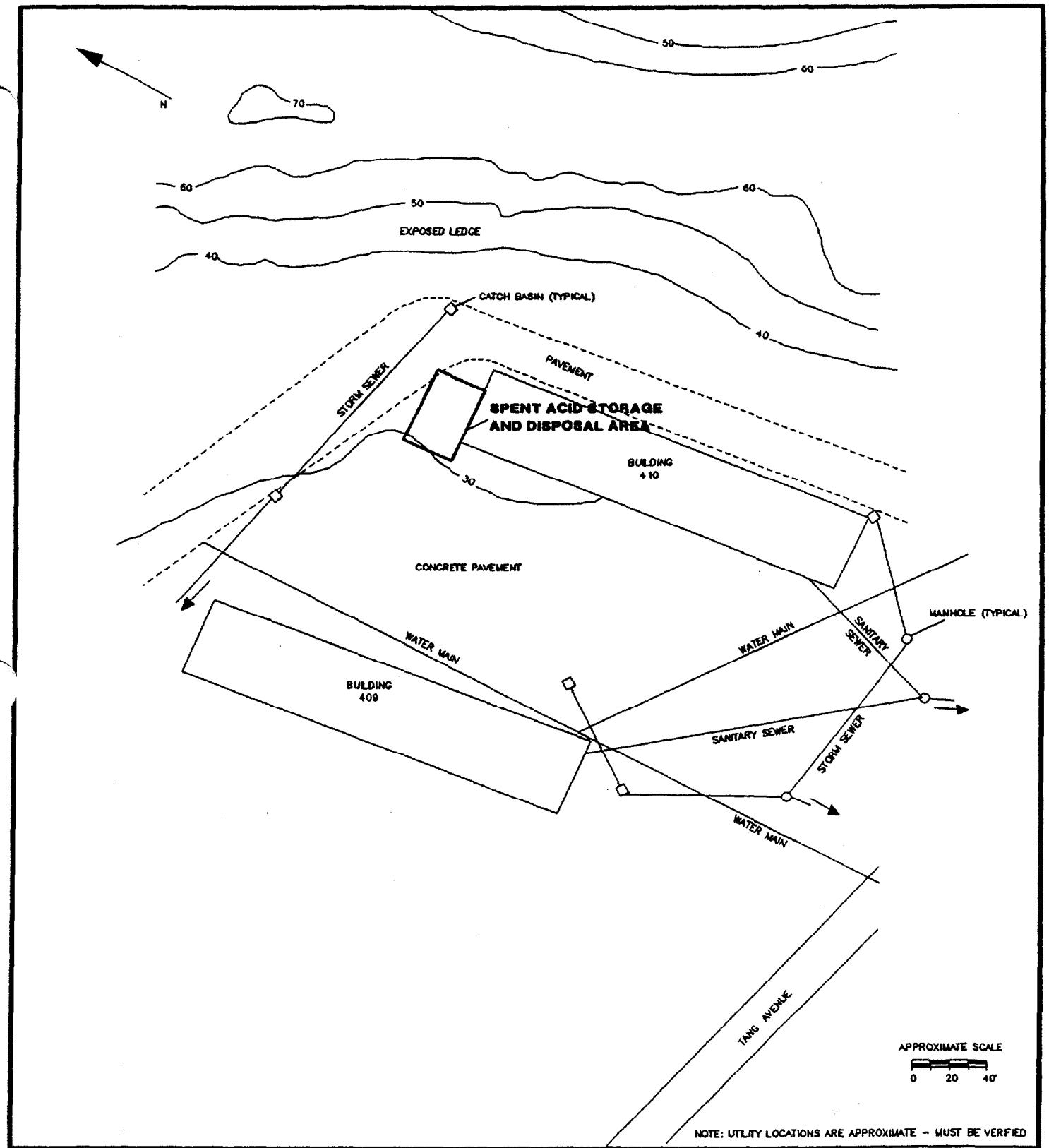
2.6.6 Spent Acid Storage and Disposal Area (Site No. 15)

The site is situated in the southeastern section of the Subase adjacent to Building 410. A site plan showing site topography, drainage features, and utility information is shown on Figure 2-11. The topography of the site is relatively flat with a 20-foot high bedrock ridge just to the east. The site is completely covered by concrete or bituminous pavement. A catch basin and storm sewer system collect surface runoff and it is directed westward.

The IAS reports that this site was used prior to and for several years after World War II for the temporary disposal of waste battery acid. It was reported that a rubber-coated underground tank existed between Buildings 409 and 410. It was approximately 12 feet long by 4 feet wide by 4 feet high. The batteries were placed on a concrete pad next to the tank where some acids reportedly occasionally leaked, however, no major spills were recorded. The acid from the batteries was placed in the tank, and when full, it was pumped into a tank truck and placed in the Area A Landfill.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 2-10 SITE PLAN OBDANE AREA
	PROPOSED	EXISTING	
		— 95 — Existing Grade Exposed Bedrock Stream	ATLANTIC ENVIRONMENTAL SERVICES, INC.



NOTE: UTILITY LOCATIONS ARE APPROXIMATE - MUST BE VERIFIED

INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 2-11 SITE PLAN SPENT ACID STORAGE AND DISPOSAL
	PROPOSED	EXISTING	
		— 95 — Existing Grade	ATLANTIC ENVIRONMENTAL SERVICES, INC.

Atlantic inspected the site and found no evidence of the location of this tank. The area is completely covered with concrete. Based on discussions with Navy personnel, the location of the tank is unclear. Available information indicates it was possibly adjacent to the northwest corner of Building 410. This area appears to be a former vehicle scale and associated scale house. A below ground sump with a pipe from Building 410 is observed in this area.

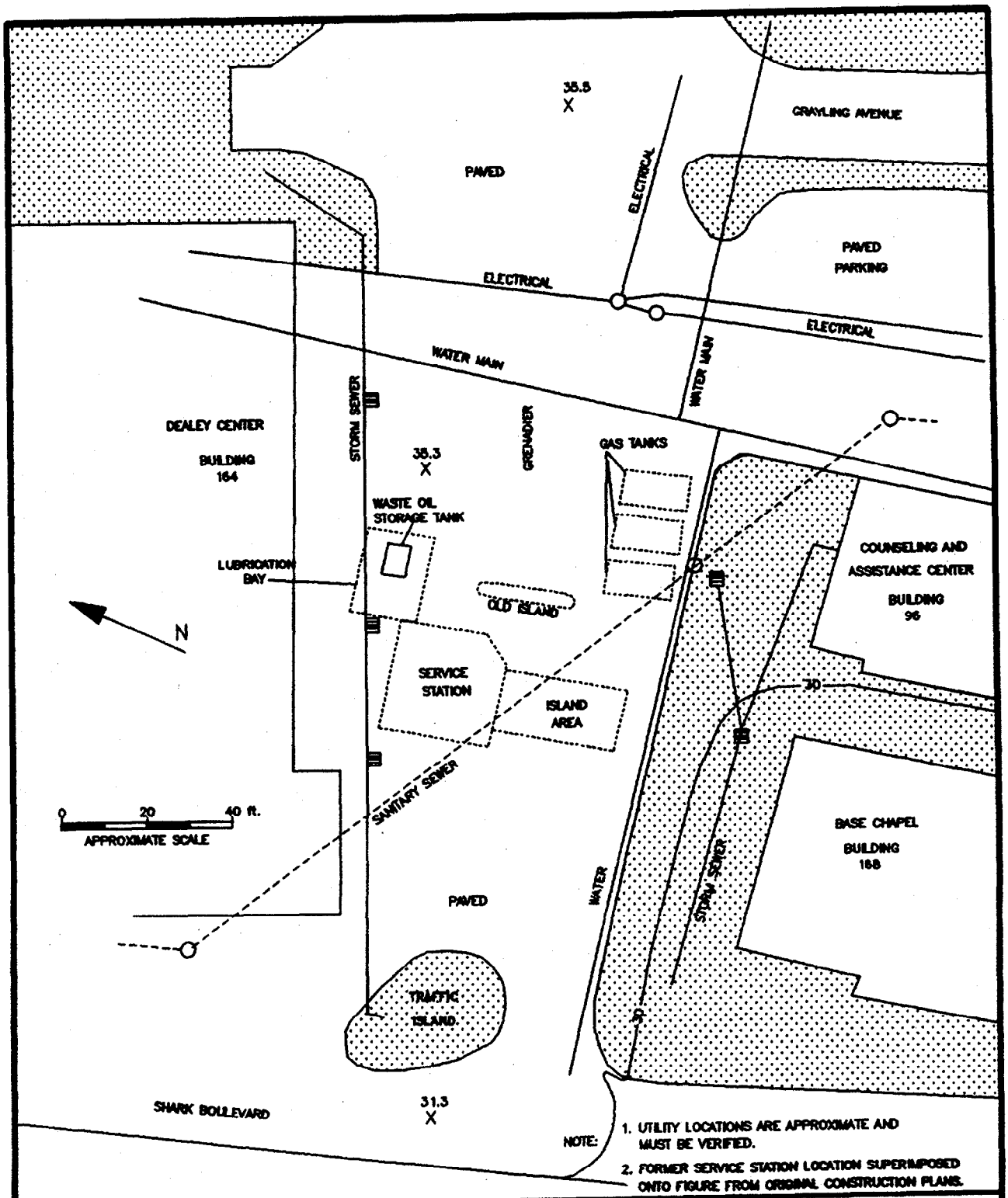
It is expected that any acid which may have been released at this site has been washed away or buffered. Risks that this site site may pose would be due to the possible presence of metals associated with batteries. Potential pathways include exposures to soils and transport to ground water.

2.6.7 Former Gasoline Station (Site No. 18)

The site is located in the current roadway and parking area just south of Building No. 164 (Dealey Center) in the west central portion of the Subase. A site plan showing the site topography, drainage features, utility information, and former gasoline station is shown on Figure 2-12. The site is entirely covered by asphalt and slopes to the southwest toward Shark Boulevard. Drainage is provided by storm water sewers located on the north and south sides of Grenadier Avenue and the east side of Shark Boulevard.

The gasoline station was in operation from 1940 to the early 1960's. When originally constructed in 1940, the gasoline station had only one garage bay and one pump island. The locations of the underground tanks or the method of sewage disposal of the original gas station is unknown. In 1950, the site was renovated and site plans indicate that the original gasoline island was removed and replaced by two islands on the south side of the building. The original building was made smaller and a new lubrication bay was added to the northeast corner of the original structure. Site plans from 1950 show the fuel feed lines to the two 8,000 gallon and one 10,000 gallon underground gasoline tanks located on the southeast section of the site. The tanks are only depicted on the 1960's map. It is unknown if these tanks were the original tanks installed in 1940. In addition to gas tanks, a 250 gallon underground waste oil storage tank was located under the new lubrication bay floor. A 1960 site plan indicates the site being served by sanitary sewers. Additionally, a third gas island parallel and to the south of the others is depicted. Aerial photographs indicate that the gasoline station was totally demolished between 1962 and 1964. It is unknown if the gasoline tanks and associated piping or the waste oil tank were removed or remain in place.

Atlantic performed an inspection of this site on March 20, 1989. There are no traces or remnants of the gasoline station or the underground tanks. The site is completely paved and now makes up a



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 2-12 SITE PLAN FORMER GASOLINE STATION
	PROPOSED	EXISTING	
		— 95 — Existing Grade Sidewalk/Island 78.2 X Spot Grade	ATLANTIC ENVIRONMENTAL SERVICES, INC.

portion of Grenadier Avenue and parking for Building 164 (Dealey Center), Building 96 (Counseling and Assistance Center) and Building 168 (Base Chapel).

There has been no characterization of subsurface soils in the former gasoline station area. Chemicals associated with waste oil and gasoline include petroleum hydrocarbons, solvents and metals. Depending on concentration and exposure, these chemicals can pose risks to environmental receptors and human health.

2.7 Step II Sites: Site Background and Nature of Problem

The IR Step II sites which require Remedial Investigation/ Feasibility Studies (RI/FS) are the following:

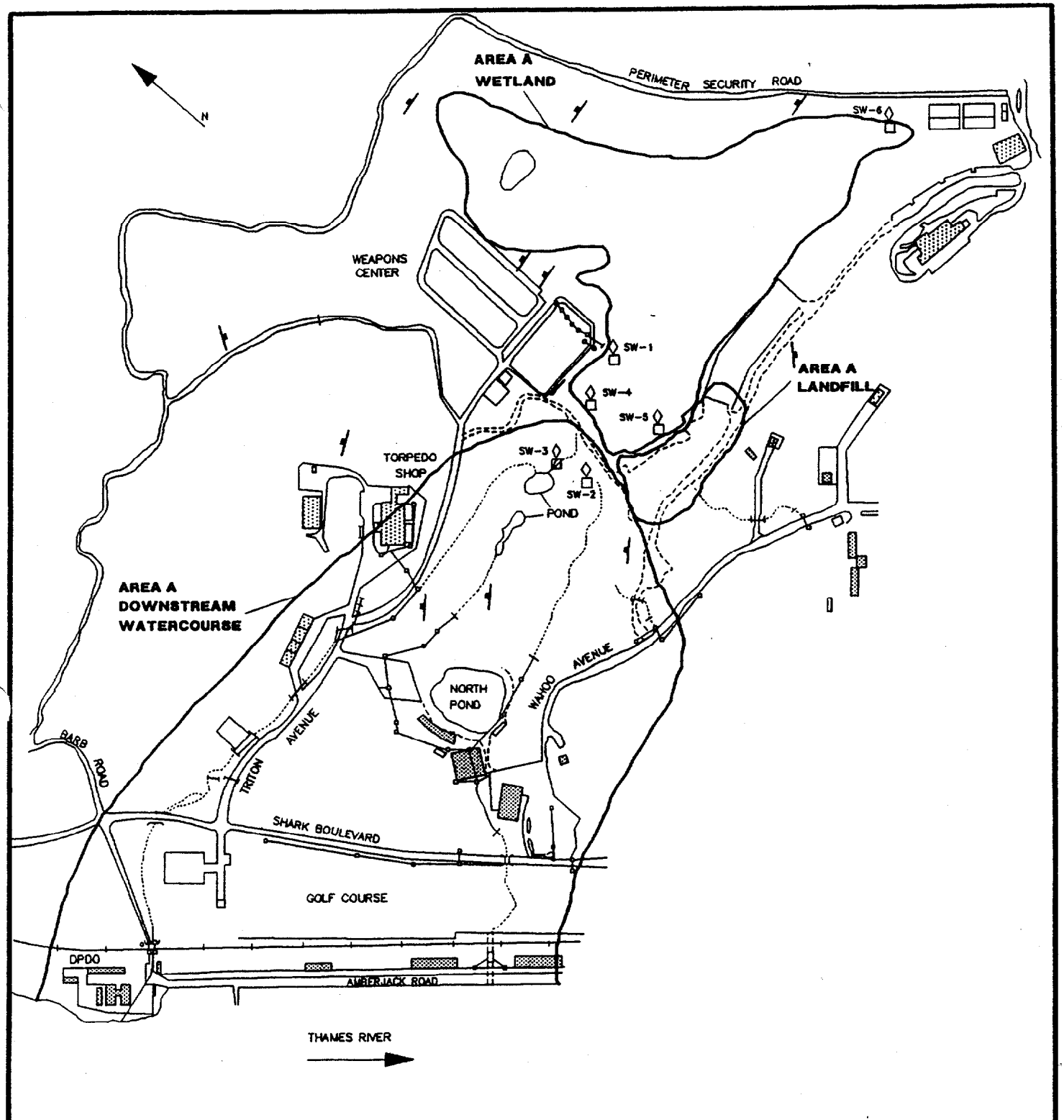
- Area A Landfill
- Over Bank Disposal Area
- DPDO Area
- Lower Subase

Contamination is known to exist on these sites with potential health and environmental effects. The objective of the Step II process is to conduct a comprehensive field investigation to define the nature and extent of site contamination, assess health and environmental risks and evaluate remediation alternatives.

2.7.1 Area A Landfill (Site No. 2)

The site is located in the northeastern and northcentral section of the Subase and access is available via a dirt road off of Wahoo Avenue. A site plan, which shows site topography, drainage features, is shown on Figure 2-13. The landfill area is relatively flat with a steep ridge sloping down to the landfill on the south and the Area A Wetland to the north. Drainage from the landfill is from south to north, into the Area A Wetland and ultimately carried downstream by several streams which discharge to the Thames River. Atlantic's evaluation and discussion of this site is divided into three areas 1) Area A Landfill, 2) Area A Wetland, and 3) Area A Downstream Watercourses.

Area A Landfill - This area was used as a landfill for an undetermined number of years prior to 1957. The site was officially closed in 1973. Previously, the area was low-lying with a stream traversing it and draining approximately 148 acres to the north and west. The watershed is shown on Figure 2-5, and in addition to Subase property, includes residential and undeveloped land to the west of Route 12.



	LEGEND		
	PROPOSED	EXISTING	
INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT		Building ◊ SW-1 – Surface Water Sample □ – Sediment Sample Stream Strike and dip direction of joints Culvert	FIGURE 2-13 SITE PLAN AREA A LANDFILL ATLANTIC ENVIRONMENTAL SERVICE, INC.

The Subase incinerator ceased operation in 1963, and all wastes were then disposed of in Area A, unburned. This practice continued until 1973. All non-salvageable materials generated by the submarines and base operations were landfilled in this area. As previously stated, waste acid from the Spent Acid Storage and Disposal Area were disposed in the Area A Landfill. After closure of the landfill, a concrete pad was created for above ground storage of "hazardous" industrial wastes. At the time of the IAS survey, there were 42 steel drums, 87 transformers (mineral and PCB), and 60 to 80 electric switches located on the pad. Leaks were evident coming from two transformers and several electric switches. It is not known whether the oil leaks were mineral or PCB. Most drums were stacked on wooden pallets, and those having PCB labels were covered and bound with plastic sheeting.

The IAS noted that at the edge of the landfill, which borders the wetland, steel drums, oxygen candles, wood scrap, metal scrap, concrete, and tires were exposed by either erosion of the fill material or recent dumping. In two locations along this edge, it was evident that petroleum compounds had been recently poured from containers and had flowed down the edge of the landfill into the marsh.

The area fill method was reportedly used in landfill operations. The refuse was dumped from the face of the deposited refuse and covered with earth. The cover material used on the landfill was gravel obtained from the Groton water supply reservoir. The material is very permeable and allows quick percolation of surface water. The water table, based on the presence of the marsh, is probably within the landfilled refuse.

A review of aerial photographs indicated that the landfill extended along the wetland to the current tennis court area. This fill may have been construction fill but it is unknown.

Atlantic performed a visual inspection of the Area A Landfill and Wetland on September 30, 1988. Orange colored landfill leachate was observed along the toe of slope of the landfill extending from the dike to, and including areas along, the deployed parking area. The side slope face of the landfill had been covered with fill, therefore, the material in the landfill was not visible. Sand bags and contractors equipment are currently stored on the landfill. Other equipment, several transformers, and removed underground storage tanks are located on the concrete pad area.

<u>Area A Wetland</u> - The Thames River was dredged in 1957, and the spoils were deposited in this wetland area. An earthen dam was constructed to retain the spoil which is 600 to 800 feet wide and covers approximately 25 acres. The wetland vegetation is

predominately phragmites; a small pond is located on the southeast portion of the wetland. Atlantic learned during the course of this study that pesticide "bricks" were placed on the wetland ice during winter and allowed to melt and discharge into the wetland for mosquito control.

Area A Downstream Water Courses - Several streams, discharge areas, and North Pond exist downstream of the dike at the Area A Wetland and Landfill Surface water features are shown on Figure 2-13.

The main discharge from the Area A wetland is by four 24 inch metal culverts through the dike. This forms a small stream which flows west for approximately 200 feet into a small pond. Under normal flow conditions, the discharge from this pond is from a small stream flowing north and then west past the OBDANE site. It continues under and adjacent to Triton Avenue, under Shark Boulevard and ultimately discharges at the DPDO site. The small pond previously mentioned does have a discharge structure to the south. During periods of high flow and high pond level, some discharge could pass through this structure flowing south to a stream coming from the Over Bank Disposal Site to be subsequently discussed.

At the base of the dike and the Over Bank Disposal Site, is a small wetland. Ground water discharges from the Area A Wetland to this small wetland. A stream flows from the wetland west toward North Pond, a recreational swimming area for Subase personnel. Under normal conditions, the stream enters a culvert which bypasses the pond and it subsequently discharges to the golf course and ultimately to the Thames River. There is a manhole adjacent to North Pond that connects another pipe that flows to the pond. The invert elevation is several inches higher than the main culvert, therefore, under normal flow conditions no water flows to the pond. However, under heavier runoff periods, it is quite likely that some discharges to North Pond occurs. During Atlantic's site inspection, the pond had been drained, however, some water remained. This indicates that the pond likely receives ground water discharge from the Area A watershed.

In December 1984, Wehran initiated a Verification Study of the Area A Landfill site. Three rounds of surface water and sediment samples were collected from six locations in the vicinity of the Area A Wetland and downstream water courses between December 1984 and April 1985. The first round of samples was analyzed for volatile organic compounds (VOC), base/neutral extractable compounds (B/N) also referenced to as poly aromatic hydrocarbons (PAH's), acid extractable compounds (A/E), pesticides and PCB compounds (Pest./PCB) and elemental metals/miscellaneous compounds (metals). The samples from the second and third rounds were analyzed for VOCs and metals. The results are summarized on Tables 2-1 and 2-2. The sample locations are shown on Figure 2-13.

TABLE 2-1

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

AREA A LANDFILL/OBDA
ANALYTICAL RESULTS
SURFACE WATER

Parameter	Sample Location (All Results in ppm)*					
	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6
Volatiles						
Methylene chloride		0.27	0.19		0.31	
Base/Neutrals						
Bis(2-ethyl hexyl) phthalate	.118	0.44				
Butyl benzyle phthalate	.115					
Di-n-octyl-phthalate	.245	.032				
Metals						
Antimony	.4	.4	.2	.2	.2	
Arsenic				.004		
Cadmium				.03		
Copper	.03	.120	.02	.02	.02	
Cyanide (total)	.175					
Nickel	.08	.04	.03		.03	
Phenols (total)		.096	.132	.188	.194	.092
Zinc	0.1	.152	.10	.08	.05	.05

1. * All results shown are the greatest concentrations measured at each location.

TABLE 2-2

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

AREA A LANDFILL/OBDA
ANALYTICAL RESULTS
SEDIMENTS

Parameter	Sample Location (All Results in ppm)*					
	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6
Volatiles						
Benzene		0.24				
Chloroform				.01		
Methylene chloride	0.29	.150	.018	.016	.031	.027
Toluene (methyl chloroform)	.016	.016	.10	.092	.058	.036
Base Neutrals						
Benzo (a) anthracene	1.20					
Benzo (b) fluoranthene	.95					
Benzo (k) fluoranthene	.95					
Benzo (g,h,i) perylene	.55					
Benzo (a) pyrene	.75					
Chrysene	.55					
Fluoranthene	1.85					
Prenanthrene	.75					
Pyrene	1.35					
Pesticides						
4,4 DDD		79.0	91.0	17.0	.010	12.0
4,4 DDE	.0048	7.4	2.5	1.30	.093	.820
4,4 DDT	.022	59.0	4.8	17.6		17.0
Metals						
Antimony	18.3	36.2	18.4	12.0	10.4	12.7
Arsenic	3.21	1.96	3.68	2.94	2.92	1.33
Beryllium	0.44	0.68	2.62	0.48	0.31	.51
Cadmium	0.80	1.81	2.50	0.64	0.49	0.49
Chromium	20.4	7.5	12.0	9.84	9.37	6.6
Copper	30.8	11.3	33.2	20.0	26.3	13.9

(continued)

TABLE 2-2 (CONTINUED)

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

ANALYTICAL RESULTS
SEDIMENTS

Parameter	Sample Location (All Results in ppm)*					
	SW-1	SW-2	SW-3	SW-4	SW-5	SW-6
Cyanide (total)	2.53	.36	.79	0.63	1.52	0.11
Lead	104	38.7	5960.0	1486.0	39.2	24.6
Mercury			.28			.06
Nickel	18.32	32.14	22.5	13.2	15.0	13.5
Phenols (total)						
Selenium						
Silver						
Thallium	5.86	2.35	4.47	3.24	2.48	3.25
Zinc	57.2	90.5	169	53.8	56.5	30.4

1. * All results shown are the greatest concentrations measured at each location.

The surface water results showed the highest concentration of VOC contamination (methylene chloride 0.31 ppm) in the vicinity of the landfill (SW-5) with similar levels in the surface water streams discharging from the landfill (SW-2, SW-3). Some PAH compounds were noted in the surface water of the Area A Wetland (SW-1) and downstream of the wetland (SW-2). Metals were detected in all of the surface water samples collected by Wehran. Sample SW-6, at the upstream location of the wetlands, had the lowest levels of metals, while all other sample locations had generally consistent levels.

The sediment results showed VOC compounds (methylene chloride and toluene) at all sampling locations. The only PAH compounds were detected on the far side of the Area A Wetland (SW-1) adjacent to the Weapons Storage Area. Pesticides were found in all six samples, the sample closest to the landfill had the overall lowest concentration. The pesticides present were DDT, DDE, and DDD. The past practice of applying pesticides to the wetland is the probable cause of their presence.

Eleven metals were detected in the sediment samples collected from Area A. Levels of antimony, arsenic, cadmium, chromium, cyanide, mercury, copper, lead, nickel, zinc, and thallium were detected. Because they were analyzed on a weight basis, they cannot be compared to CTDEP or USEPA standards which are based on EP Toxicity analysis, and there are no other appropriate or relevant standards for soil analyses by weight. Elevated levels of cyanide were found at SW-1 which is near the Weapons Storage Area.

The presence of these chemicals in the wetlands and drainages of Area A pose the following potential risks:

- effects upon aquatic and terrestrial biota within the Area A wetland system; these effects include the bioaccumulation of chemicals;
- effects upon aquatic/estuarine biota due to transport of chemicals to the Thames River via surface drainage systems and/or ground water;
- possible degradation of ground water and migration to offsite residential water supply wells.
- human health effects associated with contact with chemicals in the Area A wetland system; it is expected that the opportunity or probability of contact is low due to the restricted nature of the site.

- human health effects associates with contact with chemicals that have been transported from Area A via the drainage ways; of particular interest is the possibility that some of these materials may have entered the swimming pond (North Pond) via runoff or ground water inflow.

2.7.2 Over Bank Disposal Area (Site No. 3)

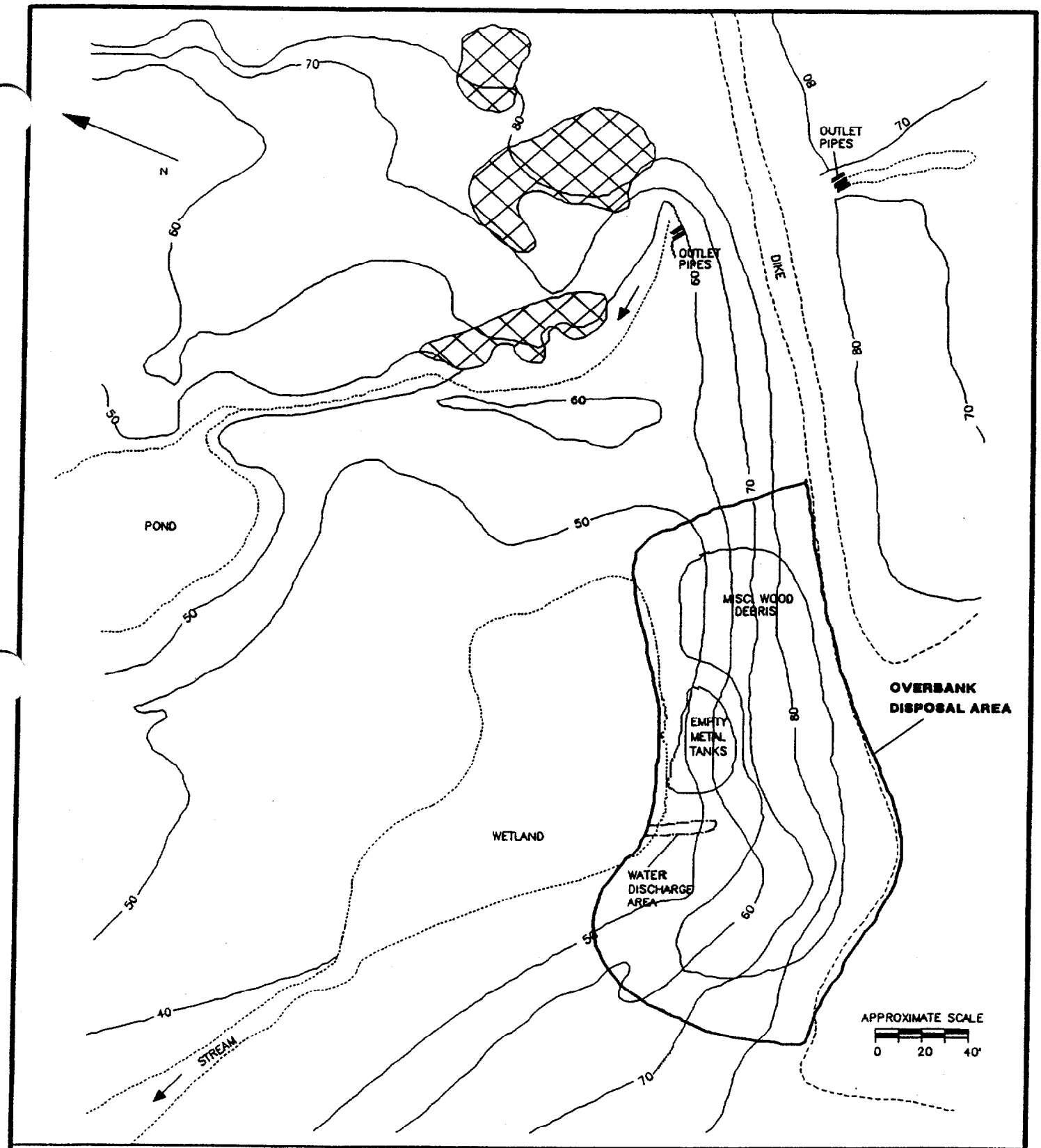
This site is located on the slope of the dike below and adjacent to the Area A Landfill. It is located on the southwest end of the dike. The slope of the dike approaches a 45° grade in this disposal area. A small wetland exists at the base of the dike. The site is shown on Figure 2-14.

This area served as a disposal site after the earthen dam was constructed in 1957. The condition of the materials and vegetation on the site during the 1982 IAS survey indicated that the material had been there for many years. Envirodyne concluded that there appeared to have been no effort to cover the waste materials which included thirty partially covered 200-gallon metal fuel tanks and much scrap lumber. The material was disposal down the dike opposite the marsh.

Atlantic made a site inspection on September 30, 1988, and observed old telephone poles with creosote, approximately thirty empty 200-gallon tanks with no marking as to the former contents, several empty 55 gallon drums, and scrap wire rolls onsite. Bright orange organic sediments were observed in water discharging from the base of the dike embankment. The drainage from this wetland and site is discussed in Section 2.7.1.

In December 1984, Wehran initiated a Verification Study of the Over Bank Disposal Area. Three rounds of surface water and sediment samples were collected from six locations in the vicinity of the Area A wetland and nearby drainage ways between December 1984 and April 1985. The first set of samples were analyzed for VOC's, B/Ns, A/Es, Pest./PCBs, and metals. The samples from the second and third sets were analyzed for VOCs and metals. The results are shown in Table 2-1 and 2-2 and were discussed in the previous section.

One sample SW-2, was collected from this wetland area at the base of the Over Bank Disposal Area. The surface water results indicated VOC compounds (methylene chloride, 0.27 ppm) were present. Concentrations of base/neutral compounds detected were bis (2-ethyl hexyl) phthalate: 0.44 ppm and di-n-octyl phthalate: 0.032 ppm. Metals were detected in this sample in levels consistent with other analysis results from Area A.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 2-14 SITE PLAN OVERBANK DISPOSAL AREA
	PROPOSED	EXISTING	
		— 95 — Existing Grade Exposed Bedrock Stream	ATLANTIC ENVIRONMENTAL SERVICES, INC.

The sediment sample results from SW-2 indicated the presence of VOC compounds (benzene - 0.24 ppm, methylene chloride - 0.15 ppm, and toluene - 0.016 ppm). This was the only sample that detected benzene. No base/neutrals were detected in the sediment sample. Pesticides were detected in the sediments (4,4 DDD - 79.0 ppm, 4,4 DDE - 7.4 ppm, and 4,4 DDT - 59.0 ppm) and they had the highest overall concentration of the six samples. Metals results were consistent with other detected levels except for SW-3 and SW-4 which were elevated for lead.

This area is considered to be similar to the Area A Landfill with regard to the kinds of materials present and the potential risks and exposure routes. Because it is smaller than the Area A Landfill, it poses less of a risk than the overall wetland system. However, chemicals placed in, or draining through, the Over Bank Disposal Area could be transported down the stream which flows from this area to near North Pond, the golf course, and ultimately the Thames River.

2.7.3 DPDO Area (Site No. 6)

This site is adjacent to the Thames River in the northwestern section of the Subase. The site topography, development conditions, and utilities are shown on Figure 2-13. It is relatively flat and all surface runoff would flow directly into the Thames River. The entire area is low lying and prone to flooding. The water table is approximately five feet below the ground surface. The southern one-half of the area is covered with asphalt most of which is degraded; the north portion is unpaved.

The site opened in 1950 and was used as a major Subase landfill and burning ground until 1969. The materials which reportedly were burned and landfilled were primarily inert and consisted of construction materials and combustible scrap (i.e., wood pallets, tires, old furniture) and other non-salvageable waste items. These materials were piled together at the north shoreline of what is now the DPDO and burned. The residue was pushed to the shoreline and partially covered. At the time of the IAS survey (1982), there was no burning or landfilling occurring in the area since all materials were salvaged or trucked off base to be disposed of elsewhere.

Atlantic reviewed archive photographs for the DPDO area. The 1934 photograph showed the southern portion of the fill to be existing, however, the fill for the bulkhead and docks south of the DPDO did not exist. The 1951 photograph showed the fill to be similar to its current configuration, except for the northwest portion which was not filled. If the landfill opened in 1951, perhaps most of the fill was placed in this area.

Based on Atlantic's inspection of this site, metal and wood products are stored outside throughout most of this site. Submarine batteries are stored in the southeast portion of the site adjacent to the railroad tracks; no leakage was observed. Building 479 and 355 are located on the paved area to the south. Building 491 is used for miscellaneous storage and metal bailing occurs adjacent to it on a gravel surface. Based on an inspection of building plans, Atlantic also identified the existence of a former battery acid handling facility at the north section of the site. An in-ground rubber lined tank and associated pumping facilities were present.

In December 1984, Wehran initiated a Verification Study of the DPDO Area. Three soil borings, shown on Figure 2-15, were drilled through the fill material. The soil from continuous split-spoon samples were collected and composited (0-10 feet) for laboratory analyses. Each sample was analyzed for VOCs, B/Ns, A/Es, Pest./PCBs, and Metals; there were no A/Es or Pest./PCBs detected. The results for the other fractions are presented in Table 2-3.

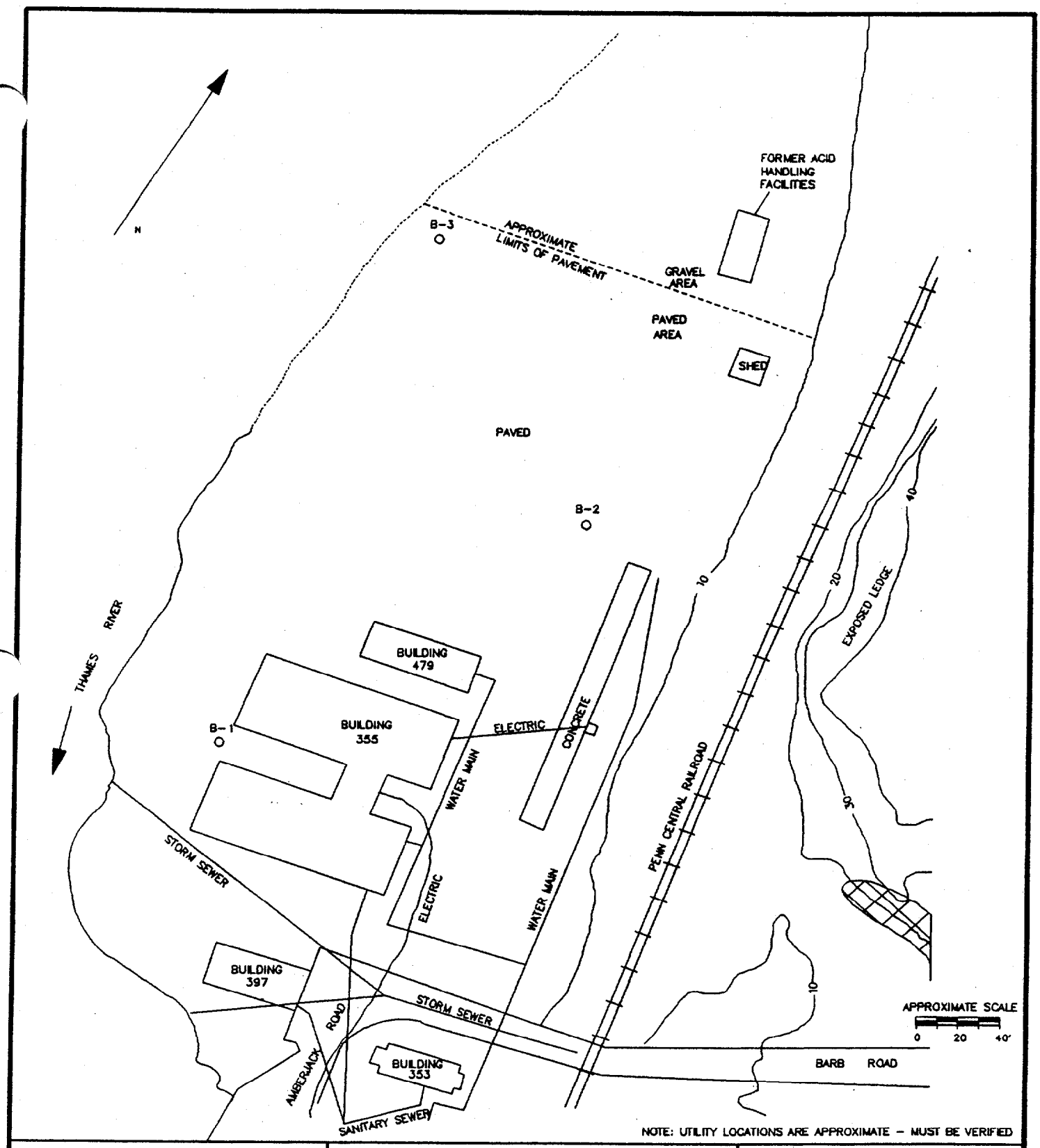
From a risk assessment perspective the following observations are made:

- high levels of copper were observed in some samples; this metal can be toxic to estuarine biota;
- moderate levels of lead were observed in some samples; this metal can be toxic to marine biota;
- low to moderate levels of other metals were present.
- moderate levels of PAHs were present; these chemicals are indicative of combustion activities.
- volatile organic compounds were present which could cause soil gas migration into onsite structures.
- ground water flow is expected to discharge directly to the river, however, there are nearby residential wells north of the north gate along Military Highway.

These issues will be addressed in the Remedial Investigation.

2.7.4 Lower Subase

The Lower Subase site under investigation is shown on Figure 2-16. It is bounded on the west by the Thames River and to the east by the Providence and Worcester Railroad. The Lower Subase is the original Subase and, hence, its history dates back to 1867. Most of the construction which took place appears to have occurred in the early 1900's (late 1910's and early 1920's) with major expansion between 1935 to 1945.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 2-15 SITE PLAN DPDO AREA
	PROPOSED	EXISTING	
		— 95 — Existing Grade Exposed Bedrock O B-1 – Test Boring	ATLANTIC ENVIRONMENTAL SERVICES, INC.

TABLE 2-3

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

SUMMARY OF SOILS LABORATORY RESULTS (ppm)[1]
DPDO AREA

PARAMETER	B-1	B-2	B-3
Volatiles			
Chloroform			.016
1.1 Dichloroethene	.030		.026
1.2 Dichloroethene	.011		.039
Methylene chloride	.036		.057
Toluene	.096	.041	.076
1.1.1 Trichloroethane	.013		
Trichloroethylene		.030	.011
Base/Neutrals			
Acenaphthene	1.85		
Anthracene	5.0		1.60
Benzo (a) anthracene	5.35		5.60
Benzo (b) fluoranthene	2.35		3.55
Benzo (k) fluoranthene	3.30		1.95
Benzo (g,h,i) perylene	1.30		1.65
Benzo (a) pyrene	2.65		2.35
Chrysene	4.85		4.65
Fluoranthene	11.0		12.3
Fluorene	8.8		
Indeno (1,2,3 cd) pyrene	0.7		1.25
Naphthalene			1.05
Prenanthrene	18.2		7.25
Pyrene	9.3		9.2
Metals			
Antimony	12.8	7.5	13.0
Arsenic	1.73	1.50	1.87
Beryllium	0.25	0.30	0.50
Cadmium	0.49	0.45	4.40
Chromium	10.7	9.44	26.4
Copper	43.4	38.9	1000.00
Cyanide (total)	0.07	0.07	0.1

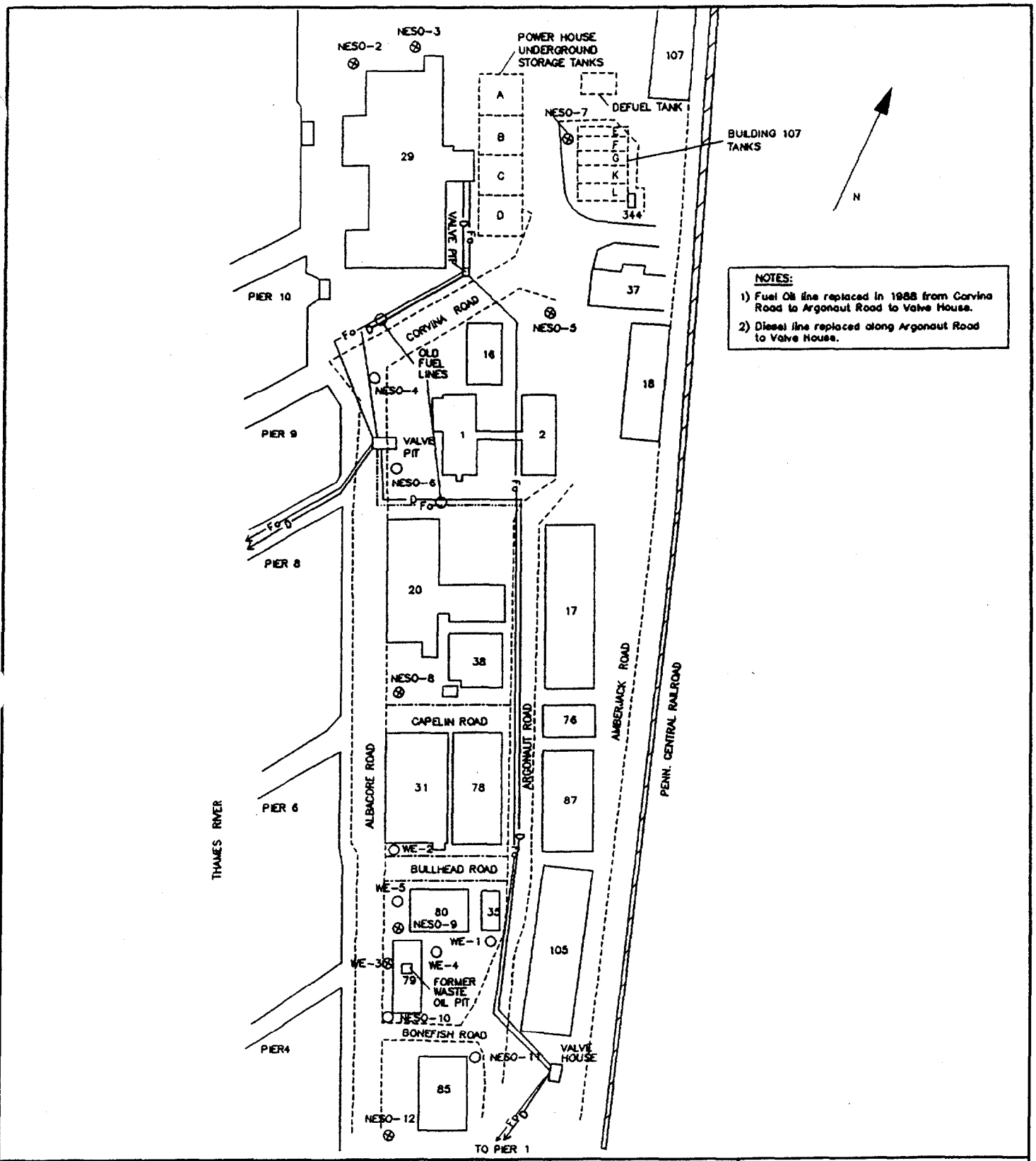
(continued)

TABLE 2-3 (CONTINUED)

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

SUMMARY OF SOILS LABORATORY RESULTS (ppm)[1]
DPDO AREA

PARAMETER	B-1	B-2	B-3
Lead	30.6	45.8	750
Nickel	9.87	10.2	130
Silver		0.35	2.10
Thallium	4.44	2.99	4.00
Zinc	103.0	8.19	1050.00



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 2-16 SITE PLAN LOWER SUBASE
	PROPOSED	EXISTING	
		—D— Diesel Line —Fo— Fuel Oil Line —Fo— Out of Service Fuel Oil Line ○ NESO-1 – NESO Well ○ WE-1 – Wehran Well ⊗ Destroyed Well	ATLANTIC ENVIRONMENTAL SERVICES, INC.

Prior investigations of petroleum contamination at the Lower Subase included a Navy Environmental Site Office (NESO) report, "Oil Contamination of the Groundwater at Subase, New London, CT.", dated February 1979, and "Subsurface Oil Contamination-Lower Base" by Wehran Engineering Corporation dated November 1987. It was the opinion of Atlantic and the Navy that based on Wehran Study results and further Navy investigation of the Lower Base, the source(s) of the oil contamination at the Building 79 Waste Oil Pit remained undefined, and that a Step II investigation of the Lower Subase was required.

Potential sources of fuel oil contamination on the Lower Subase are summarized below:

Building 79 Waste Oil Pit - this building is located adjacent to a major portion of the contamination identified in the Wehran report. This area contained a railroad spur and diesel train engines were serviced inside of the building. The service area included a pit into which waste oil and solvents drained during the cleaning and servicing of the diesel engines. The pit is no longer in use and has been filled with concrete. Available building maps show a subsurface drain pipe from the pit extending outside the building foundation toward Albacore Road The discharge location is undefined on the maps. The Building 79 Waste Oil Pit is shown on Figure 2-16.

The Power Plant Oil Tanks - these underground tanks are located adjacent to the power house (Building 29) and were in operation since World War II. The four tanks which were recently replaced, had a 170,000 gallon capacity and were constructed of concrete. Tanks A and B contained #6 grade fuel oil which is pumped to them from the tank farms on the south end of the base. Tank C contained diesel oil, and tank D contained waste oil from the power plant bilge water oil recovery system. Mr. Mansfield reported that when these tanks were replaced, it was apparent that oil leakage had previously occurred. The tanks were replaced about six months ago. The old tanks, which were constructed of concrete, were repaired and used as a containment structure for the new tanks. The tank locations are shown on Figure 2-16.

Fuel Oil Storage Tanks at Building 107 - The five underground storage tanks are constructed of concrete and have been in use since prior to World War II. Three of the tanks (E, F, and G) each have a 125,000 gallon capacity and are used to store diesel fuel. Tanks K and L have a 25,000 gallon capacity and are used to store lube oil. The tanks are still in existence and their locations are shown on Figure 2-16.

Fuel Oil Distribution System - A underground #6 fuel oil and diesel fuel distribution system exists on the Lower Subase. The lines are used to transmit fuel to the power house, to the tanks under the ball field near the main gate, and to fuel ships at the

piers. The #6 fuel oil and diesel lines along Argonaut Road have recently been replaced. The #6 fuel oil line is installed in concrete lined trenches shared with other utilities including steam and condensate. The diesel fuel lines are direct burial.

NESO conducted an investigation of the Lower Subase to determine the source and extent of oil found in the soils in the riverfront area. A total of twelve monitoring wells were installed across the Lower Subase as part of the investigation. The study found contamination near the powerhouse tanks toward the Thames River, to a lesser degree around the tanks south of Building 107, and northwest of Building 79. The oil found in the vicinity of Building 79 was concluded to be a lubricating oil. The NESO well locations are shown on Figure 2-16.

The NESO report recommended the abandonment of the waste oil pit (it was filled with concrete) and the installation of a recovery well system. A recovery well system was installed near Building 79 in 1985 (approximate) and operated for a period of two months. It was determined to be ineffective for the heavy fuel oil found and was abandoned.

Subsequent to the NESO and IAS reports, Wehran completed a study of the Lower Base entitled "Site Investigation Subsurface Oil Contamination Lower Base". The conclusions and recommendations of this report are excerpted below:

In conclusion, three separate oil contaminated areas seem to be present:

1) The concrete utility trench is contaminated with a #6 fuel oil that is less than one year old (Argonaut Road).

2) The manholes, soils, and ground water in the vicinity of Building 79, are contaminated with a #6 fuel oil that is greater than one year old and trace levels of waste oil.

3) The manholes, soil, and ground water in the vicinity of Buildings 29 and 345 are contaminated with #5 and #6 oils.

Recommendations for these three sites include:

1) The inspection of the #6 fuel line and the subsequent cleaning of the trench.

2) Oil mopping of the sludge oil in the manholes and/or excavation of the oil laden soils.

3) An additional study of the operations and distribution of oil in Building 29, including further study of the adjacent contaminated manholes.

Recommendation #1 was completed with the replacement of the #6 and diesel lines from the valve house at the entrance to the Lower Subase along Argonaut Road to the Power House. Fuel lines remain along Corvina Road to the piers. Specifications were prepared by the Navy for the testing of existing fuel lines along Corvina Road. The project has not been awarded to date.

Atlantic investigated the Building 79 site on September 30, 1988 and revisited the Lower Subase on November 7, 1988. Numerous manholes throughout the Lower Subase were inspected and oil contamination was noted only in an electric telephone manhole north of Building 79 on Albacore Road. The oil appears to be No. 6 fuel oil which had entered the manhole through utility ducts.

Potential environmental risks are associated with the discharge into ground water or runoff of the petroleum materials into the adjacent Thames River. Risks will depend on the magnitude of this transport. It is expected that the shoreline along the base has been, and continues to be, influenced by a number of sources of petroleum hydrocarbons.

3.0 FIELD MOBILIZATION

The field mobilization will consist of the following steps and are subsequently discussed in the following sections. (Section 7.0 presents the complete operation schedule).

- Field Office
- Decontamination Area and Tool Storage Area
- Field Laboratory
- Waste Storage Area
- Sampling Locations
- Heavy Equipment Mobilization
- Emergency Procedures
- Onsite Safety Briefing

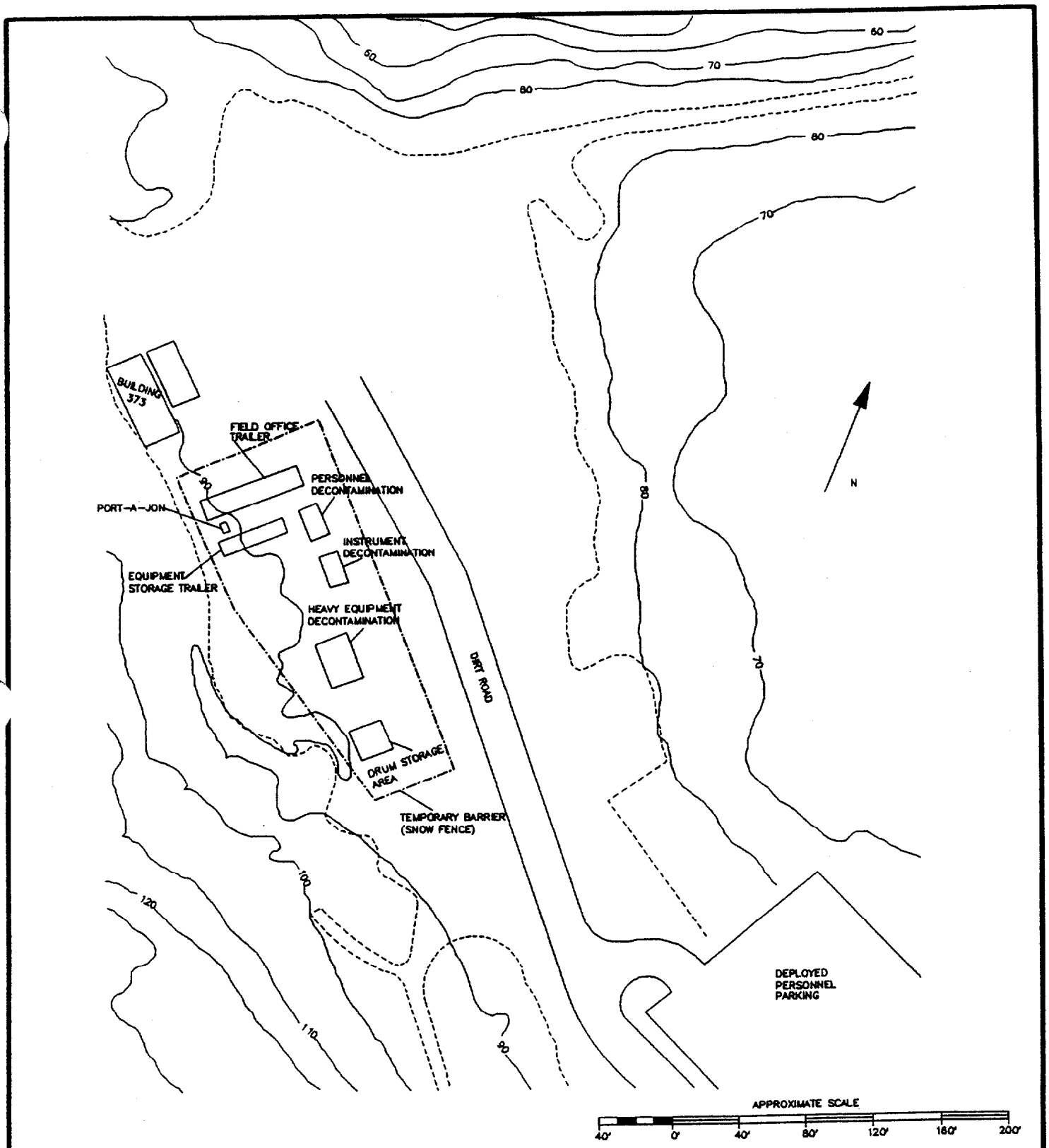
3.1 Field Office

An onsite trailer will serve as the field office/operations center and will be located at the Area A Landfill within the private contractors parking area. The site office location is shown on Figure 3-1.

There are no utility services onsite. Telephones will be mobile units; water will be from a tank truck. A portable toilet facility will be located onsite for site workers. The field office will be designated as a "clean area" and only authorized personnel will be allowed access. The site trailer will serve as the main field operation and communication center throughout the field activities. Copies of all site reports, investigation plans, maps, sample log books, and chain-of-custody records will be maintained in this trailer. As specified in the project Health and Safety Plan (HASP), critical emergency situation information (e.g., emergency numbers, hospital location map) will be prominently displayed in the field office for quick reference.

3.2 Equipment Storage Trailer and Decontamination Area

A second trailer will be located adjacent to the field office trailer for the storage of equipment, field instruments, and protective clothing and equipment. The equipment storage trailer will have two separate rooms to segregate the protective clothing and equipment from the field equipment and instruments. An equipment decontamination area will be located outside the equipment storage trailer and will be clearly marked. Hand tools and drilling equipment (augers, drill rods, and core barrels) will be steam cleaned over a bermed plastic liner. Field sampling equipment will also be cleaned and decontaminated in this area. A personnel decontamination area will be located next to the equipment



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 3-1 LOCATION OF ATLANTIC'S BASE OF OPERATIONS
	PROPOSED	EXISTING	
		— 95 — Existing Grade	ATLANTIC ENVIRONMENTAL SERVICES, INC.

decontamination area on the concrete pad and facilities for boot and glove washing, disposable coverall removal, and hand-washing will be available. Decontamination procedures are described in the site Health and Safety Plan (HASP). Wastewater generated from both personnel and equipment decontamination activities will be collected on and stored in Department of Transportation (DOT) approved 55 gallon drums. Prior to disposal offsite, disposable gloves, boots and coveralls will also be drummed. Areas of equipment storage, equipment decontamination, and personnel decontamination are depicted in Figure 3-1.

3.3 Field Laboratory

A field laboratory will be located in a section of the field office trailer. The laboratory will contain a pH meter, conductivity meter, filtering apparatus, HNu photoionization detector, precleaned and prepreserved sample containers, deionized water, decontamination solutions, sample shipping containers, mailing labels, and field notebooks. The HNu, Model PI101 will be used to monitor organic vapor emissions from field samples and ambient air quality in field work areas. The calibration and operation procedures for the HNu detector are outlined in Atlantic Procedure No. 1051 (Appendix A).

3.4 Establish Waste Storage Area

A waste storage area will be established onsite and will consist of various wastes generated during field operations. These wastes may include: decontamination solutions, disposable equipment, well development water, and drill cuttings. Generated wastes will be collected daily and stored in 55 gallon DOT-approved steel drums. The drum storage area will be clearly marked and secured (Figure 3-1). As individual drums are filled, they will be labeled according to site name, date, volume, and type of material. At the conclusion of field activities, the equipment decontamination liner will be drummed, and all the drums containing wastes will be delivered to the Navy for disposal.

3.5 Sampling Locations

All test borings and monitoring wells will be marked by using fluorescent paint and indicated by a circle. The sample location number will be painted adjacent to the marker.

Locations for monitoring wells, test borings, surface soil samples, and sediment samples are identified in Section 4.0. Information concerning the locations of underground utilities has been developed as part of this plan from available Navy mapping. Navy personnel will be contacted 10 days in advance of subsurface investigation to obtain drilling permits.

3.6 Heavy Equipment to the Site

Drilling rigs will be mobilized to the site and will be parked in a designated section of the private contractors area at the Area A Landfill. An area will be available for the storage of small tools and safety equipment.

3.7 Emergency Procedures

In the event of an emergency, it is necessary to identify routes to the nearest hospital. Specific routes to both the emergency room at the Naval Submarine Base and New London Hospital are identified in the HASP and will be reviewed by site workers. Directions will be posted in the field office trailer.

3.8 Onsite Safety Briefing

Prior to field sampling activities, a safety briefing will be conducted by the Atlantic site safety engineer. The briefing will include a review of potential safety hazards inherent to each specific site and an explanation of the HASP. Documentation of safety training and medical histories of all site workers will be obtained at this time. No one will be allowed to work on any of the sites until this documentation has been obtained.

4.0 FIELD INVESTIGATION

The field investigation proposed at each site is based on site history of waste disposal practices, available chemical data from previous investigations, and Atlantic's site inspection. The field sampling activities for each individual site will include one or more of the following: radiological survey, geophysical survey, soil gas survey, installation of monitoring wells, drilling of test borings, and sampling of ground water, surface water, surface sediments, subsurface soil and surface soil. The subsequent Section (4.1) will document general field sampling techniques which will be followed.

4.1 General

Atlantic has technical standards and procedures which will be followed during the field operations. The specific Atlantic procedures that will be used during this investigation are presented in Appendix A and the procedure titles and corresponding number are presented in Table 4-1. The field sampling program designed for each site will refer to Atlantic's company procedures during field activities. The procedures will be referred after each sampling technique by the Atlantic procedure number (eg., Sample Preservations for Solid and Liquid Matrices (A.P. 1040)).

Atlantic will use a HNu Photoionization detector and Photovac portable gas chromatograph to perform screening analysis during field activities. The HNu is useful in determining general levels of organic vapors in air. Soil samples will be initially screened for level of organic vapors in the field, prior to laboratory analysis. The operation and calibration procedures for the HNu detector are described in Atlantic Procedure No. 1051.

A soil gas survey will be performed at the DPDO Area, the Area A Landfill, Torpedo Shops, Former Gasoline Station, Goss Cove Landfill, and Lower Subase to detect levels of volatile compounds. The soil gas surveys will be performed using a Photovac Model 10S50 portable field gas chromatograph with CPSIL 19 capillary column and a photoionization detector. Soil gas samples will be obtained by using the following method (see Figure 4-1):

- A plunger bar is used to drive a one-half inch diameter, four foot (maximum) deep hole in the ground.

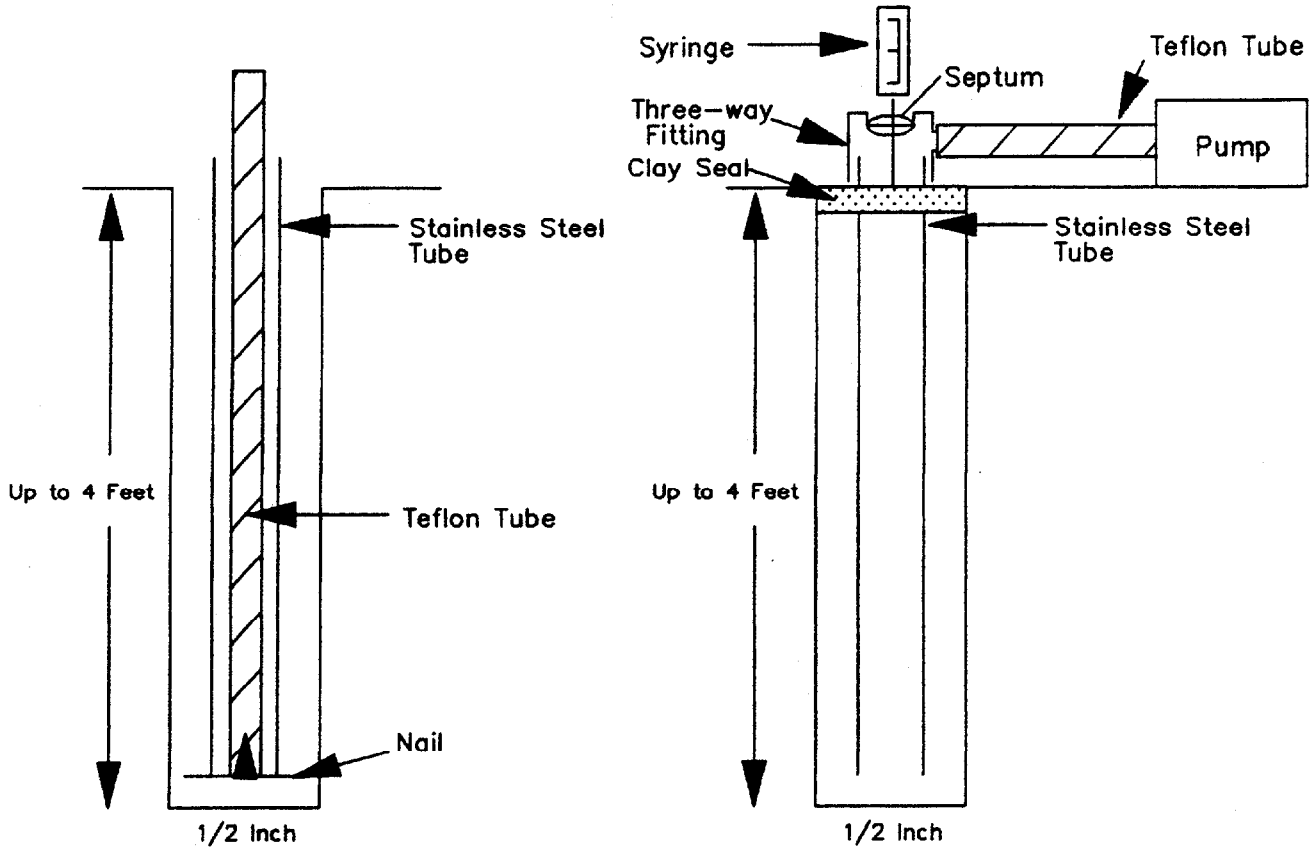
- A pre-rinsed, four-foot long 1/4" O.D. stainless steel tube is used to collect the sample. To prevent soil from plugging the tube as it is lowered into the cavity, a section of teflon tubing is inserted into the stainless steel tube. A nail with

TABLE 4-1

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

SUMMARY OF APPLICABLE TECHNICAL PROCEDURES
ATLANTIC ENVIRONMENTAL SERVICES, INC.

PROCEDURE NUMBER	PROCEDURE TITLE
1020	Field Procedures for Collection of Surface Soil Samples
1021	Field Procedures for Collection of Subsurface Soils
1022	Field Procedures for Collection of Surface Water and Sediment Samples for Hazardous Waste Determination
1023	Field Procedures for Collection of Ground Water Samples for Hazardous Waste Determination
1030	Field Procedures for Logging Subsurface Conditions During Test Boring and Well Logging
1040	Sample Preservation for Solid and Liquid Matrices
1041	Sample Chain-of-Custody Procedure
1042	Shipping Procedures for Environmental Field Samples
1051	Operation and Calibration of the HNu Systems Photoionizer Model PI-101
1060	Cleaning Procedure for Sampling Devices used in Environmental Site Investigation



INSTALLATION RESTORATION STUDY **NAVAL SUBMARINE BASE** **NEW LONDON** **GROTON, CT**	**FIGURE 4-1** **SCHEMATIC DIAGRAM OF** **SOIL GAS SAMPLING APPARATUS** ATLANTIC ENVIRONMENTAL SERVICES, INC.

a head larger than the inside diameter of the steel probe then is placed in the teflon tube. After the tube is placed into the hole in the ground, the teflon tube is pulled out, causing the nail to drop and allowing vapors to be drawn into the open end of the stainless steel tube. Clay is placed around the tube at the soil surface creating a seal that prevents surface air from mixing with the gas from the soil.

- A three-way Swagelok fitting is placed on the open end of the steel tube at the ground surface. One end of the fitting is connected to a teflon tube leading to a small personal sampler air pump. A small teflon-coated septum is secured over the remaining opening of the fitting. The pump is switched on and allowed to run for 3-5 minutes at a flow rate of 50 to 100 ml/min. The soil gas sample is collected by inserting a pre-rinsed syringe through the septum and withdrawing 10-500 ml of air.

- The sampling apparatus is removed from the hole and flushed with high flows of ambient air.

The gas sample obtained is injected directly into the Photovac instrument. The column temperature is adjusted to 30° or 40°C depending on ambient conditions. Retention times of the unknown peaks from the soil gas are identified by comparison to standards that are taken from the headspace above a combined standard of specific aromatic and chlorinated hydrocarbons in water. A standard of 10 ppm benzene in air also is used to evaluate peak variation due to fluctuation in instrument sensitivity and provide a base for comparison of relative concentrations. Standards are run at the beginning, middle, and end of each sampling day and, when necessary, to document any retention time shifts. Relative concentrations are determined from integration by the Photovac 10S50 of the areas beneath the peaks that represented the different compounds in the soil gas.

If high concentrations of contaminants are present, the syringe and sampling devices are rinsed with methanol, dried using a portable heat gun, and purged with high pressure zero air.

An ambient air sample is collected through the sampling apparatus and analyzed as a blank at the beginning of each sampling day as well as after any probes have been recleaned as the result of high concentrations in the previous sample.

An environmental radiation survey will be conducted by Radiation Safety Associates, Inc. of Hebron, Connecticut at the DPDO Area, the vicinity of the Area A Landfill, and the Goss Cove Landfill. A grid pattern will be set up across each site on a 25 foot spacing. Gamma

readings will be measured at each grid point with a Ludlum Model 19 Micro-R meter. If gamma levels are found at twice the background value (established off of the site) a more detailed grid will be made around the point to determine if there may be a source of contamination A Ludlum Model 18 count read meter will be available to measure gross alpha or gross beta if warranted.

A geophysical survey will be performed by Weston Geophysical of Westboro, Massachusetts, at the DPDO Area, the vicinity of the Area A Landfill, Former Gasoline Station, the Goss Cove Landfill, and the Lower Subase. There are four survey methodologies that may be used:

- The Ground Penetrating Radar (GPR) survey method can be used to determine the location of buried metallic objects, lithologic changes and possibly the depth of the landfill materials. The GPR system transmits microwave energy into the ground. This energy is reflected from materials with differing electrical properties (such as the dielectric constant or conductivity). Typically, reflections occur from metallic objects and from lithologic changes. Reflected GPR energy is detected by the radar antenna and displayed on a graphic recorder. Metallic objects such as buried tanks or pipes, produce a characteristic strong parabolic signal on the GPR chart recording.

- The Electromagnetic Terrain Conductivity (EM) survey method is a relatively rapid walk over survey technique that can be used to detect buried metal objects, the extent of a landfill area and to locate and trace a conductive contaminate plume. The EM instrument is used in conjunction with a chart recorder or a digital data recorder so that continuous conductivity data is acquired along each survey line. Metallic objects typically are highly conductive and cause a reverse polarity conductivity reading in the immediate vicinity of the object. Landfill materials typically differ in conductivity values from natural soils; consequently the extent of a landfill is associated with an abrupt change in conductivity values or more uniform conductivity readings. Many contaminants, particularly landfill leachates, are highly conductive and, therefore, detectable and traceable using the EM survey method.

- Electrical resistivity sounding data will be acquired using a Soiltest Stratameter or an equivalent resistivity instrument. The sounding data will be acquired using the Lee Modification of the Wenner array electrode array and electrode spacings of up to 100 to 200 feet. The results of the sounding survey will be computer modeled to evaluate the vertical resistivity characteristics of anomalous areas detected by the EM survey.

- The magnetic survey method measures the strength of the earth's total magnetic field at any particular location and can be used to locate buried metal objects and determine the extent or perimeter of a landfill. Ferrous metallic objects cause a local fluctuation in the earth's magnetic field.

Due to the varying conditions (open and clear, scattered metallic debris, buried utilities, overhead utilities, etc.) at each of the areas to be investigated, the exact survey program will be decided onsite. The general approach is to investigate the area of interest with EM on parallel survey lines spaced approximately 20 to 25 feet apart. Anomalous areas will be investigated in more detail using magnetics (10 to 20 foot station intervals) or resistivity, as well as GPR. The EM, resistivity and magnetic survey methods are useful in determining where anomalous conditions due to buried metal or other conditions exist, GPR results can indicate the depth, size, shape, and number of buried objects. Surface metal debris adversely affects EM and magnetic survey results, therefore, in areas with surface metal debris or overhead utilities, the GPR survey method will be the most effective. The GPR will have reprocessing capabilities, and magnetic tape recording.

Single well hydraulic tests will be performed on approximately one-half of the monitoring wells to determine aquifer characteristics for use in characterizing the existing ground water conditions and for use in evaluating remedial alternatives. The hydraulic tests will be conducted after completion of the ground water sampling. During each test, the well will be equipped with an electronic water level measuring system. The water level measuring system will consist of a downhole pressure transducer connected by a cable to a battery-powered data logger. The specific hydraulic tests that may be used are single well pump tests, slug tests or constant head tests. The specific tests that will be chosen will depend on the expected hydraulic conductivity of the aquifer materials, whether the well screen brackets the water table, the quality of the ground water within a monitoring well, and the depth to ground water.

All drill cuttings with visual contamination or with significant volatile organic readings (monitored by either an HNu Model PI 101 photo ionization detector or a Foxboro Century Model OVA-128 flame ionization detector) will be contained in 55 gallon drums. The drums will be labeled with the type of material within (soil, water or sludge), the data collected, the site location, and boring number (or some other sampling location designation if appropriate). The drums will be stored at the hazardous waste storage facility on the Subase until the Subase contractor can dispose of the drums. Analysis of the drum contents will be required to determine the method of disposal. The contents must be analyzed for the RCRA characteristic

parameters (40 CFR 261.21, 261.22, 261.23 and 261.24) and in accordance with the Toxicity Characteristic Leaching Procedure (TCLP - Appendix I, 40 CFR 268). Monitoring well purge and development waters, as well as any other wastes, will be handled in the same manner.

4.2 Step I Sites

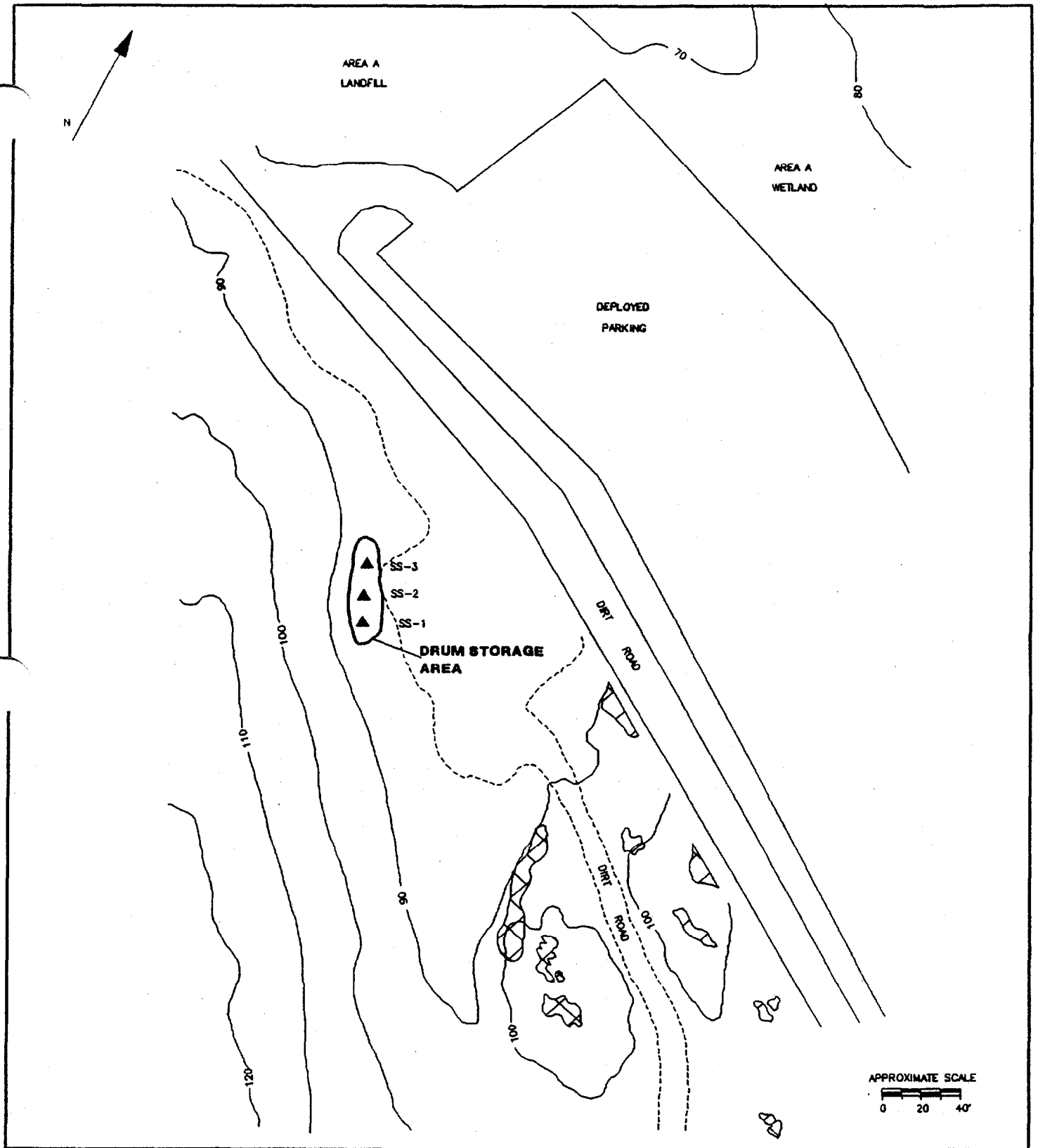
A field sampling program was developed by Atlantic in order to screen the Step I Sites for the presence of onsite contamination. Analytical data will be used to assess the nature of the contamination and evaluate health and environmental risks. Based on these findings, a determination will be made whether to proceed to Step II as required.

4.2.1 CBC Drum Area (Site No. 1)

The field investigation will be limited to collecting a total of six surface and near surface soil samples, from three specified locations, in the area associated with drum storage. The selected location is directly within the storage area on flat ground where the highest soil contaminants would be expected. Soil sample locations are shown on Figure 4-2. The samples will be collected (A.P. 1020) with a stainless steel hand auger and stainless steel spoon; the sampling equipment will be decontaminated between sampling rounds to prevent cross-contamination (A.P. 1060). A discrete sample will be collected from each location (three total) at a depth of 0-6 inches and analyzed for Toxicity Characteristic Leaching Procedure (TCLP) metals and PCBs in accordance Contract Laboratory Protocol (CLP). The samples will also be analyzed for total petroleum hydrocarbons by EPA Method 418.1. A composite sample of the three 0-6 inch samples will be analyzed for Target Compound List (TCL) Organics and Metals in accordance with CLP. An additional soil sample will be obtained from a depth of 12-18 inches from each location (three samples total) and initially screened in the field with a HNu photoionization detector to determine the presence of organic vapors. The samples will be analyzed by the laboratory for TCL volatile organic compounds according to CLP procedures. Table 4-2 summarizes the specifics of the site sample type, analysis and rational.

Individual soil sample information will be logged in a field notebook, placed on the sample jar labels, and recorded on a chain-of-custody form (A.P. 1041) which will contain the following data:

- Sample Number
- Sample Depth
- Date
- Time



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 4-2 FIELD SAMPLING PLAN CBC DRUM STORAGE AREA
	PROPOSED	EXISTING	
	▲ SS-1 – Surface Soil Sample	—95— Existing Grade Exposed Bedrock	ATLANTIC ENVIRONMENTAL SERVICES, INC.

TABLE 4-2

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

CBC DRUM STORAGE AREA (Site No. 1)
SUMMARY OF PROPOSED SAMPLES

SAMPLE DESIGNATION	SAMPLE TYPE/DEPTH	ANALYSIS	RATIONALE
1-SS-1S, 1-SS-2S, 1-SS-3S	Surface Soil 0-6 inches	TCLP Metals - PCBs: CLP Petroleum Hydrocarbons: EPA Method 418.1	Screen surface soils for past drum leaks possibly containing metals (eg. waste oils)[1], total petroleum hydrocarbons and PCBs.
1-SS-4C	Composite of SS-1S, SS-2S SS-3S	TCL organics and Metals: CLP	For health and environmental risk assessment
1-SS-1D, 1-SS-2D, 1-SS-3D	Surface soil/ 12-18 inches	TCL Volatile organics: CLP Petroleum Hydrocarbon: EPA Method 418.1	Screen near surface soils for volatile organics from past drum leaks[2]

1. Due to adsorbtive nature of metals, highest concentrations would be expected at the ground surface.
2. Due to mobile and volatile nature of volatile organics, measureable concentrations would be expected below the ground surface.

- Analysis Requested
- Preservative
- Project Number
- Initials of the Collector

The samples will be preserved at a temperature of 4°C (A.P. 1040) and reported on chain-of-custody form (A.P. 1041), prior to sample shipment (A.P. 1042) to the analytical laboratory. QA/QC samples will be collected as specified in the QA/QC Plan.

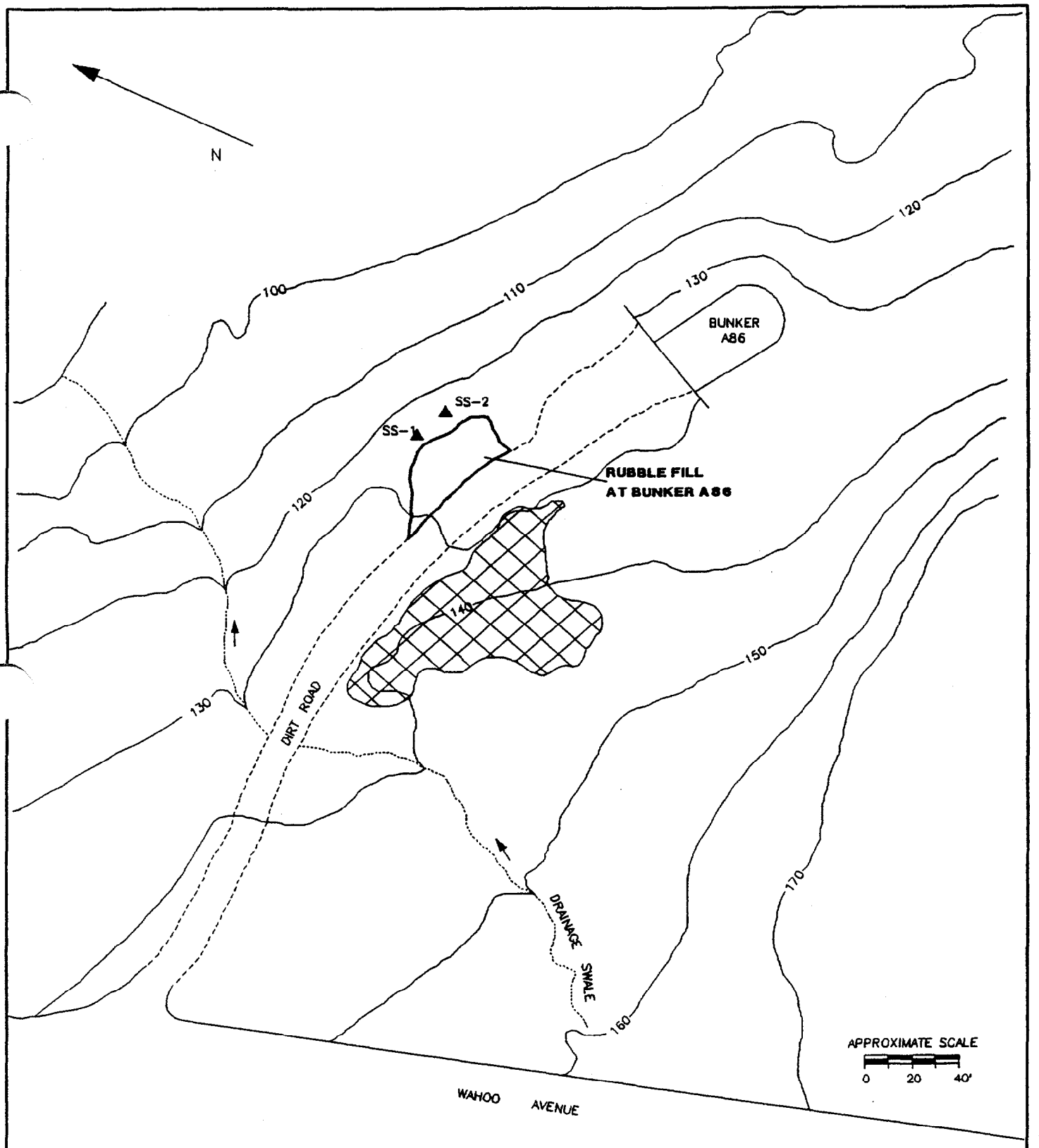
4.2.2 Rubble Fill at Bunker A-86 (Site No. 4)

The rubble fill disposal area has principally construction fill, however, a few empty chemical containers were observed by Atlantic. The field investigation will include obtaining surface soil samples from two locations at the base of the fill area (Figure 4-3). If contaminants have migrated from the fill, these locations should represent points of higher concentrations. The samples will be collected (A.P. 1020) with a stainless steel hand auger and stainless steel spoon; the sampling equipment will be decontaminated between sampling locations to prevent cross-contamination (A.P. 1060). Soil samples from a depth of 0-6 inches and 12-18 inches will be collected at each location. The shallow soil samples will be analyzed for PCBs and TCLP metals in accordance with CLP procedures. The deeper soil samples will be analyzed for TCL volatile organics according to the latest version of the EPA CLP. A composite soil sample of the shallow (0-6 inches) samples will be analyzed for TCL Organics and Metals by CLP. Table 4-3 summarized the specifics of the site sampling type, analysis, and rational.

Individual soil sample information will be logged in a field notebook , placed on the sample jar label, and recorded on a chain-of-custody form (A.P. 1941) which will include the following data:

- Sample Number
- Sample Depth
- Date
- Time
- Analysis Requested
- Preservative
- Project Number
- Initials of the Collector

The samples will be preserved at a temperature of 4°C (A.P. 1040) prior to sample shipment (A.P. 1042) to the analytical laboratory.. QA/QC samples will be collected as specified in the QA/QC Plan.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 4-3 FIELD SAMPLING PLAN RUBBLE FILL AT BUNKER A86
	PROPOSED	EXISTING	
	▲ SS-1 - Surface Soil Sample	—95— Existing Grade Exposed Bedrock	ATLANTIC ENVIRONMENTAL SERVICES, INC.

TABLE 4-3

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

RUBBLE FILL AT BUNKER A-86 (Site No. 4)
SUMMARY OF PROPOSED SAMPLES

SAMPLE DESIGNATION	SAMPLE TYPE/DEPTH	ANALYSIS	RATIONALE
4-SS-1S	Surface Soil 0-6 inches	TCLP Metals - PCBs: CLP	Screen surface soils for possible metals and PCB contamination from empty chemical containers[1]
4-SS-2S	Surface Soil/ 0-6 inches	TCLP Metals - PCBs: CLP	Screen surface soils for possible metals contamination[1]
4-SS-3C	Composite of SS-1S, SS-2S	TCL Organics/and Metals: CLP	For health and environmental risk assessment
4-SS-1D	Surface soil/ 12-18 inches	TCL Volatile Organics: CLP	Screen near surface soils for possible volatile organics
4-SS-2D	Surface soil/ 12-18 inches	TCL Volatile organics: CLP	Screen near surface soils for possible volatile organics

1. Due to adsorbtive nature of metals, highest concentrations would be expected at the ground surface.
2. Due to mobile and volatile nature of volatile organics, measureable concentrations would be expected below the ground surface.

4.2.3 Torpedo Shops (Site No. 7)

These buildings which make up the Torpedo Shops relied upon septic leachfields as their sewage treatment until 1983, when the site was connected to sanitary sewers. Various fuels, solvents, petroleum, and metal contaminated wastewater generated in the overhaul of undersea weapons may have been accidently discharged to the septic system via uncapped floor drains, sinks and toilet facilities. The purpose for the proposed field investigation is to screen for onsite soil, ground water, sediment or surface water contamination due to the former leaching fields or surface runoff.

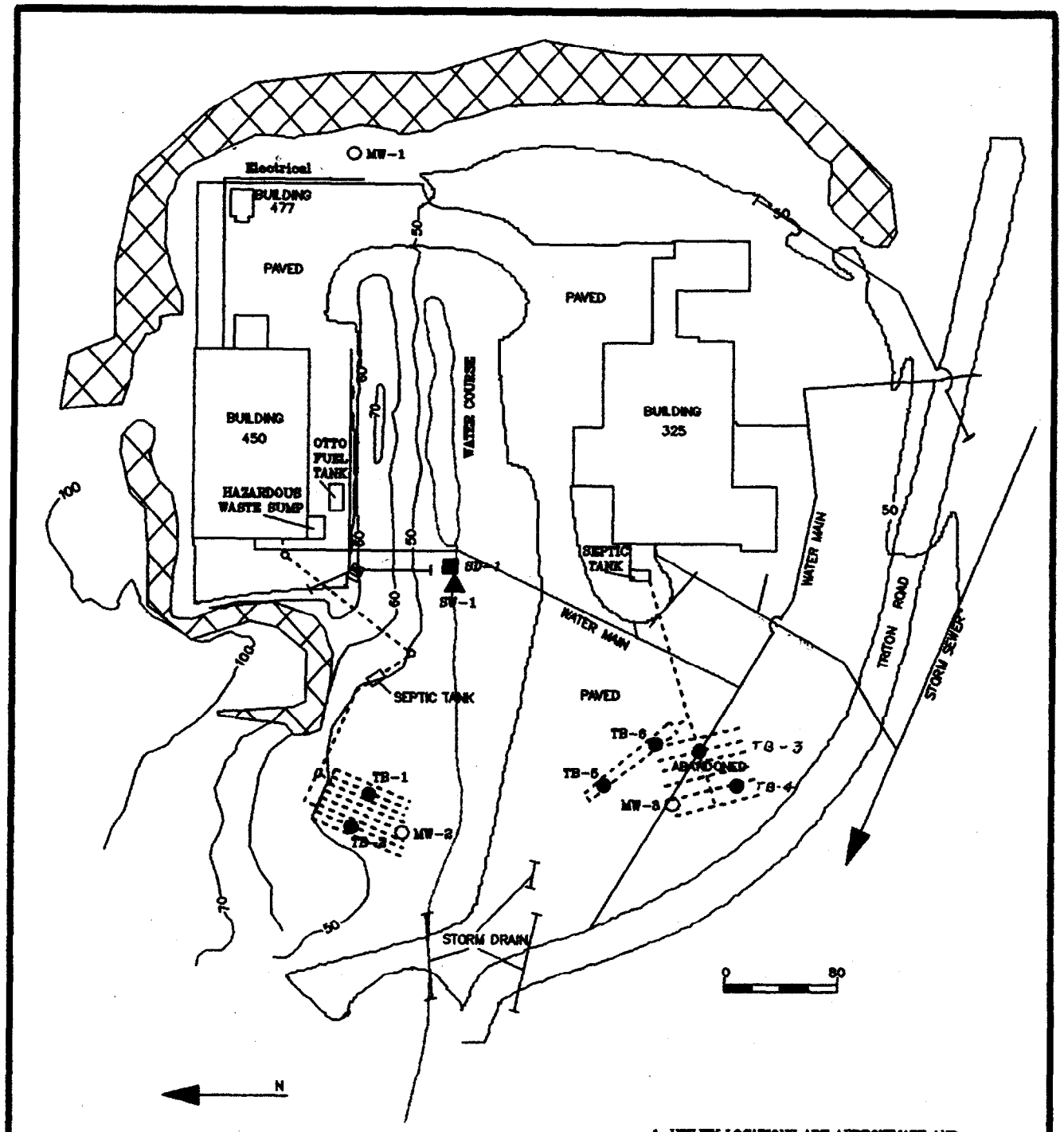
Prior to any subsurface investigations, soil gas surveys of the septic leaching systems will be conducted in order to locate areas of volatile organic contamination. If hot spots are identified within the leachfields, the survey will be expanded to delineate the extent of contamination. A detailed description of the soil gas survey methodology is presented in Section 4.1.

Surface water runoff in the area could possibly be transporting hazardous materials into downstream water courses and ultimately the Thames River. One surface water sample will be collected (A.P. 1022) from the Torpedo Shop site. The sample will be taken from the location indicated on Figure 4-4. It will be analyzed for TCL Organics and Metals by CLP.

One sediment sample will be collected (A.P. 1022). The selection of this sample area was based on area topography noted during Atlantic's site inspection and will be taken from the same location as the surface water sample. It is at the outlet of the storm drainage system from Building 450. The sediment sample will be representative of any hazardous waste deposited by surface water runoff.

One additional sediment and surface water sample will be considered in the evaluation of this site. The Area A - Downstream Watercourse Study (see Section 4.3.1.3) overlaps the torpedo shops site on the southern boundary. The surface water and sediment samples taken just south of the ammunition bunkers (A-88 thru A-91) will also be considered in the evaluation of this site (see Figure 4-9B). These samples will determine if the Torpedo Shops are contributing to the contamination of Area A downstream water courses as well as help define the areal extent of the potential water course/sediment contaminated zone.

The sediment samples will be analyzed for TCL Organics and Metals in accordance with CLP. Table 4-4 summarizes the specifics of the site sample type, analysis and rationale.



NOTE: 1. UTILITY LOCATIONS ARE APPROXIMATE AND MUST BE VERIFIED.

INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 4-4 FIELD SAMPLING PLAN TORPEDO SHOPS
	PROPOSED	EXISTING	
	▲ SD-1 Sediment Sample ■ SW-1 Surface Water Sample ● TB-1 Test Boring ○ MW-1 Monitoring Well	—95— Existing Grade Exposed Bedrock Face - - - - - Former Septic System	ATLANTIC ENVIRONMENTAL SERVICES, INC.

TABLE 4-4

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

TORPEDO SHOPS (SITE NO. 7)
SUMMARY OF PROPOSED SAMPLES

Sample Designation	Sample Type/Depth	Analysis	Rationale
7-TB-1, 7-TB-2 7-TB-3, 7-TB-4 7-TB-5, 7-TB-6	Boring soil samples/depth determined in the field	TCL Organics and Metals: CLP	Screen for possible soil contamination in leaching field
7-MW-1	Boring soil samples/depth determined in the field	TCL Organics and Metals: CLP	Upgradient background soil sample
MW-2, 7-MW-3	Boring soil sample/depth determined in the field	TCL Organics and Metals: CLP	Screen for possible soil contamination in leaching field
7-GW-1	Ground water	TCL Organics and Metals: CLP	Upgradient background ground water sample
7-GW-2, 7-GW-3	Ground water	TCL Organics and Metals: CLP	Screen for possible leachin of contaminants into ground water
7-SD-1	Sediment/0-6 inches	TCL Organics and Metals: CLP	Screen for possible sediment contamination
7-SW-1	Surface water	TCL Organics and Metals: CLP	To assess surface water quality

A total of nine test borings will be drilled at this site. Each boring will be advanced with 4-inch hollow stem augers to a depth of 20 feet or auger refusal, whichever is less. Three of these borings will be completed as bedrock monitoring wells. Soil samples will be collected continuously in advance of the augers using a 2-inch split-spoon sampler in accordance with ASTM D-1586. Boring and well locations are shown on Figure 4-4. The actual location may vary based on results of the soil gas survey.

The split-spoons will be decontaminated between each use to prevent cross-contamination according to the following procedure:

- Alconox detergent tap water wash
- Tap water rinse
- 10% Nitric acid rinse (only if sample is to be analyzed for metals)
- Distilled/deionized water rinse (only if sample is to be analyzed for metals)
- Methanol rinse
- Final distilled/deionized water rinse
- Air dry

Drill rods and augers will be steam cleaned after each boring is completed. The drill rig will be steam cleaned prior to entering the site and after leaving the site.

Eight borings will be advanced through the septic field and into native soil. A soil sample will be collected from each boring (TB-1, TB-2, TB-3, TB-4, TB-5 and TB-6) and three ground water monitoring wells (MW-1, MW-2, and MW-3) will be collected (A.P. 1021) and analyzed for TCL Organics and Metals in accordance with CLP (nine soil samples total). MW-1 will serve as a background/upgradient monitoring well and the soil sample will be used to assess background soil quality.

The actual samples sent for analysis will be selected on the following basis:

- The highest HNu readings within the boring
- Visible contamination
- Lacking organic vapors or visible contamination, a soil sample will be collected above or at the water table or within the zone of the leaching trench.

Individual soil sample information will be logged in a field notebook, placed on a sample jar label, and recorded on a chain-of-custody form (A.P. 1041). The recorded data will include the following:

- Sample Number
- Sample Depth (if appropriate)
- Date

- Time
- Analysis Requested
- Preservative
- Project Number
- Name and Initials of Collector

The samples will be preserved at a temperature of 4°C (A.P. 1040) prior to sample shipment (A.P. 1042) to the analytical laboratory. QA/QC samples will be collected as specified in the QA/QC plan.

Three monitoring wells will be installed. Due to the shallow bedrock at this site, bedrock monitoring wells will be required. MW-1 will be used as an upgradient well and will be placed in the extreme northeast corner of the site (see Figure 4-4)

Bedrock monitoring wells, approximately 50 feet deep, will be drilled at all locations. An 8-inch, minimum, hole will be drilled by either the mud rotary or air hammer method five feet into the bedrock or to a depth of 20 feet, whichever is deeper. A neat cement grout will be tremied into the borehole and up at least two feet above the top of the bedrock. A 6-inch diameter steel casing will be set into the grout and allowed to set for a minimum of 24 hours. The borehole will be advanced with a 6-inch nominal air hammer drill sufficiently deep enough to encounter the saturated zone. The compressed air used to drive the hammer and bring the cuttings to the surface will be filtered so there are no trace amounts of lubricating oils which may contaminate the bedrock well.

The drill rods will be steam cleaned after each boring is completed. The drill rig will be steam cleaned prior to entering the site and after completing the drilling at the site.

All monitoring wells will be developed at least one day after the grout around the casing has been installed. Development will include means of pumping water from the well. In the bedrock wells, the drill rods may be left in the bottom of the well and the compressed air used to displace water from the well. Development in all of the wells will continue until the discharge is visually clear or after four hours, whichever comes first.

Ground water samples will be collected (A.P. 1023) from the monitoring wells at least two weeks after they have been developed. A sample will be collected (A.P. 1040) using a dedicated stainless steel bailer. Prior to sampling, the water level in each well will be measured to 0.01 feet using an electronic water level meter and the level recorded in a field notebook. Four to five well volumes will be purged in order to collect a representative sample. The well elevation will be surveyed to determine ground water flow gradient.

Stainless steel bailers will be decontaminated prior to sampling according to the following decontamination procedure:

- o Alconex detergent and tap water rinse
- o Tap water rinse
- o 10% nitric acid rinse
- o Distilled/deionized water rinse
- o Methanol rinse
- o Distilled/deionized water rinse
- o Air dry

Bailer line will be changed between samples. Ground water samples will be collected from the wells and analyzed for TCL Organics and Metals in accordance with CLP. Table 4-4 summarizes the site sample type analysis and rationale.

4.2.4 Goss Cove Landfill (Site No. 8)

The Goss Cove Landfill was operated from 1946 to 1957 and reportedly only incinerator ash and inert rubble was disposed. However, several large gas cylinders were observed during the excavation of a utility trench through the site. One tank was leaking propane, the contents of the other tanks are not known. Based on the findings of gas cylinders in the landfill and the fact that it served as a Subase landfill for ten years, the exact nature of disposed material is undefined. The Nautilus Museum and associated parking lot are directly over the landfill area.

Radiological, geophysical, and soil gas surveys will be performed prior to drilling activities to further characterize the site.

An environmental radiation survey will be conducted by Radiation Safety Associates Inc. of Hebron, Connecticut. The purpose of the survey is to screen for gamma, beta or alpha radiation in accordance with OSHA hazardous waste investigation requirements. A detailed description of the radiation survey methodology is presented in Section 4.1

Weston Geophysical Corporation will perform a geophysical study by using either a GPR, EM, resistivity or magnetic survey to determine the presence of buried metal objects, drums or underground tanks. The study will be conducted on the same grid pattern established for the radiological survey. It is important to identify locations of buried objects prior to drilling in order to prevent safety hazards. A detailed description of the geophysical survey methodologies and selection process are presented in Section 4.1. The selected methodology will be use to screen for any remaining subsurface gas cylinders.

Atlantic will perform a soil gas survey using a Photovac Model 10S50 portable gas chromatograph. The purpose of the survey is to identify locations within the old landfill which may have volatile organic contamination and possibly to identify the specific compound. A detailed description of the soil gas survey methodology is presented in Section 4.1.

Based on results of the three surveys, test borings will be drilled in areas of suspect contamination. A total of seven test borings will be drilled onsite. Each boring will be advanced with 4-inch I.D. hollow stem augers to a depth of 20 feet based on auger refusal or limit of fill. Recall that the limits of the landfill from previous test borings in this area was approximately 10-15 feet. Four of these borings will be completed as monitoring wells. Soil samples will be collected continuously in advance of the augers using a 2-inch split-spoon sampler and in accordance with ASTM D-1586. Boring and well locations are shown on Figure 4-5. The actual locations may vary based on the results of the three surveys.

The split-spoon samplers will be decontaminated between each use to prevent cross-contamination, according to the following procedure:

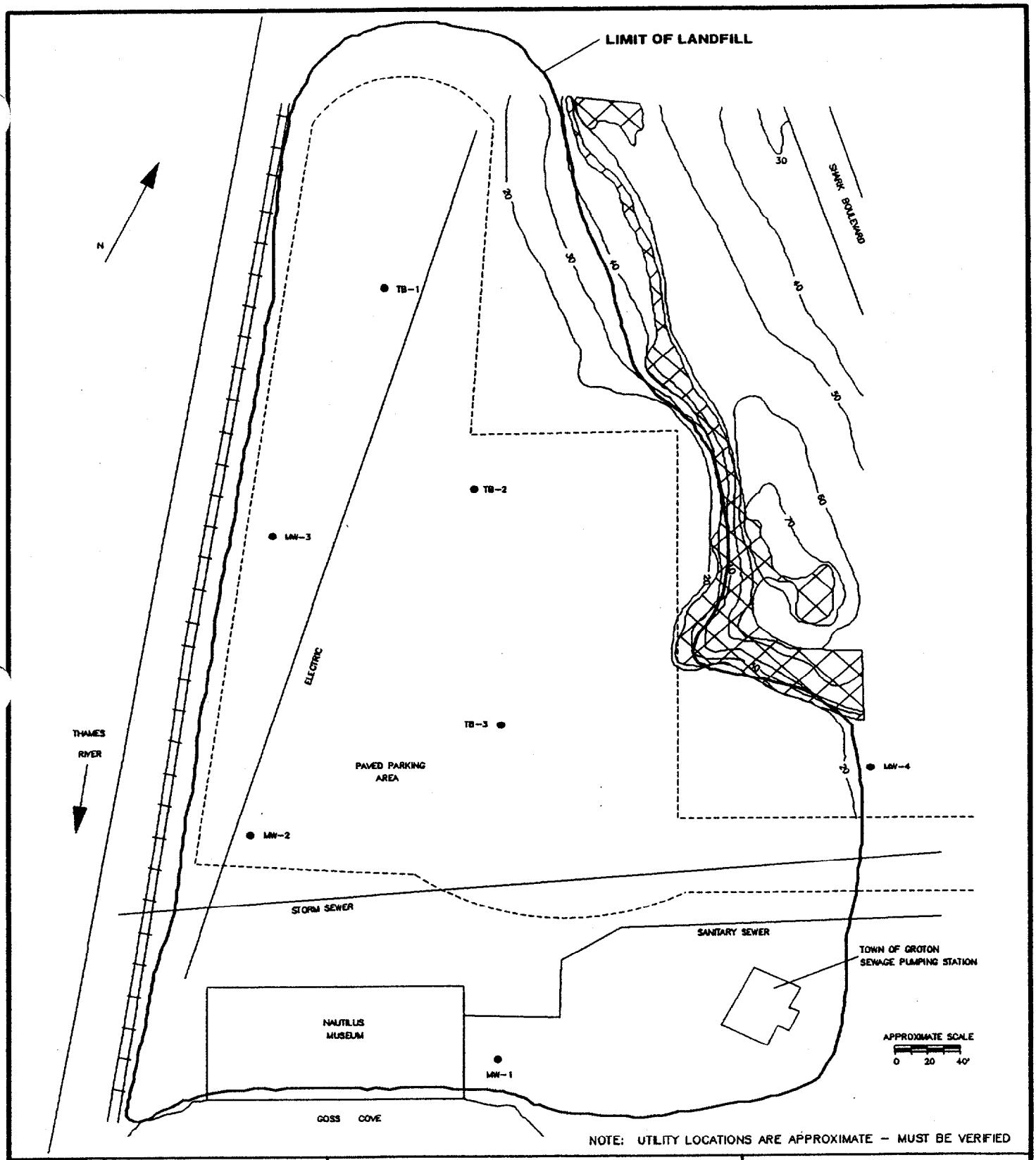
1. Alconox detergent and tap water wash
2. Tap water rinse
3. 10% Nitric acid rinse (only if sample is to be analyzed for metals)
4. Distilled/deionized water rinse (only if sample is to be analyzed for metals)
5. Methanol rinse
6. Final distilled/deionized water rinse
7. Air dry

Drill rods and augers will be steam-cleaned after each boring is completed. The drill rig will be steam-cleaned prior to entering the site and after leaving the site. Auger cuttings may be collected and drummed for possible offsite disposal as detailed in Section 4.1.

A soil sample will be collected (A.P. 1021) from the three borings (TB-1, TB-2, and TB-3) and the four ground water monitor wells (MW-1, MW-2, MW-3, MW-4) and analyzed for TCL Organics and Metals in accordance with the latest version of the CLP. The actual samples sent for analysis will be selected on the following basis:

- the highest HNu readings within the boring
- visible contamination
- lacking organic vapors, or visible contamination, a soil sample will be collected above the water table.

Four monitoring wells will be installed to a depth of about 20 to 15 feet to be base of the landfill. MW-4 will be used as an upgradient well and will be placed near the access road. Wells



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 4-5 FIELD SAMPLING PLAN GOSS COVE LANDFILL
	PROPOSED	EXISTING	
	● TB-1 – Test Boring ● MW-1 – Monitoring Well	—95— Existing Grade Exposed Bedrock ○ TB-1 – Test Boring	ATLANTIC ENVIRONMENTAL SERVICES, INC.

will be constructed using 2 inch I.D. PVC materials and the screened interval will be 15 feet in length and the screen slot size will be 0-020 inches. The top of the screen will be placed several feet above the water table to allow for ground water fluctuations but will also allow for the proper seal around the well at the ground surface. The screened interval will be packed with washed silica sand to at least one foot above the top of the screen and a bentonite pellet seal (minimum one foot thick) will be placed above the sand. The annulus will be sealed with cement/bentonite (6 to 1 ratio, respectively) grout. A protective steel curb box with locking cap will be installed above the well casing. An overburden monitoring well construction diagram is presented in Appendix B. The wells will be developed at least one day after they have been installed. Development will include the use of a surge block and simultaneously pumping to remove fines from the sand backfill. Development will continue until the discharge is visually clear of after four hours, whichever comes first.

Ground water samples may be collected (A.P. 1023) from the monitoring wells at least two weeks after they have been developed. The need to collect and analyzed ground water samples will depend upon results from the site investigation at the DPDO Area, and any information developed during the three preliminary surveys. If any of this information indicates that ground water samples should be collected and analyzed, a sample would be collected (A.P. 1040) using a dedicated stainless steel bailer. Prior to sampling, the water level in each well will be measured to 0.01 feet using an electronic water level meter and the water level will be recorded in the field notebook. A minimum of four well volumes would be purged in order to collect a representative sample. The well elevations will be surveyed to determine ground water flow gradient.

Stainless steel bailers would be decontaminated prior to sampling according to the following decontamination procedure:

1. Alconox detergent and tap water wash
2. Tap water rinse
3. 10% nitric acid rinse
4. Distilled/deionized water rinse
5. Methanol rinse
6. Distilled/deionized water rinse
7. Air dry

Bailer line would be changed between samples. Ground water samples would be collected from the wells and be analyzed for TCL Organics and Metals in accordance with CLP and for the radiological parameters Gross Alpha and Gross Beta. If ground water samples are collected for analysis, a surface water sample will also be collected from the Thames River to determine the possible affect of river water

quality on the ground water quality. Based on a study by Wheran Engineering (Final Site Investigation - Subsurface Oil Contamination - Lower Subase, Naval Submarine Base - New London, Groton, Connecticut) there may be a mixing of river water and ground water about 100 to 150 feet in from the river's edge. Table 4-5 summarizes the specifics of the site sample type, analysis, and rational.

Individual soil sample information will be logged in a field notebook, placed on the sample jar label, and recorded on a chain-of-custody form (A.P. 1041). The recorded data will include the following:

- Sample number
- Sample depth (if appropriate)
- Date
- Time
- Analysis requested
- Preservative
- Project number
- Name and initials of the collector

The samples will be preserved at a temperature of 4°C (A.P. 1040) prior to sample shipment (A.P. 1042) to the analytical laboratory. QA/QC samples will be collected as specified in the QA/QC Plan.

4.2.5 OBDANE (Site No. 14)

The OBDANE is no longer utilized for disposal and visible soil staining was not observed during Atlantic's visual inspection. The field sampling will include collecting four soil samples (A.P. 1020) from two locations downslope from the disposal area as shown on Figure 4-6. Two soil samples from a depth of 0-6 inches, will be collected from each location, and analyzed for TCLP metals in accordance with CLP procedures. A composite sample of the two 0-6 inch samples will be analyzed for TCL Organics and Metals. Two additional surface soil samples will be collected from each location at a depth of 12-18 inches and analyzed for TCL volatile organics by CLP. Table 4-6 summarizes the specifics of the site sample type, analysis, and rational.

Individual soil sample information will be logged in a field notebook, placed on the sample jar label, and recorded on a chain-of-custody form (A.P. 1041). The recorded data will include the following:

- Sample number
- Sample depth
- Date
- Time
- Analysis requested

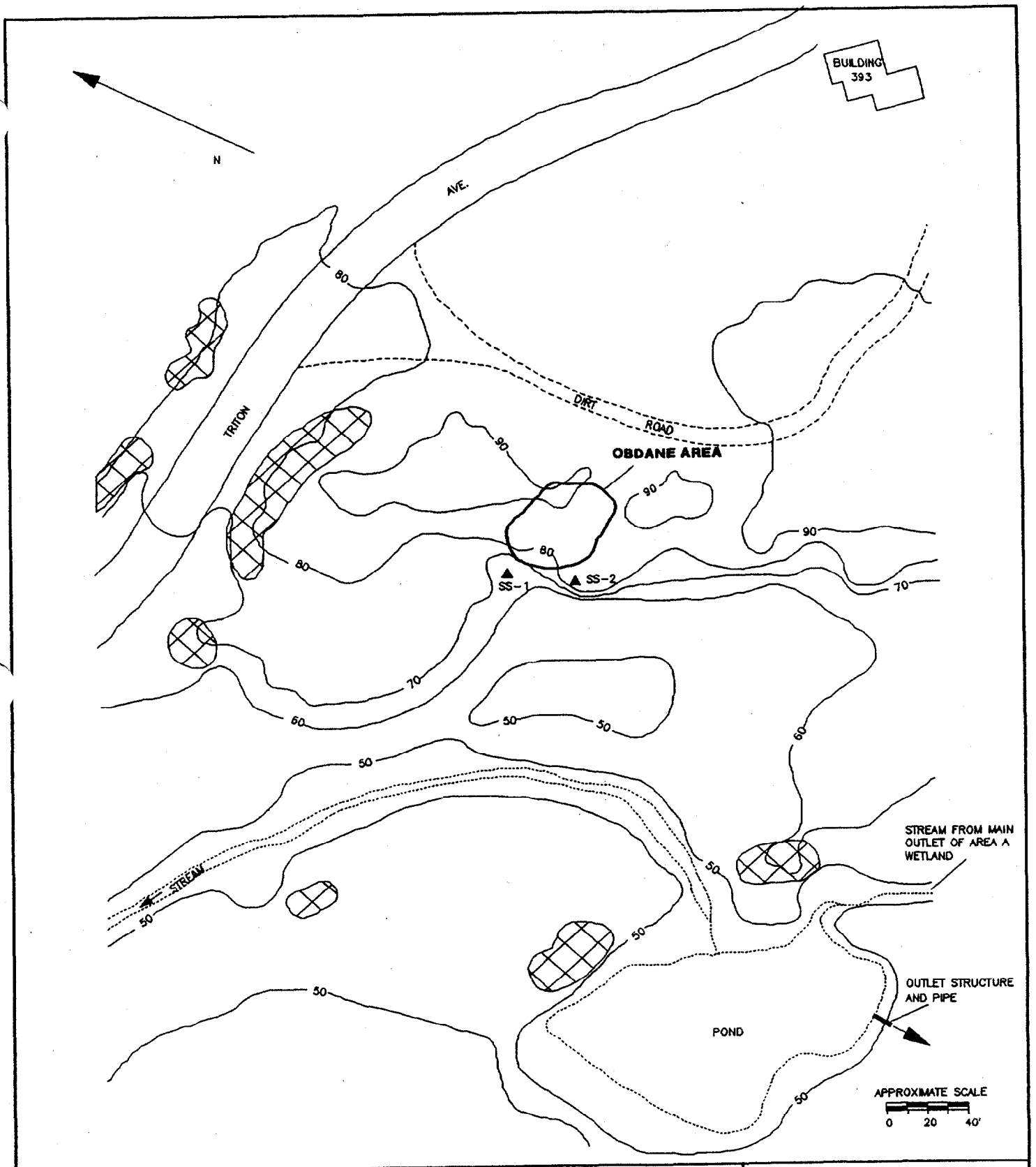
TABLE 4-5

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

GOSS COVE LANDFILL (Site No. 8)
SUMMARY OF PROPOSED SAMPLES

SAMPLE DESIGNATION	SAMPLE TYPE/DEPTH	ANALYSIS	RATIONAL
8-TB-1, 8-TB-2 8-TB-3	Boring soil sample/depth determined in the field	TCL Organics and Metals: CLP	Screen for possible contamination of soils (e.g, landfill material)[1]
8-MW-1, 8-MW-2 8-MW-3, 8-MW-4	Boring soil sample/depth determined in the field	TCL Organics and Metals: CLP	Screen for possible contamination of soils (e.g, landfill materials)[1]
8-GW-1, 8-GW-2 8-GW-3, 8-GW-4	Ground water	TCL Organics and Metals: CLP, Gross Alpha and Beta	Screen for possible leaching of contaminants into the ground water[1]
8-SW-1	Surface water	TCL Organics and Metals: CLP, Gross Alpha and Beta	Assess river water quality and determine affect on ground water quality.

1. Landfill material reportedly inert, but gas cylinders of unknown contents have been found onsite, hence, a full scan of contaminants is warranted.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 4-6 FIELD SAMPLING PLAN OBDANE AREA
	PROPOSED	EXISTING	
	▲ SS-1 – Surface Soil Sample	—95— Existing Grade Exposed Bedrock Stream	ATLANTIC ENVIRONMENTAL SERVICES, INC.

TABLE 4-6

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

OVER BANK DISPOSAL AREA - NORTH EAST (SITE NO. 14)
SUMMARY OF PROPOSED SAMPLES

Sample Designation	Sample Type/Depth	Analysis	Rationale
14-SS-1S, 14-SS-2S	Surface Soil/ 0-6 inches	TCLP Metals: CLP	Screen surface soils for contamination due to spillage/ leachate from disposal area[1]
14-SS-3C	Composite of SS-1S and SS-2S	TCL Organics and Metals: CLP	For health and environmental risk assessment.
14-SS-1D, 14-SS-2D	Surface Soil/ 12-18 inches	TCL volatile organics: CLP	Screen near surface soils for volatile organics from past spillage[2].

NOTES:

1. Due to absorptive nature of metals, highest concentrations would be expected at the ground surface.

2. Due to mobile and volatile nature of volatile organics, measurable concentrations would be expected below the ground surface.

- Preservative
- Project number
- Name and initials of the collector

The samples will be preserved at a temperature of 4°C (A.P. 1040) prior to sample shipment (A.P. 1042) to the analytical laboratory. QA/QC samples will be collected as specified in the QA/QC Plan.

4.2.6 Spent Acid Storage and Disposal Area (Site No. 15)

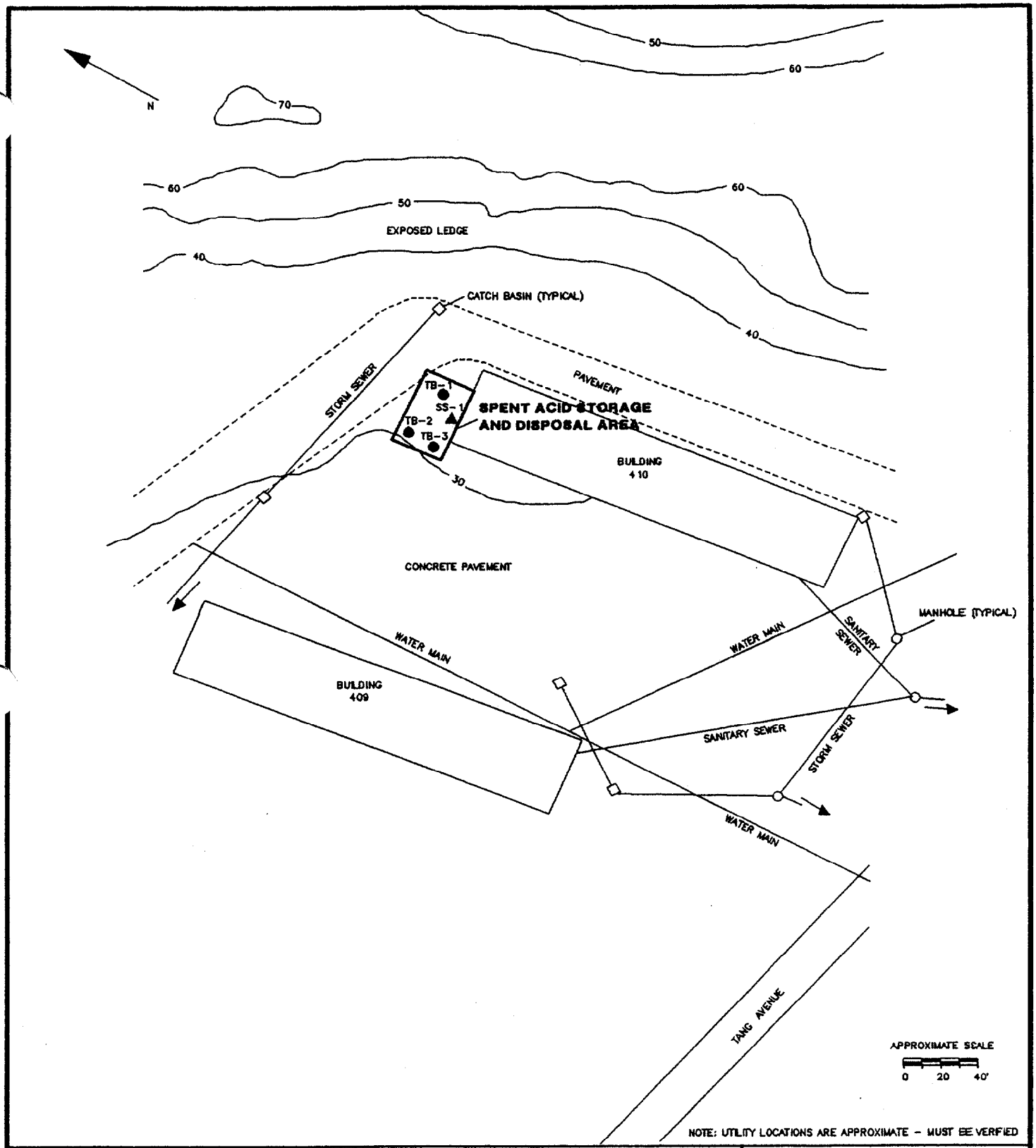
The Spent Acid Storage and Disposal Area was used prior to, and several years after, World War II for storage and disposal of waste battery acid. The field sampling will include removing the wood top from the reported area where the waste acid storage tank existed for inspection. If necessary, probing with a steel bar will help determine the nature and location of the tank bottom if present (e.g. rubber, concrete or steel lined or open to the subsurface soils). If probing with a steel bar is unsucessful, Atlantic will use GPR in the area to help determine the nature and location of the tank bottom. Atlantic will use a metal detector to trace any piping leading into or out of the tank to determine if there are any other nearby areas that may be contaminated due to the spent acid.

After this initial screening, a tank bottom sample will be collected (A.P. 1022) and analyzed for pH as well as TCLP metals.

Three test borings will be drilled onsite based on the preliminary tank inspection and tracing of any pipes connecting to the tank. Tentative locations of the borings are shown on Figure 4-7. The borings will be drilled to bedrock or a maximum depth of 20 feet. The borings will be advanced with 4 inch I.D. hollow stem augers and split spoon samples will be collected continuously in accordance with ASTM D-1586. The split spoons will be decontaminated between each use to prevent cross-contamination according the the following procedure:

1. Alconox detergent and tap water wash
2. Tap water rinse
3. 10% nitric acid rinse (only if sample is to be analyzed for metals)
4. Distilled/deionized water rinse (only if sample is to be analyzed for metals)
5. Methanol rinse
6. Final distilled/deionized water rinse
7. Air dry

Three soil samples will be collected from each test boring (A.P. 1021) for laboratory analysis; 0-4 feet and two at 4-8 feet. Table 4-7 summarizes the specifics of the site sample type, analysis, and rational.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 4-7 FIELD SAMPLING PLAN SPENT ACID STORAGE AND DISPOSAL
	PROPOSED	EXISTING	
	● TB-1 - Test Boring ▲ SS-1 - Surface Soil Sample	—95— Existing Grade	ATLANTIC ENVIRONMENTAL SERVICES, INC.

TABLE 4-7

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

SPENT ACID STORAGE AND DISPOSAL AREA (SITE NO. 15)
SUMMARY OF PROPOSED SAMPLES

Sample Designation	Sample Type/Depth	Analysis	Rationale
15-SS-1	Sediment/ Tank Bottoms	pH, TCLP Metals: CLP	Screen area near tank bottom for metals associated with spent battery acid.
15-TB-1S 15-TB-2S 15-TB-3S	Soil/0-4'	pH, TCLP Metals: CLP	Screen subsurface soils for metals from potential spills of spent acid.
15-TB-1D 15-TB-2D 15-TB-3D	Soil/4-8'	pH, TCLP Metals: CLP	Screen subsurface soils for metals at a depth near tank bottom.
15-TB-3D	Soil/4-8'	TCL Organics: CLP	Screen for possible contamination of subsurface soil from other types of contaminants.

Individual sample information will be logged in a field notebook, placed on the sample jar label, and recorded on a chain-of-custody form (A.P. 1041). The recorded data will include following:

- Sample number
- Sample depth
- Date
- Time
- Analysis requested
- Preservative
- Project number
- Name and initials of the collector

The samples will be preserved at a temperature of 4°C (A.P. 1040) prior to sample shipment (A.P. 1042) to the analytical laboratory. QA/QC samples will be collected as specified in the QA/QC Plan.

4.2.7 Former Gasoline Station (Site No. 18)

The gasoline station was operated from 1940 until the early 1960's. Prior to the renovation in 1950, the exact location of any underground tanks or waste collection systems is unknown. Following renovation in 1950, site plans indicate the existence of feed lines to two 8,000 gallon and one 10,000 gallon underground gasoline tanks, another lubrication bay and a 250 gallon waste oil sump under the new bay's floor. The location of the tanks are only depicted on a 1960 map and it is unknown if these were the original tanks installed in 1940. It is unknown if any of the gasoline tanks (and associated piping) or the waste oil sump was removed during site demolition between 1962 and 1964. The entire site is covered by asphalt and no remnants of the gasoline station are evident. A portion of Grenadier Avenue and parking for adjacent buildings now occupy the site.

Geophysical and soil gas surveys will be performed prior to drilling activities to further characterize the site.

Weston Geophysical Corporation will perform a geophysical study by using either a GPR, EM, resistivity or magnetic survey to determine the presence of buried underground fuel lines, drums or underground tanks. It is important to identify the locations of buried objects prior to drilling in order to prevent safety hazards and also to determine if remaining underground tanks could exist which could be a source for ongoing releases. A detailed description of the geophysical survey methodologies and selection process are presented in Section 4.1. The selected methodology will be used to screen for any remaining subsurface tanks or piping systems.

Atlantic will perform a soil gas survey using a Photovac Model 10S50 portable gas chromatograph. The purpose of the survey is to identify locations on the site which may have volatile organic contamination and to identify the specific compounds. This will be used to assess potential existing/past tank leakage, fuel line leakage, or previous spills/releases for possible onsite septic systems. A detailed description of the soil gas survey methodology is presented in Section 4.1.

Based on the results of the two surveys, test borings will be drilled in areas of suspect contamination. A total of five test borings will be drilled onsite. The borings will be drilled to refusal or a maximum depth of 20 feet. Each boring will be advanced with 4-inch I.D. hollow stem augers and split-spoon samples will be collected continuously in accordance with ASTM D-1586. Boring locations are shown on Figure 4-8.

The actual locations may vary based on the results of the two surveys.

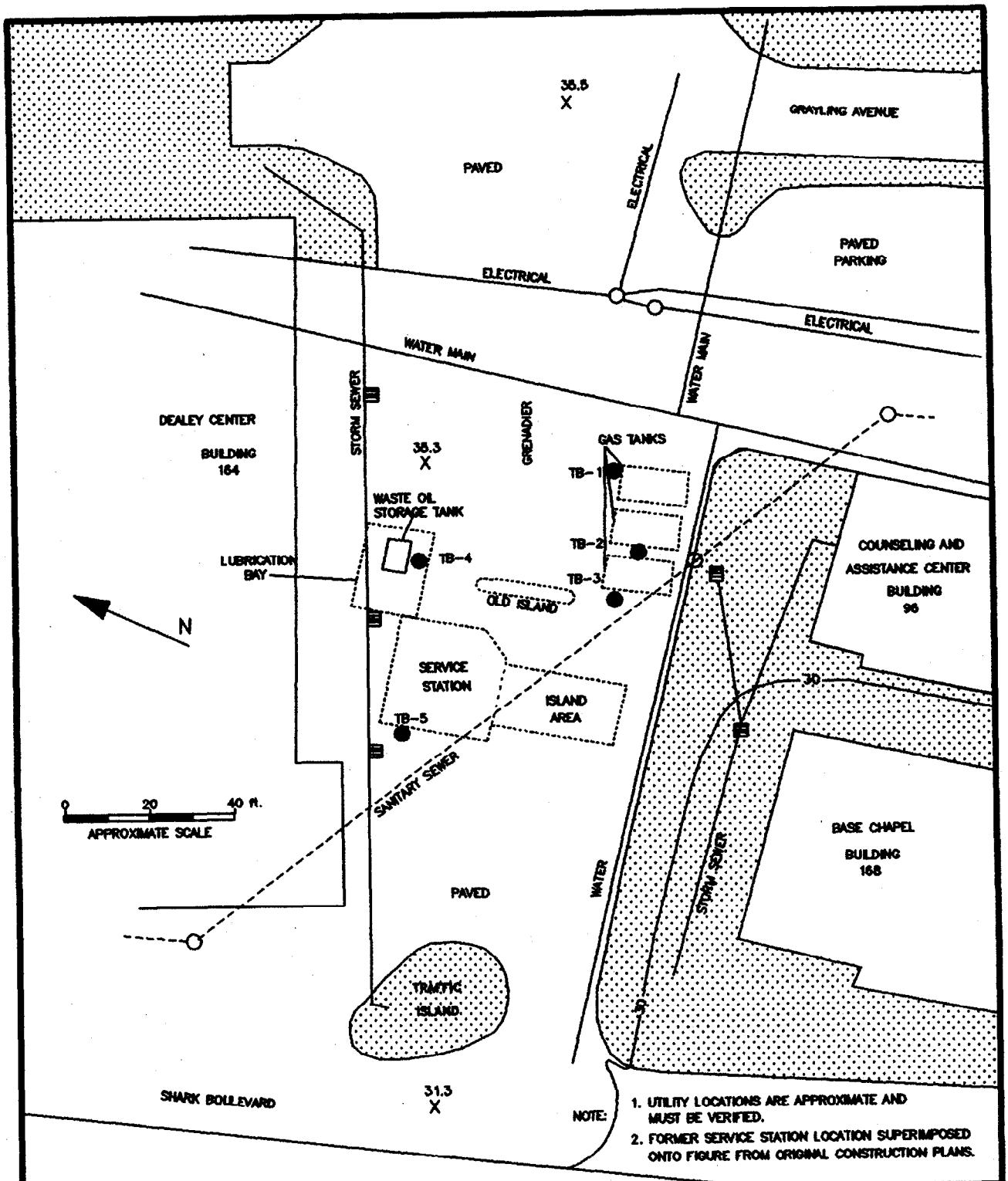
The split-spoon samplers will be decontaminated between each use to prevent cross-contamination, according to the following procedures:

1. Alconox detergent and tap water wash
2. Tap water rinse
3. 10% Nitric acid rinse (only if sample is to be analyzed for metals)
4. Distilled/deionized water rinse (only if sample is to be analyzed for metals)
5. Methanol rinse
6. Distilled/deionized water rinse
7. Air dry

Drill rods and augers will be steam cleaned after each boring is completed. The drill rig will be steam cleaned prior to entering the site and after leaving the site.

A soil sample will be collected (A.P. 1021) from the test borings and analyzed for TCL Volatile Organics and TCLP Metals in accordance with the latest version of the CLP. Table 4-8 summarizes the specifics of the site sampling type, analysis, and rationale. The actual samples sent for analysis will be selected on the following basis:

- The highest HNu readings within the boring.
- Visible contamination.
- Lacking organic vapors or visible contamination, a soil sample will be collected above or at the water table.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 4-8 FIELD SAMPLING PLAN FORMER GASOLINE STATION
	PROPOSED	EXISTING	
	● TB-1 – Test Boring	----- Former Structure —95— Existing Grade Sidewalk/Island 78.2 X Spot Grade	ATLANTIC ENVIRONMENTAL SERVICES, INC.

TABLE 4-8

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

FORMER GASOLINE STATION (SITE NO. 18)
SUMMARY OF PROPOSED SAMPLES

Sample Designation	Sample Type/Depth	Analysis	Rationale
18-TB-1, 18-TB-2 18-TB-3	Boring soil sample/ depth determined in the field	TCL VOCs, TCLP Metals: CLP	Screen for residual petroleum contamination from gas tanks
18-TB-4	Boring soil sample/ depth determined in the field	TCL VOCs, TCLP Metals: CLP	Screen for residual contamination from waste oil tank
18-TB-5	Boring soil sample/ depth determined in the field	TCL VOCs, TCLP Metals: CLP	Screen for residual contamination from former service area.

Individual sample information will be logged in a field notebook, placed on a sample jar label and recorded on a chain-of-custody form (AP 1041). The recorded data will include the following:

- o Sample Number
- o Sample Depth
- o Date
- o Time
- o Analysis Requested
- o Preservative
- o Project Number
- o Name and Initials of Collector

The samples will be preserved at a temperature of 4°C (AP 1040) prior to sample shipment (AP 1042) to the analytical laboratory. QA/QC samples will be collected as specified in the QA/QC plan.

4.3 Step II Sites

A comprehensive field sampling program was developed by Atlantic to determine the extent of onsite contamination, evaluate environmental and health risks, and evaluate remedial alternatives.

4.3.1 Area A Landfill

The Wehran, February, 1988, report included sampling of the Area A Landfill, the Area A Wetland, and, what Atlantic is now referring to as, the Area A Downstream Water Course. These general areas are shown on Figure 2-13. For the purpose of this plan, these three areas will be addressed separately, however the results will be used to address the environmental concerns of the area as a whole.

4.3.1.1 Area A - Landfill

The landfill was operated for an unknown number of years prior to 1957, and up until 1973. It is reported that the materials disposed, up until 1963, were residues of incinerated non-salvageable wastes. The incinerator broke down in 1963, and all wastes were then being disposed of in Area A unburned. After 1973, "hazardous" industrial materials were stored on a concrete pad. Transformers, both mineral and PCB, electrical switches and 55-gallon steel drums have been known to have been stored on the pad.

Prior to any subsurface investigations, radiological, geophysical and soil gas surveys will be conducted as part of the OSHA hazardous waste safety protocol, as well as trying to locate any unknown sources of subsurface contamination (e.g., buried drums, gas

cylinders, storage tanks or grossly contaminated soils). The radiological, geophysical and soil gas surveys will be conducted as described earlier in Section 4.1.

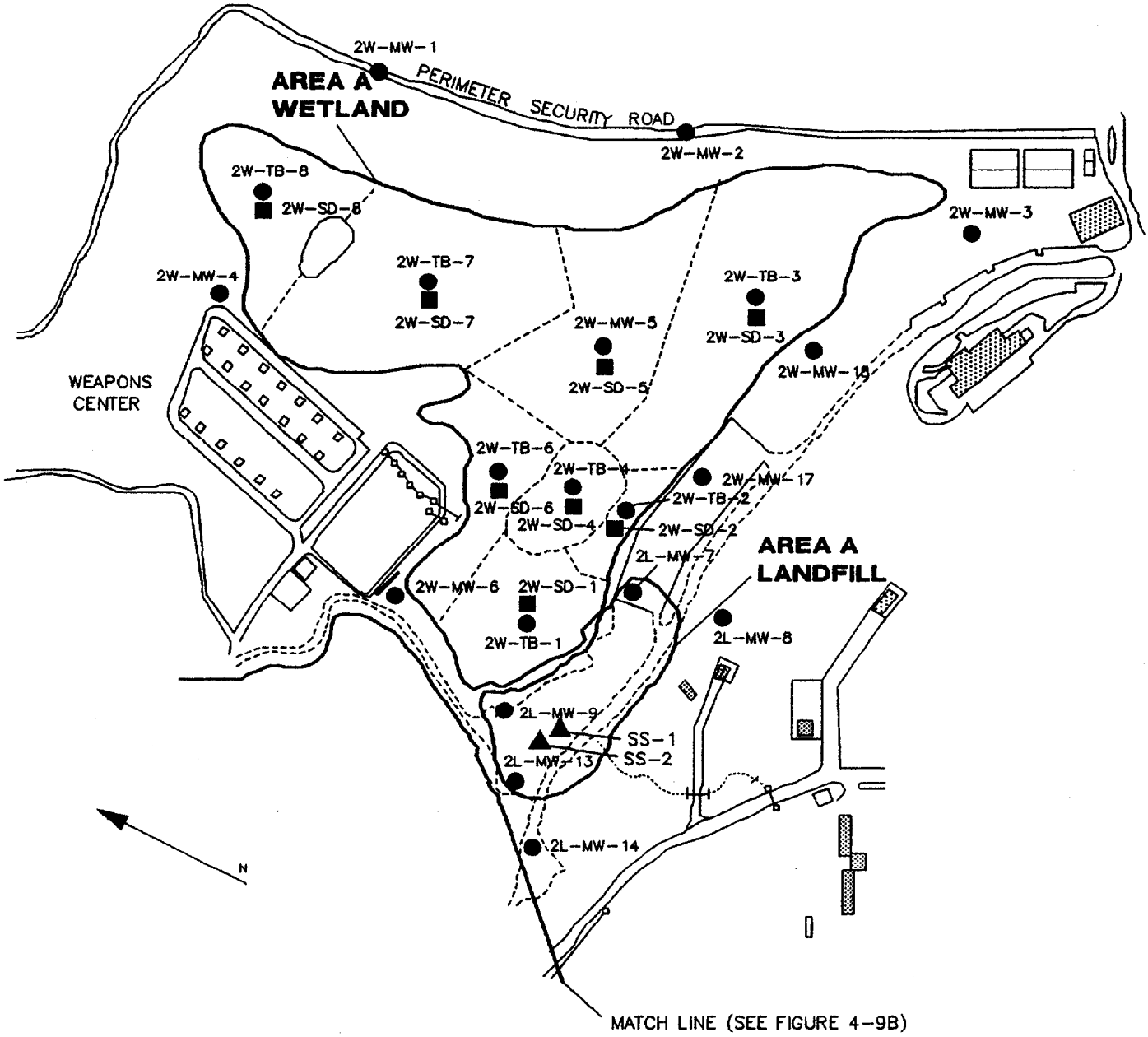
Two surface soil samples will be collected just off of the edge of the concrete pad on which the "hazardous" industrial materials were stored. The approximate locations of the samples are shown on Figure 4-9A, the actual locations will be selected in the field at points where there appears to be surface runoff. The samples will be analyzed for TCL Organics and Metals by CLP, and for TCLP Metals and Pesticides.

The subsurface field investigation will include six nested monitoring wells in the immediate vicinity of the landfill and seven additional soil borings to try and locate any former acid pits. Monitoring wells 2L-MW-7, 2L-MW-8, 2L-MW-9, 2L-MW-13, 2L-MW-14, 2L-MW-17, and 2L-MW-18 as shown on Figure 4-9A, will be drilled as follows:

- Soil borings will be drilled at each location, down to bedrock with 4-inch I.D. hollow stem augers. Split-spoon samples will be collected continuously in accordance with ASTM D-1586. The split-spoons will be decontaminated between samples with the following procedure:

  1. Alconox detergent and tap water wash
  2. Tap water rinse
  3. 10% nitric acid rinse (only if sample is to be analyzed for metals)
  4. Distilled/deionized water rinse (only is sample is to be analyzed for metals)
  5. Methanol rinse
  6. Final distilled/deionized water rinse
  7. Air dry

  The soil samples will be screened with a HNu PI101 for both health safety monitoring as well as an indication of volatile organic contamination. The soil samples will also be screened in the field for pH values. A pH meter capable of taking pH readings directly from the soil will be used to speed up the screening process. Selected soil samples will be sent back to the field laboratory for verification of results. Two soil samples from borings MW-7, MW-9, MW-13, MW-17 and MW-18 and one soil sample from MW-8 and MW-14 will be selected for analysis of TCL Organics and Metals and for TCLP Metals and Pesticides by CLP. The samples will be selected on the following basis:



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 4-9A FIELD SAMPLING PLAN AREA A LANDFILL AND WETLAND
	PROPOSED	EXISTING	
	● TB-1 – Test Boring Sample ● MW-1 – Monitoring Well ■ SD-1 – Sediment Sample ▲ SS-1 – Surface Soil Sample	Building	ATLANTIC ENVIRONMENTAL SERVICE, INC.

- the highest HNu readings within the boring
- visible contamination
- the lowest pH level
- lacking organic vapors, visible contamination, or significantly lower pH values, one soil sample will be collected from just above the water table or bedrock, whichever is highest, and the second sample (where appropriate) from two to four feet below ground surface (within any fill material).

Drill rods and augers will be steam cleaned after each boring is completed. The drill rig will be steam cleaned prior to entering the site and after completing the drilling at the site. Auger cuttings may be collected and drummed in DOT approved 55-gallon drums for possible offsite disposal as specified in Section 4.1.

- Bedrock will be cored in monitoring wells 2L-MW-7 and 2L-MW-13. A minimum of 20 feet of rock core will be collected with an Nx, double tube core barrel. The bedrock will be cored until the Rock Quality Designation (RQD) is at least 75%. The rock will be cored to confirm the bedrock formation as well as to assess the degree of fracturing in the bedrock. The corehole will be filled with a neat cement grout tremied into the bottom of the corehole.

- If after completing the drilling down to bedrock, the water table has been encountered at least five feet above the bedrock, a shallow monitoring well will be installed. The shallow wells will be constructed of 2-inch I.D. Schedule 40 PVC screen and riser with flush threaded joints. The well screen will be minimum of 10 feet with a slot size of 0.020 inches. The top of the screen will be placed two feet above the water table to allow for ground water fluctuations, but will also allow for the proper seal around the well at the ground surface. A washed silica sand will be backfilled around the screen and to at least one foot above the screen. A bentonite pellet seal, at least two feet thick, will be placed directly on top of the sand backfill. The remainder of the annulus will be backfilled with a cement/bentonite (6 to 1 ratio, respectively) slurry. A protective steel 6-inch diameter casing with locking cap, will be installed so that at least three feet of the casing is set below ground. The outside of the protective casing will be painted with fluorescent paint and the well number painted on the top of the locking cap. A 2-foot by 2-foot concrete seal, sloped away from the well, will be installed around the protective casing. An overburden monitoring well construction diagram is presented in Appendix B.

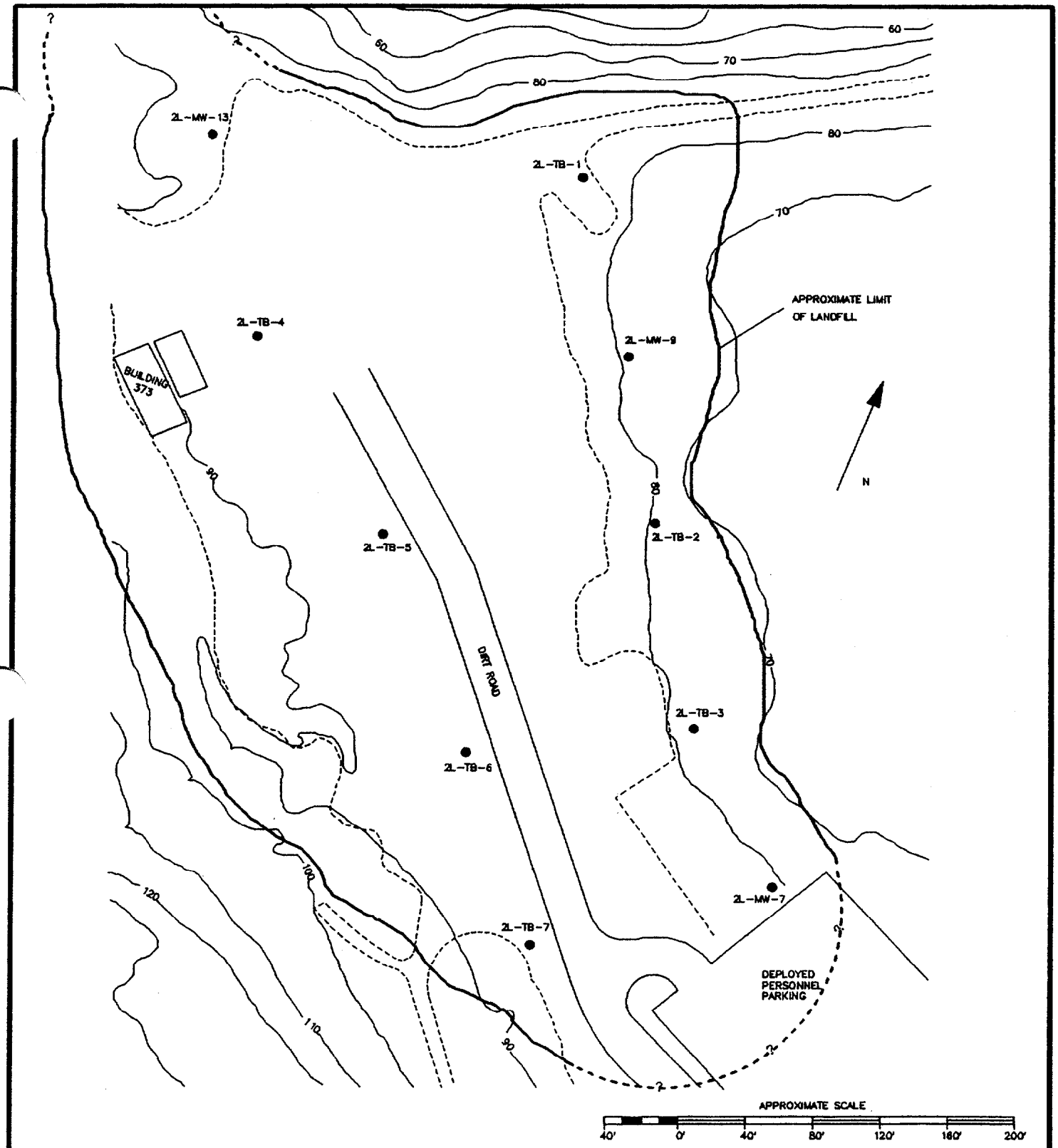
- A bedrock monitoring well will be drilled approximately 50 feet deep at all five locations. An 8-inch, minimum, hole will be drilled by either the mud rotary or air hammer method five feet into the bedrock or to a depth of 20 feet, whichever is deeper. A neat cement grout will be tremied into the borehole and up at least two feet above the top of the bedrock. A 6-inch diameter steel casing will be set into the grout and allowed to set for a minimum of 24 hours. The borehole will be advanced sufficiently deep to encounter a saturated zone with a 6-inch nominal air hammer drill. The compressed air used to drive the hammer and bring the cuttings to the surface will be filtered so there are no trace amounts of lubricating oils which may contaminate the bedrock well.

  The drill rods will be steam cleaned after each boring is completed. The drill rig will be steam cleaned prior to entering the site and after completing the drilling at the site. All drill cuttings may be collected and drummed in DOT approved 55 gallon drums for possible offsite disposal as specified in Section 4.1.

- All monitoring wells will be developed at least one day after the grout around the casing has been installed. Development will include some means of pumping water from the well. In the bedrock wells, the drill rods may be left in the bottom of the well and the compressed air used to displace water from the well. In the shallow wells either a centrifugal or peristaltic pump may be used to evacuate water. If necessary for the shallow wells, a surge block will be used simultaneously with the pumping to help speed up the development process. Development in all of the wells will continue until the discharge is visually clear or after four hours, whichever comes first.

The seven additional soil borings will be drilled at the locations shown on Figure 4-9B. The borings will be advanced down to bedrock with 4 inch I.D. hollow stem augers and split-spoon samples will be collected continuously in accordance with ASTM D-1586. The split-spoons will be decontaminated between each use to prevent cross-contamination according to the following procedure:

1. Alconox detergent tap water wash
2. Tap water rinse
3. 10% nitric acid rinse (only if sample is to be analyzed for metals)
4. Distilled/deionized water rinse (only if sample is to be analyzed for metals
5. Methanol rinse
6. Final distilled/deionized water rinse
7. Air dry



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 4-9B FIELD SAMPLING PLAN AREA A LANDFILL BORING LOCATIONS
	PROPOSED	EXISTING	
	● TB-1 - Test Boring ● MW-1 - Monitoring Well	—95— Existing Grade	ATLANTIC ENVIRONMENTAL SERVICES, INC.

The soil samples will be screened with a HNu PI 101 for both health and safety monitoring as well as an indication of volatile organic contamination. The samples will also be screened in the field for pH. A pH meter capable of taking pH readings directly from the soil will be used to speed up the screening process. Selected soil samples will be sent back to the field laboratory for verification of results.

Ground water samples will be collected (A.P 1023) from the monitoring wells at least two weeks after they have been developed. The samples will be collected using a dedicated stainless steel bailer. Prior to sampling, the water level in each well will be measured to the nearest 0.01 foot using an electronic water level meter. The wells will be surveyed to determine ground water flow directions and vertical gradients. The water level will be recorded in the field notebook. A minimum of four well volumes will be purged prior to collection of the sample.

Stainless steel bailers will be decontaminated prior to sampling according to the following decontamination procedure:

1. Alconox detergent and tap water wash
2. Tap water rinse
3. 10% nitric acid rinse
4. Distilled/deionized water rinse
5. Methanol rinse
6. Distilled/deionized water rinse
7. Air dry

The bailer line will be changed between samples.

Ground water samples will be collected and analyzed for TCL Organics and Metals in accordance with CLP and for the radiological parameters Gross Alpha and Gross Beta. Table 4-9 summarizes the specifies of the site sample type, analysis and rational. TCL organics includes volatile organic, semi-volatile organics, (base neutral and acid extractables), pesticides and PCBs.

Individual sample information will be logged in a field notebook, placed on the sample jar label, and recorded on a chain-of-custody form (A.P. 1041). The recorded data will include the following:

- sample number
- sample depth (if appropriate)
- date
- time
- analysis requested
- preservative
- project number
- name and initials of the collector

TABLE 4-9

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

AREA 2 - LANDFILL (Site No. 2)
SUMMARY OF PROPOSED SAMPLES

SAMPLE DESIGNATION	SAMPLE TYPE/DEPTH	ANALYSIS	RATIONALE
2L-MW-7-X 2L-MW-9-X 2L-MW-9-X 2L-MW-13-X 2L-MW-14-X 2L-MW-8-X 2L-MW-17 2L-MW-18	Soil(2)/See Note 2 Soil(2)/See Note 2 Soil(2)/See Note 2 Soil(2)/See Note 2 Soil(1)/See Note 3 Soil(1)/See Note 3 Soil(2)/See Note 2 Soil(2)/See Note 2	TCL Organics and Metals, TCLP Metals and Pesticides: CLP	Screen for contamination of soils[2] Assess soil contamination for health and environmental risk and remediation evaluation.
2L-GW-7S, 2L-GW-7D 2L-GW-8S, 2L-GW-8D 2L-GW-9S, 2L-GW-9D 2L-GW-13S,2L-GW-13D 2L-GW-14S,2L-GW-14D 2L-GW-17S,2L-GW-18S	Ground water	TCL Organics and Metals: CLP, Gross Alpha and Gross Beta	Screen for ground water contamination. MW-8 is background/ upgradient well. MW-7, MW-9, MW-13, MW-17, MW-18 are on downgradient edge of landfill. MW-14 is potential downgradient bedrock well based on bedrock structure. MW-17 and MW-18 are shallow wells.
2L-SS-1, 2L-SS-2	Surface soil, 0-6 inches	TCL Organics and Metals, TCLP Metals and Pesticides: CLP	Screen for contamination of surface soils by runoff from concrete pad

(continued)

TABLE 4-9 (CONTINUED)

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

AREA 2 - LANDFILL (Site No. 2)
SUMMARY OF PROPOSED SAMPLES

NOTES:

(2) Denotes number of soil samples collected at boring.

1. X = a number representing the depth of the sample.

2. For borings within the landfill (MW-7, MW-9, MW-13, MW-17, MW-18), two samples will be collected from two distinct depths for analysis; one below landfill cover material (probable sample depth 2-4 feet) and a second immediately above the water table from visible contamination or detected organic vapors.

3. For borings outside of the landfill (MW-8, MW-14), sample location will be selected based on standard protocol.

The samples will be preserved at a temperature of 4°C (A.P. 1040) prior to sample shipment (A.P. 1042) to the analytical laboratory. QA/QC samples will be collected as specified in the QA/QC Plan.

4.3.1.2 Area A - Wetland

The Thames River was dredged in 1957 and the spoils were disposed of in this area. To help control insects, brickets of insecticide were placed on the frozen ice within the wetland, so as the ice thawed the insecticides would disperse throughout. Elevated levels of DDT, DDD, and DDE were found in the wetland sediments. The only known disposal in this area is the dredge spoil. However, the Wehran investigation did find B/Ns in the surface water and shallow sediments within the northwest area, close to the Weapons Storage Area.

Because of the nature of the site, and that the only known disposed material is dredge spoil, no preliminary site surveys are planned for this area. The field investigation program will include the collection of surface water, sediment and boring samples and the installation and sampling of nested monitoring wells 2W-MW-1, 2W-MW-2, 2W-MW-3, 2W-MW-4, 2W-MW-5 and 2W-MW-6 at the locations shown on Figure 4-9A around the perimeter of the wetland.

A total of eight composite sediment samples will be collected (A.P. 1022). The selection of these eight subareas was based on physical characteristics noted during the Atlantic site inspection and from the aerial photographs, as well as the nature of the immediate surroundings from the eight subareas designated on Figure 4-9A. Each composite sample subarea will be further divided into twelve sampling blocks. Each composite sample will be collected from four of the twelve blocks which will be selected for actual sampling by a random number generator. Furthermore, each selected sampling block will be subdivided into four quadrants and equal amounts of sediment will be collected from each quadrant. The sediment samples will be analyzed for TCL Organics and Metals and for TCLP Metals and Pesticides in accordance with CLP. These samples are to define the lateral extent of contamination for remediation evaluation and to determine levels of contamination for health and environmental risk assessment. One grab composite sample will be collected (A.P. 1022) from the stormwater culvert draining the northwest portion of the Weapons Center (see Figure 4-9A). The sample will be analyzed for TCL Organics and Metals, and for TCLP Metals and Pesticides. This sample will help determine the impact, if any, of the Weapons Center on the Area A Wetlands.

A total of two surface water samples will be collected (A.P. 1022) from the Area A Wetland. The samples will be collected from the locations shown on Figure 4-9A. The samples will be analyzed for TCL Organics and Metals by CLP.

Eight soil borings (2W-BH-1 through 2W-BH-8) will be drilled at the locations shown on Figure 4-9A; the locations correspond to the approximate center of the eight subareas developed for the sediment sampling.

The borings will be advanced with 4-inch I.D. hollow stem augers and split-spoon samples will be collected continuously for the first six feet and every five feet, or detectable change in stratigraphy, thereafter in accordance with ASTM D-1586. The split-spoons will be decontaminated between each use to prevent cross-contamination according to the following procedure:

1. Alconox detergent tap water wash
2. Tap water rinse
3. 10% nitric acid rinse (only if sample is to be analyzed for metals)
4. Distilled/deionized water rinse (only if sample is to be analyzed for metals)
5. Methanol rinse
6. Final distilled/deionized water rinse
7. Air dry

The borings will be advanced through the dredge spoil and into native soil. Soil samples, from each boring, will be collected (A.P. 1021) from 0-2, 4-6, 10-12, 15-17 and 20-22 feet to define the extent of vertical contamination. The samples will be analyzed for TCL Organics and Metals by CLP and for pH. The soil samples will be screened for volatile organics with an HNu and for pH with a meter capable of taking pH readings directly from the soil.

A monitoring well, 2W-MW-5, will be installed in the soil boring drilled at the location shown on Figure 4-9A to assess ground water quality within the wetland. The well will be constructed of 2 inch I.D. Schedule 40 PVC screen and riser with flush threaded joints. The well screen be a minimum of 10 feet with a slot size of 0.020-inches. The top of the screen will be placed four feet below the ground surface (the water table will be within one foot of the ground surface) to allow for the proper seal around the well at the ground surface. A washed silica sand will be backfilled around the screen and to one foot above the screen. A bentonite pellet seal, one foot thick, will be placed directly on top of the sand backfill. The remainder of the annulus will be backfilled with concrete. A protective steel 6-inch diameter casing, with locking cap, will be installed so that two feet of the casing is set below the ground. The outside of the protective casing will be painted with fluorescent paint and the well number painted on the top of the locking cap. The concrete seal will be 2-feet by 2-feet at the ground surface and sloped away from the protective casing.

Monitoring well nests 2W-MW-1, 2W-MW-2, 2W-MW-3, 2W-MW-4 and 2W-MW-6 will be drilled as follows:

- Soil borings will be drilled, at each location, down to bedrock with 4 inch I.D. hollow stem augers and split-spoon samples will be collected continuously in accordance with ASTM D-1586. The split-spoons will be decontaminated between each use to prevent cross-contamination according to the following procedure:

  1. Alconox detergent tap water wash
  2. Tap water rinse
  3. 10% nitric acid rinse (only if sample is to be analyzed for metals)
  4. Distilled/deionized water rinse (only if sample is to be analyzed for metals
  5. Methanol rinse
  6. Final distilled/deionized water rinse
  7. Air dry

  The soil samples from the monitor wells will be screened with a HNu PI101 for both health and safety monitoring as well as an indication of volatile organic contamination. A soil sample from each boring will be selected for TCL Organics and Metals analysis by CLP and for TCLP Metals and Pesticides. The samples will be selected on the following basis:

  - the highest HNu readings within the boring
  - visible contamination
  - from just above the water table or bedrock, whichever is highest

  Drill rods and augers will be steam cleaned after each boring is completed. The drill rig will be steam cleaned prior to entering the site and after completing the drilling at the site. Auger cuttings may be collected and drummed in DOT approved 55 gallon drums for possible offsite disposal as specified in Section 4.1.

- Bedrock will be cored in monitoring wells 2-MW-2 and 2-MW-4. A minimum of 20 feet of rock core will be collected with an Nx double tube core barrel. The bedrock will be cored until the RQD is at least 75%. The rock will be cored to confirm the bedrock formation as well as to assess the degree of fracturing within the bedrock. The corehole will be filled with a neat cement grout tremied into the bottom of the corehole.

- If, after completing the drilling down to bedrock the water table has been encountered at least five feet above the bedrock, a shallow monitoring well will be installed. The shallow wells will be constructed of 2-inch I.D. Schedule 40 PVC screen and riser with flush threaded joints. The well screen will be a minimum of five feet with a slot size of 0.020 inches. The top of the screen will be placed two feet above the water table, if possible, but in all cases will allow for the proper seal around the well at the ground surface. A washed silica sand will be backfilled around the screen and to at least one foot above the screen. A bentonite pellet seal, at least one foot thick will be placed directly on top of the sand backfill. The remainder of the annulus will be backfilled with a cement/bentonite (6 to 1 ratio, respectively) slurry. A protective steel 6-inch diameter casing, with locking cap, will be installed so that at least three feet of the casing is set below ground. The outside of the protective casing will be painted with fluorescent paints and the well number painted on the top of the locking cap. A 2-foot by 2-foot concrete seal, sloped away from the well will be installed around the protective casing.

- A bedrock monitoring well will be drilled approximately 50 feet deep within ten feet of any overburden well at all five locations. A minimum 8-inch hole will be drilled by either the mud rotary or air hammer method five feet into the bedrock, or to a depth of 20 feet, whichever is deeper. A neat cement grout will be tremied into the bedrock and up to at least two feet above the top of the bedrock. A 6-inch diameter steel casing will be set into the grout and allowed to set for a minimum of 24 hours. The borehole will be advanced sufficiently deep to encounter a saturated zone with a 6-inch nominal air hammer drill. The compressed air used to drive the hammer and bring the cuttings to the surface will be filtered so there are no trace amounts of lubricating oils which may contaminant the bedrock well.

  The drill rods will be steam cleaned after each well is completed. The drill rig will be steam cleaned prior to entering the site and after completing the drilling at the site. All drill cuttings may be collected and drummed in DOT approved 55 gallon drums for possible offsite disposal as specified in Section 4.1.

- All monitoring wells will be developed at least one day after the grout around the casing has been installed. Development will be by some means of pumping water from the well. In the bedrock wells, the drill rods may be left in the bottom of the well and the compressed air used to

displace water from the well. In the shallow wells either a centrifugal or peristaltic pump may be used to evacuate water. If necessary for the shallow wells, a surge block will be used simultaneously with the pumping to help speed up the development process. Development of the wells will continue until the discharge is visually clear or after four hours, whichever comes first.

Ground water samples will be collected (A.P. 1023) from the monitoring wells at least two weeks after they have been developed. The samples will be collected using a dedicated stainless steel bailer. Prior to sampling, the water level in each well will be measured to the nearest 0.01 foot using an electronic water level meter. The wells will be surveyed to determined ground water gradients. The water level will be recorded in the field notebook. A minimum of four well volumes will be purged prior to collection of the sample.

Stainless steel bailers will be decontaminated prior to sampling according to the following decontamination procedure:

1. Alconox detergent and tap water wash
2. Tap water rinse
3. 10% nitric acid rinse
4. Distilled/deionized water rinse
5. Methanol rinse
6. Distilled/deionized water rinse
7. Air dry

The bailer line will be changed between samples.

Ground water samples will be collected and analyzed for TCL Organics and Metals in accordance with CLP and the radiological parameters Gross Alpha and Gross Beta. Table 4-10 summarizes the specifics of the site sample type, analysis and rational.

Individual sample information will be logged in a field notebook, placed on the sample jar label, and recorded on a chain-of-custody form (A.P. 1041). The recorded data will include the following:

- sample number
- sample depth (if appropriate)
- date
- time
- analysis requested
- preservative
- project number
- name and initials of the collector

TABLE 4-10

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

AREA A- WETLAND (Site No. 2)
SUMMARY OF PROPOSED SAMPLES

SAMPLE DESIGNATION	SAMPLE TYPE/DEPTH	ANALYSIS	RATIONALE
2W-SD-1, 2W-SD-2 2W-SD-3, 2W-SD-4 2W-SD-4, 2W-SD-6 2W-SD-7, 2W-SD-8	Sediment/ 0-6 inches	TCL Organics and Metals, TCLP Metals and Pesticides: CLP	To assess the horizontal extent of contamination for health and environmental risk assessment and remedial alternative evaluation.[1]
2W-SD-9	Sediment/ 0-6 inches	TCL Organics and Metals, TCLP Metals and Pesticides: CLP	To assess impact of drainage from Weapons Center on the Area A Wetlands.
W-SW-1, 2W-SW-2	Surface water	TCL Organics and Metals: CLP	To assess surface water quality.
2W-TB-1-2, 2W-TB-2-2 2W-TB-3-2, 2W-TB-4-2 2W-TB-5-2, 2W-TB-6-2 2W-TB-7-2, 2W-TB-8-2	Soil/0-2 feet	TCL Organics and Metals, TCLP Metals and Pesticides: CLP	To assess the vertical extent of contamination to estimate volumes for remedial evaluation.[1]
2W-TB-1-6, 2W-TB-2-6 2W-TB-3-2, 2W-TB-4-6 2W-MW-5-6, 2W-TB-6-6 2W-TB-7-6, 2W-TB-8-6	Soil/4-6 feet	TCL Organics and Metals, TCLP Metals and Pesticides: CLP	To assess the vertical extent of contamination to estimate volumes for remedial evaluation.[1]
2W-TB-1-12, 2W-TB-2-12 2W-TB-3-12, 2W-TB-4-12 2W-MW-5-12, 2W-TB-6-12 2W-TB-7-12, 2W-TB-8-12	Soil/ 10-12 feet	TCL Organics and Metals, TCLP Metals and Pesticides: CLP	To assess the vertical extent of contamination to estimate volumes for remedial evaluation.[1]
2W-TB-1-17, 2W-TB-2-17 2W-TB-3-17, 2W-TB-4-17 2W-MW-5-17, 2W-TB-6-17 2W-TB-7-17, 2W-TB-8-17	Soil/ 15-17 feet	TCL Organics and Metals, TCLP Metals and Pesticides: CLP	To assess the vertical extent of contamination to estimate volumes for remedial evaluation.[1]

(continued)

TABLE 4-10 (CONTINUED)

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

AREA A- WETLAND (Site No. 2)
SUMMARY OF PROPOSED SAMPLES

SAMPLE DESIGNATION	SAMPLE TYPE/DEPTH	ANALYSIS	RATIONALE
2W-TB-1-22, 2W-TB-2-22 2W-TB-3-22, 2W-TB-4-22 2W-MW-5-22, 2W-TB-6-22 2W-TB-7-22, 2W-TB-8-22	Soil/ 15-17 feet	TCL Organics and Metals, TCLP Metals and Pesticides: CLP	To assess the vertical extent of contamination to estimate volumes for remedial evaluation.[1]
2W-MW-1-X[2] 2W-MW-2-X[2] 2W-MW-3-X[2] 2W-MW-4-X[2] 2W-MW-6-X[2]	Soil/to be determined in the field	TCL Organics and Metals: TCLP Metals and Pesticides: CLP	MW-1, MW-2, MW-3 to establish background information of subsurface soils.[1] MW-4, MW-6 to assess potential impact of Weapon Storage Area.[1]
-GW-1-S, 2W-GW-1-D 2W-GW-2-S, 2W-GW-2-D 2W-GW-3-S, 2W-GW-3-D 2W-GW-4-S, 2W-GW-4-D 2W-GW-5-S, 2W-GW-6-S 2W-GW-6-D	Ground water	TCL Organics and Metals: CLP, Gross Alpha and Gross Beta	To assess impact of landfill, pesticide use, and potential contamination from Weapon Storage Area on the ground water.[1] MW-1, MW-2, MW-3 (background wells) MW-4, MW-6 (to evaluate migration from Area A Landfill north or from Weapon Center to Area A Wetland. Other wells downgradient of landfill are included on Figure 4-7B and Table 4-9.

1. Landfill and other disposal materials insufficiently documented, a full scan of contaminants is warranted.
2. X = a number representing the actual depth of the sample.

The samples will be preserved at a temperature of 4°C (A.P. 1040) prior to sample shipment (A.P. 1042) to the analytical laboratory. QA/QC samples will be collected as specified in the QA/QC Plan.

The major environmental risks associated with conditions in Area A include the potential effects of metals, petroleum hydrocarbons, and pesticides compounds on fish and wildlife. Direct sampling of sediments and soils of this area will provide the needed data with which to characterize the sources of these chemicals. In addition, the following studies are suggested:

Biological Survey of Area A

A biological survey of Area A will be carried out to identify the major habitat types, plant species, bird species, fish species, and mammal species in the area. This survey would be carried out in accordance with standard survey methods. The emphasis will be placed on qualitative rather than quantitative analyses. The following program is recommended:

1. Wildlife Survey (Birds and Mammals) - several site visits will be made during late spring and early summer to identify the major habitat types and to document the kinds of plants, birds, and mammals present in their habitats. A small mammal trapping program (live trapping) will be used to help in the assessment of these species.

2. Fish Survey - fish collections will be made in ponded areas within Area A on one occasion in early Summer. Collections will be made using experimental gill nets, seines, and tackle.

Results of these surveys will be presented on a map of the area and in tabular form. The overall purpose of the survey is to document and characterize the environmental receptors in the Area A wetland system.

Residue Analysis of Selected Bird Species

Most of the chemicals that may exert effects on vertebrate in Area A are characterized by a high potential for bioaccumulation. Thus, the presence of these chemicals at elevated levels in the tissues of animals provides a direct indication of exposure and also serves to indicate if effects are possible. Bird species are good candidates for evaluating uptake of chemicals in wetland found webs. These animals are near the top of the food webs, are known to be sensitive to chemicals identified at the site, and are of interest to the public and regulatory agencies.

It is recommended that collections be made of one or two species of birds in Area A for the purpose of tissue analysis. One of these species would be water fowl and the other would be a wetland species known to feed on animal matter (e.g. insects). The following protocol would be used:

1. Sampling would focus on young-of-the-year (juvenile) birds;

2. Ten individuals for each species would be collected within Area A and at a reference area;

3. Samples will be stored frozen until prior to analysis;

4. Individual birds will be debeaked and declawed and their digestive system removed in preparation for analysis;

5. Whole animal preparations will be made;

6. Samples will be analyzed for pesticides and metals.

Residues in Fish Tissue

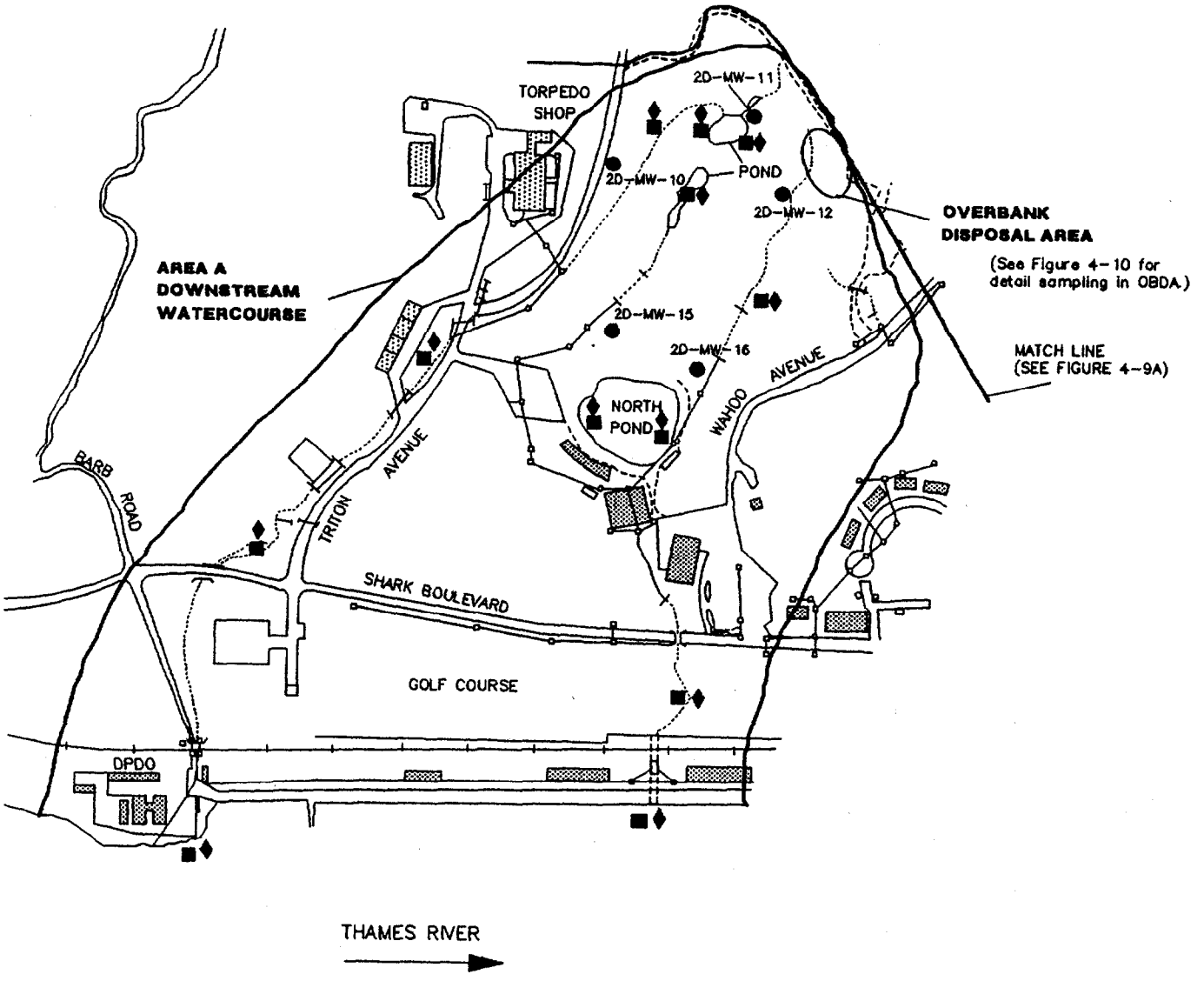
Selected species of fish collected during the biological survey will be examined for tissue residue of pesticides and metal compounds. One of the species selected for analysis would be a top carnivore (e.g. largemouth bass or chain pickerel); then other species would be a forage species used as a source of food by other fish, birds, and mammals. An effort would be made to gather a number of individuals that could be combined to form several composite samples. Analysis would be performed on the fillet (muscle) tissue and on the liver. It is estimated that there would be the following number of samples:

Areas	Composite	Species	Tissues	Samples
2	3	2	2	24

Levels of pesticides and metal compounds in tissues would be compared with the data base developed for other areas.

4.3.1.3 Area A - Downstream Watercourses

The Wehran report documented contamination in the surface water and sediments a short distance downstream of the Area A Landfill, Area A - Wetland and the Over Bank Disposal Area. The field investigation program will include the collection of surface water, sediment, and boring samples and the installation and sampling of nested monitoring wells 2D-MW-10, 2D-MW-11, 2D-MW-15 and 2D-MW-16 at the locations shown on Figure 4-9C (2D-MW-12 is included in DPDO site



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 4-9C FIELD SAMPLING PLAN AREA A DOWNSTREAM WATERCOURSE
	PROPOSED	EXISTING	
	● MW-1 – Monitoring Well ■ SD-1 – Sediment Sample ♦ SW-1 – Surface Water Sample		ATLANTIC ENVIRONMENTAL SERVICE, INC.

discussion). These wells will be used to assess potential migration of contaminants in the ground water from the Area A Landfill and Wetland.

A total of twelve surface water and sediment samples will be collected (A.P. 1022) from bodies of standing water, from portions of the drainage channels that are open and where the discharge flows into the Thames river. The surface water samples will be collected (A.P. 1022) from the same locations as the sediment samples. The sample locations will include two at North Pond and one within the Golf Course to evaluate potential health risks.

The surface water samples will be analyzed for TCL Organics and Metals by CLP and also analyzed for pH, both in the field and in the laboratory. Two samples located half way down each of the two streams from Area A, will be analyzed for the radiological parameters Gross Alpha and Gross Beta. The sediment samples will be analyzed for TCL Organics and Metals in accordance with CLP, and for TCLP Metals and Pesticides.

Monitoring well nests 2D-MW-10, 2D-MW-11, 2D-MW-15 and 2D-MW-16 will be drilled as follows:

- Soil borings will be drilled, at each location, down to bedrock with 4 inch I.D. hollow stem augers and split-spoon samples will be collected continuously in accordance with ASTM D-1586. The split-spoons will be decontaminated between each use to prevent cross-contamination according to the following procedure:

  1. Alconox detergent tap water wash
  2. Tap water rinse
  3. 10% nitric acid rinse (only if sample is to be analyzed for metals)
  4. Distilled/deionized water rinse (only if sample is to be analyzed for metals
  5. Methanol rinse
  6. Final distilled/deionized water rinse
  7. Air dry

  The soil samples will be screened with a HNu PI101 for both health and safety monitoring as well as an indication of volatile organic contamination. A soil sample from each boring will be selected for TCL Organics and Metals analysis by CLP and for TCLP Metals. The samples will be selected on the following basis:

  - the highest HNu readings within the boring
  - visible contamination
  - from just above the water table or bedrock, whichever is highest

Drill rods and augers will be steam cleaned after each boring is completed. The drill rig will be steam cleaned prior to entering the site and after completing the drilling at the site. Auger cuttings may be collected and drummed in DOT approved 55 gallon drums for possible offsite disposal as specified in Section 4.1.

- Bedrock will be cored in monitoring wells 2D-MW-10 and 2D-MW-16. A minimum of 20 feet of rock core will be collected with an Nx double tube core barrel. The bedrock will be cored until the RQD is at least 75%. The rock will be cored to confirm the bedrock formation as well as to assess the degree of fracturing within the bedrock. The corehole will be filled with a neat cement grout tremied into the bottom of the corehole.

- If, after completing the drilling down to bedrock the water table has been encountered at least five feet above the bedrock, a shallow monitoring well will be installed. The shallow wells will be constructed of 2-inch I.D. Schedule 40 PVC screen and riser with flush threaded joints. The well screen will be minimum of five feet with a slot size of 0.020-inches. The top of the screen will be placed two feet above the water table to allow for ground water fluctuations if possible, but will allow for the proper seal around the well at the ground surface. A washed silica sand will be backfilled around the screen and to at least one foot above the screen. A bentonite pellet seal, at least one foot thick will be placed directly on top of the sand backfill. The remainder of the annulus will be backfilled with a cement/bentonite (6 to 1 ratio, respectively) slurry. A protective steel 6-inch diameter casing, with locking cap, will be installed so that at least three feet of the casing is set below ground. The outside of the protective casing will be painted with fluorescent paints and the well number painted on the top of the locking cap. A 2-foot by 2-foot concrete seal, sloped away from the well will be installed around the protective casing.

- A bedrock monitoring well will be drilled approximately 50 feet deep within ten feet of any overburden well at all five locations. A minimum 8-inch hole will be drilled by either the mud rotary or air hammer method five feet into the bedrock, or to a depth of 20 feet, whichever is deeper. A neat cement grout will be tremied into the bedrock and up to at least two feet above the top of the bedrock. A 6-inch diameter steel casing will be set into the grout and allowed to set for a minimum of 24 hours. The borehole will be advanced sufficiently deep to encounter a saturated zone

with a 6-inch nominal air hammer drill. The compressed air used to drive the hammer and bring the cuttings to the surface will be filtered so there are no trace amounts of lubricating oils which may contaminant the bedrock well.

The drill rods will be steam cleaned after each well is completed. The drill rig will be steam cleaned prior to entering the site and after completing the drilling at the site. All drill cuttings may be collected and drummed in DOT approved 55 gallon drums for possible offsite disposal as specified in Section 4.1.

- All monitoring wells will be developed at least one day after the grout around the casing has been installed. Development will be by some means of pumping water from the well. In the bedrock wells, the drill rods may be left in the bottom of the well and the compressed air used to displace water from the well. In the shallow wells either a centrifugal or peristaltic pump may be used to evacuate water. If necessary for the shallow wells, a surge block will be used simultaneously with the pumping to help speed up the development process. Development of the wells will continue until the discharge is visually clear or after four hours, whichever comes first.

  Ground water samples will be collected (A.P. 1023) from the monitoring wells at least two weeks after they have been developed. The samples will be collected using a dedicated stainless steel bailer. Prior to sampling, the water level in each well will be measured to the nearest 0.01 foot using an electronic water level meter. The water level will be recorded in the field notebook. A minimum of four well volumes will be purged prior to collection of the sample.

  Stainless steel bailers will be decontaminated prior to sampling according to the following decontamination procedure:

  1. Alconox detergent and tap water wash
  2. Tap water rinse
  3. 10% nitric acid rinse
  4. Distilled/deionized water rinse
  5. Methanol rinse
  6. Distilled/deionized water rinse
  7. Air dry

  The bailer line will be changed between samples.

Ground water samples will be collected and analyzed for TCL Organics and Metals in accordance with CLP and the radiological parameters Gross Alpha and Gross Beta. Table 4-11 summarizes the

TABLE 4-11

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

AREA A - DRAINAGE WAY
SUMMARY OF PROPOSED SAMPLES

SAMPLE DESIGNATION	SAMPLE TYPE/DEPTH	ANALYSIS	RATIONALE
2D-SD-1, 2D-SD-2, 2D-SD-3, 2D-2D-4, 2D-SD-5, 2D-2D-6, 2D-SD-7, 2D-SD-8, 2D-SD-9, 2D-SD-10 2D-SD-11,2D-SD-12	Sediment	TCL Organics and Metals, TCLP Metals and Pesticides: CLP	To assess extent of contamination down stream from Area A Wetland/Landfill. To assess health and environmental risks.
2D-SW-1, 2D-SW-2, 2D-SW-3, 2D-2W-4, 2D-SW-5, 2D-2W-6, 2D-SW-7, 2D-SW-8, 2D-SW-9, 2D-SW-10 2D-SW-11,2D-SW-12	Surface Water	TCL Organics and Metals: CLP, two samples - Gross Alpha and Gross Beta	To assess extent of contamination down stream from Area A Wetland/Landfill. To assess health and environmental risks.
2D-MW-10-X[2], 2D-MW-11-X[2], 2D-MW-15-X[2] 2D-MW-16-X[2]	Boring/depth to be determined in the field	TCL Organics and Metals: CLP	To determine the extent and characteristics of any possible downgradient subsurface soil contamination[1]
2D-GW-10S, 2D-GW-10D, 2D-GW-11S, 2D-GW-11D, 2D-GW-15S, 2D-GW-15D, 2D-GW-16S, 2D-GW-16D	Ground water	TCL Organics and Metals: CLP, Gross Alpha and Gross Beta	To determine the extent and characteristics of any possible downgradient ground water contamination.[1] Health and environmental risk data - ground water remediation data.

1. Landfill and other disposal materials insufficiently documented, and full scan of contaminants is warranted.
2. X = a number representing the actual depth of the sample.

specifics of the site sample type, analysis and rational.

Individual sample information will be logged in a field notebook, placed on the sample jar label, and recorded on a chain-of-custody form (A.P. 1041). The recorded data will include the following:

- sample number
- sample depth (if appropriate)
- data
- time
- analysis requested
- preservative
- project number
- name and initials of the collector

The samples will be preserved at a temperature of 4°C (A.P. 1040) prior to sample shipment (A.P. 1042) to the analytical laboratory. QA/QC samples will be collected as specified in the QA/QC Plan.

Mussel Cages in Thames River

The primary issue with regards to the Thames River concerns the potential for chemicals in ground water or surface water entering the river and affecting estuarine biota. The Thames River supports a significant fisheries population.

Commercial fisheries in the lower Thames River include lobster, oysters (for movement to cleaner waters) and eels. Shellfish which habitate the lower Thames but are no eatable due to elevated coliform bacteria, include mussels, quahogs, oysters, and steamer clams. Blue crabs also occur throughout the lower Thames. Anadromous fish species in the river include sea run brown trout, American shad, hickory shad, alewifes, and blue back herring. The CTDEP has also recently stocked salmon in the Thames to reestablish a salmon run. Other fish species in the lower Thames, which are sought by recreational fisherman, include winter flounder, summer flounder (fluke), stripe bass, blue fish, weak fish, blackfish, cunners, menhaden, whiting and tom cod.

Most of the chemicals of interest in the Area A site have the potential for being bioaccumulated in tissue of aquatic biota. This potential can be directly evaluated through the use of caged mussels. This procedure involves placing cages of mussels for specified periods of time at particular monitoring points. The mussels are then collected and analyzed for levels of chemicals in tissues. In addition, measurements are made of mortality, actual growth, and scope for growth. The objective of the method is to determine if chemicals that can be bioaccumulated are being released near the sampling area.

The following protocol will be used:

1. Tissues will be analyzed chemically on mussels collected for transplants at time zero.

2. Four cages of mussels will be deployed at each of the five locations in the Thames River. These include: 1) an upstream control, 2) near the DPDO site area and northern drainage points from Area A; 3) near the southern drainage point from Area A, near the Goss Cove, and at the downriver "control" below Goss Cove. Because of the tidal nature of the river the upstream and downstream controls should be at least one (and preferably two) tidal excursions beyond the boundaries of the base.

3. Fifty mussels will be deployed in each cage. Ten of these will be used for analysis of scope for growth, ten will be used for analysis of growth rate and 30 will be used for chemical analysis.

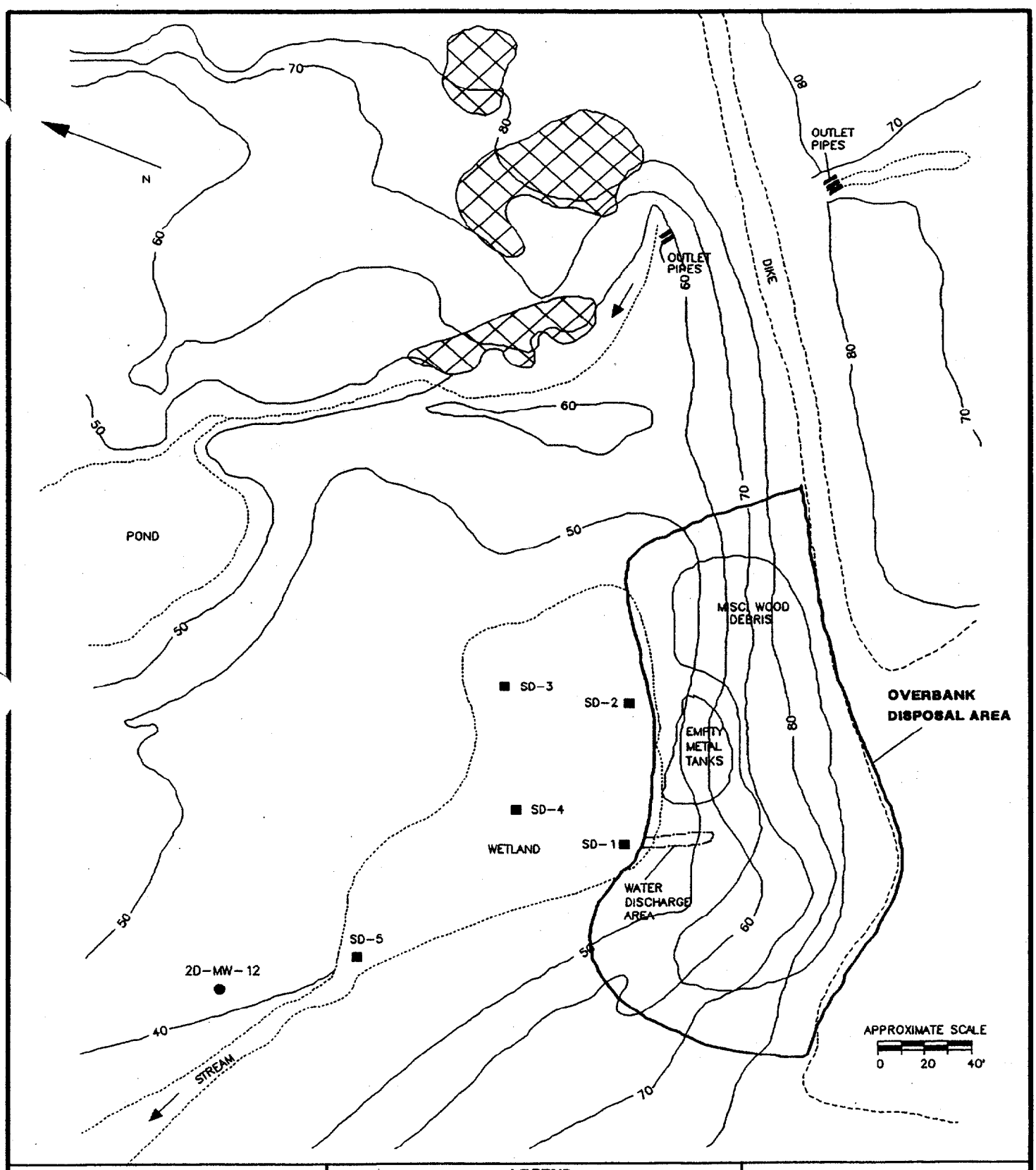
4. Samples will be analyzed after 28 days of deployment at the sampling stations. Chemical analyses will include TCL organics, metals, pesticides, and gross alpha/beta. The growth of marked mussels will also be determined.

4.3.2 Over Bank Disposal Area

The Over Bank Disposal Area (OBDA) is located just west of the Area A Landfill and is an intricate part of the investigation of this overall area. The radiological, geophysical, and soil gas surveys that will be made at the Area A Landfill will include those portions of the OBDA that can be easily accessed and traversed. However, most of the OBDA is along the steep slope and is not accessible for the preliminary surveys. The field investigation program will include surface soil samples and the installation and sampling of nested monitoring wells at the locations shown on Figure 4-10.

A total of ten sediment samples from five locations will be collected (A.P. 1020) and analyzed for TCL Organics and Metals by CLP. TCL organics includes volatile organics, semi-volatile organics (base/neutrals and acid extractables), and pesticides/PCBs. Samples will be collected using stainless steel hand augers and stainless steel spoons from 0-6 inches and 12-18 inches. The hand augers and spoons will be decontaminated between samples with the following procedure:

1. Alconox detergent and tap water wash
2. Tap water rinse
3. 10% nitric acid rinse (only if sample is to e analyzed for metals)
4. Distilled/deionized water rinse (only if sample is to be analyzed for metals)



INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

LEGEND

PROPOSED	EXISTING
■ SD-1 – Sediment Sample	—95— Existing Grade
● MW-12 – Monitoring Well	Exposed Bedrock
	Stream

FIGURE 4-10
FIELD SAMPLING PLAN
OVERBANK DISPOSAL AREA

ATLANTIC ENVIRONMENTAL SERVICES, INC.

5. Methanol rinse
6. Final distilled/deionized water rinse
7. Air dry

Monitoring well nest 3-MW-12 will be drilled as follows:

- The soil boring will be drilled down to bedrock with 4 inch I.D. hollow stem augers and split-spoon samples will be collected continuously in accordance with ASTM D-1586. The split-spoons will be decontaminated between each use to prevent cross-contamination according to the following procedure:

  1. Alconox detergent tap water wash
  2. Tap water rinse
  3. 10% nitric acid rinse (only if sample is to be analyzed for metals)
  4. Distilled/deionized water rinse (only if sample is to be analyzed for metals
  5. Methanol rinse
  6. Final distilled/deionized water rinse
  7. Air dry

  The soil samples will be screened with a HNu PI101 for both health and safety monitoring as well as an indication of volatile organic contamination. A soil sample from the boring will be selected for TCL Organics and Metals analysis by CLP and for TCLP metals. The sample will be selected on the following basis:

  - the highest HNu readings within the boring
  - visible contamination
  - from just above the water table or bedrock, whichever is highest

  Drill rods and augers will be steam cleaned after the boring is completed. The drill rig will be steam cleaned prior to entering the site and after completing the drilling at the site. Auger cuttings may be collected and drummed in DOT approved 55 gallon drums for possible offsite disposal as specified in Section 4.1.

- If, after completing the drilling down to bedrock, the water table has been encountered at least five feet above the bedrock, a shallow monitoring well will be installed. The shallow well will be constructed of 2 inch I.D. Schedule 40 PVC screen and riser with flush threaded joints. The well screen will be minimum of five feet with a slot size of 0.020 inches. The top of the screen will be placed two feet above the water table to allow for ground water fluctuations if possible, but will allow for the proper seal around the

well at the ground surface. A washed silica sand will be backfilled around the screen and to at least one foot above the screen. A bentonite pellet seal, at least one foot thick will be placed directly on top of the sand backfill. The remainder of the annulus will be backfilled with a cement/bentonite (6 to 1 ratio, respectively) slurry. A protective steel 6-inch diameter casing, with locking cap, will be installed so that at least three feet of the casing is set below ground. The outside of the protective casing will be painted with fluorescent paints and the well number painted on the top of the locking cap. A 2-foot by 2-foot concrete seal, sloped away from the well will be installed around the protective casing.

- A bedrock monitoring well will be drilled approximately 50 feet deep within ten feet of the overburden well. A minimum 8-inch hole will be drilled by either the mud rotary or air hammer method five feet into the bedrock, or to a depth of 20 feet, whichever is deeper. A neat cement grout will be tremied into the bedrock and up to at least two feet above the top of the bedrock. A 6-inch diameter steel casing will be set into the grout and allowed to set for a minimum of 24 hours. The borehole will be advanced sufficiently deep to encounter a saturated zone with a 6 inch nominal air hammer drill. The compressed air used to drive the hammer and bring the cuttings to the surface will be filtered so there are no trace amounts of lubricating oils which may contaminant the bedrock well.

  The drill rods will be steam cleaned after the well is completed. The drill rig will be steam cleaned prior to entering the site and after completing the drilling at the site. All drill cuttings may be collected and drummed in DOT approved 55 gallon drums for possible offsite disposal as specified in Section 4.1.

- The monitoring wells will be developed at least one day after the grout around the casing has been installed. Development will be by some means of pumping water from the well. In the bedrock well, the drill rods may be left in the bottom of the well and the compressed air used to displace water from the well. In the shallow well either a centrifugal or peristaltic pump may be used to evacuate water. If necessary for the shallow well, a surge block will be used simultaneously with the pumping to help speed up the development process. Development of the wells will continue until the discharge is visually clear or after four hours, whichever comes first.

Ground water samples will be collected (A.P. 1023) from the monitoring wells at least two weeks after they have been developed. The samples will be collected using a dedicated stainless steel bailer. Prior to sampling, the water level in each well will be measured to the nearest 0.01 foot using an electronic water level meter. The water level will be recorded in the field notebook. A minimum of four well volumes will be purged prior to collection of the sample.

Stainless steel bailers will be decontaminated prior to sampling according to the following decontamination procedure:

1. Alconox detergent and tap water wash
2. Tap water rinse
3. 10% nitric acid rinse
4. Distilled/deionized water rinse
5. Methanol rinse
6. Distilled/deionized water rinse
7. Air dry

The bailer line will be changed between samples.

The collected ground water samples will be analyzed for TCL Organics and Metals in accordance with CLP. Table 4-12 summarizes the specifics of the site sample type, analysis and rational.

Individual sample information will be logged in a field notebook, placed on the sample jar label, and recorded on a chain-of-custody form (A.P. 1041). The recorded data will include the following:

- sample number
- sample depth
- date
- time
- analysis requested
- preservative
- project number
- name and initials of the collector

The samples will be preserved at a temperature of 4°C (A.P. 1040) prior to sample shipment (A.P. 1042) to the analytical laboratory. QA/QC samples will be collected as specified in the QA/QC Plan.

4.3.3 DPDO Area

The DPDO Area is adjacent to the Thames River and it is relatively flat and all surface runoff flows directly into the river. The site opened in 1950; primarily inert materials (wood

TABLE 4-12

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

OVER BANK DISPOSAL AREA (Site No. 3)
SUMMARY OF PROPOSED SAMPLES

SAMPLE DESIGNATION	SAMPLE TYPE/DEPTH	ANALYSIS	RATIONALE
3-SS-1S, 3-SS-2S, 3-SS-3S, 3-SS-4S, 3-SS-5S	Surface soil/ 0-6 inches	TCL Organics and Metals, TCLP Metals and Pesticides: CLP	To determine the lateral extent of sediment contamination.
3-SS-1D, 3-SS-2D, 3-SS-3D, 3-SS-4D, 3-SS-5D	Surface soil/ 12-18 inches	TCL Organics and Metals, TCLP Metals and Pesticides: CLP	To determine if there is any downward migration of sediment contamination.
3-MW-12-X[1]	Boring/depth to be determined in the field	TCL Organics and Metals, TCLP Metals and Pesticides: CLP	Evaluate soil quality at location of down-gradient monitor well.
3-GW-12-S, 3-GW-12-D	Ground Water	TCL Organics and Metals: CLP, Gross Alpha and Gross Beta	To determine extent of ground water contamination.

1. X = a number representing the actual depth of the sample.

pallets, tires, and old furniture) and other non-salvageable waste items were burned and the residue was pushed to the shoreline and partially covered. The landfilling operation ceased in 1969.

Prior to any subsurface investigations, radiological, geophysical and soil gas surveys will be conducted as part of the OSHA hazardous waste safety protocol, as well as trying to locate any unknown sources of subsurface contamination (e.g., buried drums, gas cylinders, storage tanks or grossly contaminated soils). The radiological, geophysical and soil gas surveys will be conducted as described in Section 4.1. Depending on the initial effectiveness of the soil gas survey, it may be modified so that the slam bar would be used to probe into the ground water table so a small amount of ground water could be collected. The water would be used to fill a 40 ml vial about 3/4 full. The sample would be shaken for 60 seconds and an air sample from the headspace would be injected into the gas chromatograph.

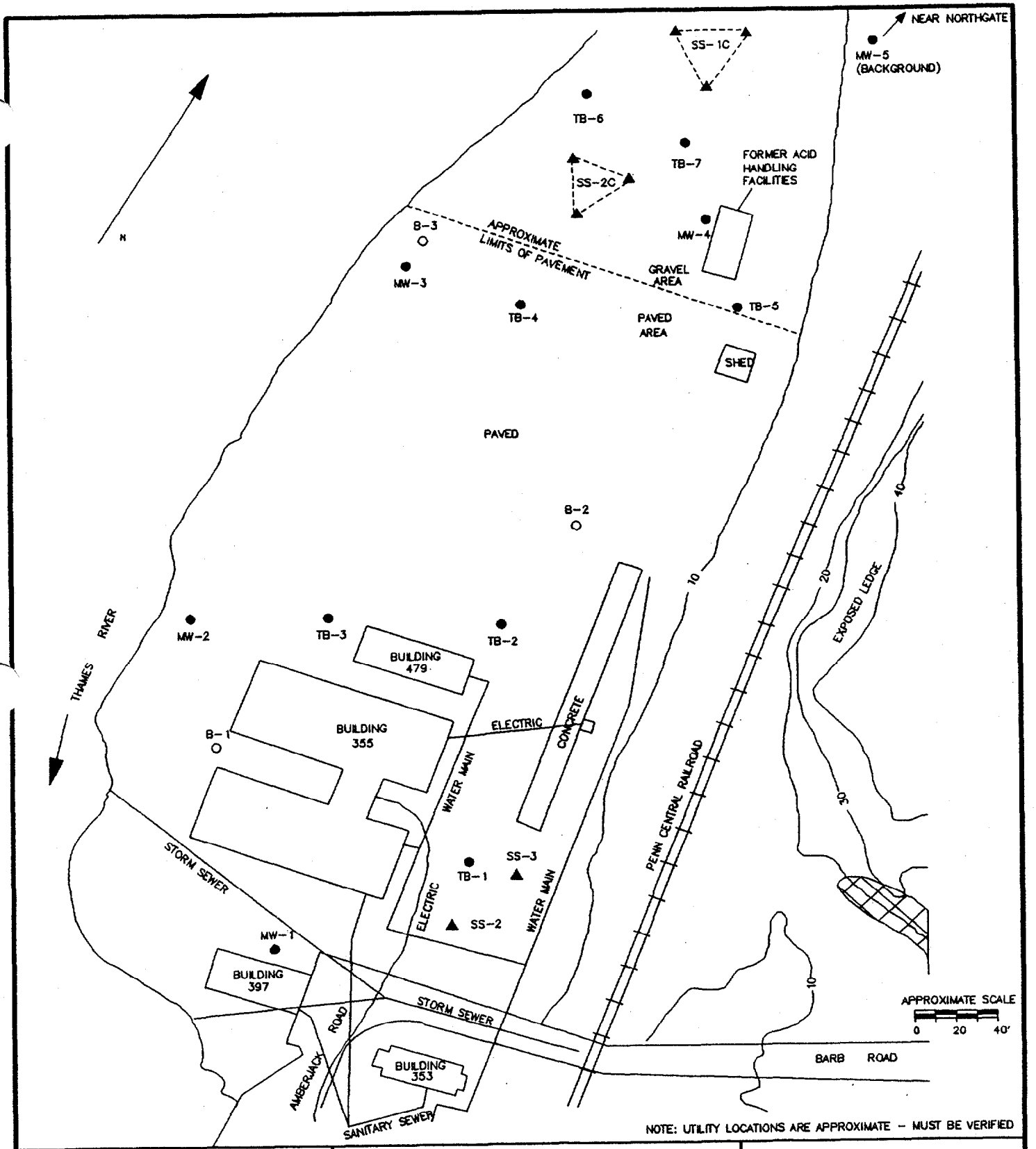
Two composite surface soil samples will be collected from the unpaved area at the north end of the DPDO Area, at the locations shown on Figure 4-11. The samples will be collected (A.P. 1020) with stainless steel spoons and composited in stainless steel bowls. The samples will be analyzed for TCL Organics and Metals by CLP. The soil samples will be used to evaluate direct contact risks for health risk assessment.

Two surface soil grab samples will be collected from the area of the current battery storage area in the southeastern corner, at the locations shown on Figure 4-11. The samples will be collected (A.P. 1020) and analyzed for TCL Organics and Metals and TCLP Metals by CLP.

The subsurface field investigation will include twelve (12) soil borings, five of them completed as monitoring wells at the locations shown on Figure 4-11, and one deeper bedrock monitoring well at MW-5.

The soil borings will be drilled, at each location, 20 feet deep with 4 inch I.D. hollow stem augers and split-spoon samples will be collected continuously in accordance with ASTM D-1586. The split-spoons will be decontaminated between each use to prevent cross-contamination according to the following procedure:

1. Alconox detergent and tap water wash
2. Tap water rinse
3. 10% nitric acid rinse (only if sample is to be analyzed for metals)
4. Distilled/deionized water rinse (only if sample is to be analyzed for metals)
5. Methanol rinse
6. Final distilled/deionized water rinse
7. Air dry



INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

LEGEND

PROPOSED	EXISTING
● TB-1 – Test Boring	—95— Existing Grade
● MW-1 – Monitoring Well	Exposed Bedrock
▲-- SS-1 – Surface Soil Sample	○ B-1 – Test Boring

FIGURE 4-11
FIELD SAMPLING PLAN
DPDO AREA

ATLANTIC ENVIRONMENTAL SERVICES, INC.

The soil samples will be screened with a HNu PI101 for both health and safety monitoring as well as an indication of volatile organic contamination. Two soil samples will be selected from each boring for TCL Organics and Metals analysis by CLP and for the TCLP Metals. One sample from each boring will be from 0-2 feet. The other sample will be selected on the following basis:

- the highest HNu readings within the boring
- visible contamination
- from just above the water table

Drill rods and augers will be steam cleaned after each boring is completed. The drill rig will be steam cleaned prior to entering the site and after completing the drilling at the site. Auger cuttings may be collected and drummed in DOT approved 55 gallon drums for possible offsite disposal as specified in Section 4.1.

The wells will be constructed of 2-inch I.D. Schedule 40 PVC screen and riser with flush threaded joints. The well screen will be a minimum of ten feet with a slot size of 0.020-inches. The top of the screen will be placed several feet above the water table to allow for ground water fluctuations, if possible, but will allow for the proper seal around the well at the ground surface. A washed silica sand will be backfilled around the screen and to at least two feet above the screen. A bentonite pellet seal, at least two feet thick, will be placed directly on top of the sand backfill. The remainder of the annulus will be backfilled with a cement/bentonite (6 to 1 ratio, respectively) slurry. A protective steel 6-inch diameter, with locking cap, will be installed so that at least three feet of the casing is set below ground. The outside of the protective casing will be painted with fluorescent paint and the well number painted on the top of the locking cap. A 2-foot by 2-foot concrete seal, sloped away from the well, will be installed around the protective casing.

Bedrock will be cored in monitoring well MW-5. A minimum of 20 feet of rock core will be collected with an Nx, double tube core barrel. The bedrock will be cored until the Rock Quality Designation (RQD) is at least 75%. The rock will be cored to confirm the bedrock formation as well as to assess the degree of fracturing in the bedrock. The corehole will be filled with a neat cement grout tremied into the bottom of the corehole.

A bedrock monitoring well will be drilled approximately 50 feet deep at the location of MW-5. An 8-inch, minimum, hole will be drilled by either the mud rotary or air hammer method five feet into the bedrock or to a depth of 20 feet, whichever is deeper. A neat cement grout will be tremied into the borehole and up at least two feet above the top of the bedrock. A 6-inch diameter steel casing will be set into the grout and allowed to set for a minimum of 24 hours. The borehole will be advanced sufficiently deep to encounter

a saturated zone with a 6-inch nominal air hammer drill. The compressed air used to drive the hammer and bring the cuttings to the surface will be filtered so there are no trace amounts of lubricating oils which may contaminate the bedrock well.

The monitoring wells will be developed at least one day after the well has been installed. Development will be by some means of pumping water from the well. Either a centrifugal or peristaltic pump may be used to evacuate water. If necessary, a surge block will be used simultaneously with the pumping to help speed up the development process. Development of the wells will continue until the discharge is visually clear or after four hours, whichever comes first.

Ground water samples will be collected (A.P. 1023) from the monitoring wells at least two weeks after they have been developed. The samples will be collected using a dedicated stainless steel bailer. Prior to sampling, the water level in each well will be measured to the nearest 0.01 foot using an electronic water level meter. The water level will be recorded in the field notebook. A minimum of four well volumes will be purged prior to collection of the sample. A surface water sample will be collected (A.P. 1022) from the Thames River (see Figure 4-11) at the same time that the ground water samples are collected. The sample will help assess the possible affect of the river water quality on the ground water quality. Based on a study by Wheran Engineering (Final Site Investigation - Subsurface Oil Contamination - Lower Subase, Naval Submarine Base - New London, Groton, Connecticut) there may be a mixing zone of river water and ground water about 100 to 150 feet in from the river's edge.

Stainless steel bailers will be decontaminated prior to sampling according to the following decontamination procedure:

1. Alconox detergent and tap water wash
2. Tap water rinse
3. 10% nitric acid rinse
4. Distilled/deionized water rinse
5. Methanol rinse
6. Distilled/deionized water rinse
7. Air dry

The bailer line will be changed between samples.

Ground water samples will be collected and analyzed for TCL Organics and Metals in accordance with CLP, gross alpha and beta, and analyzed for pH, both in the field and in the laboratory. Table 4-13 summarizes the specifics of the site sample type, analysis and rational.

TABLE 4-13

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

DPDO AREA (Site No. 6)
SUMMARY OF PROPOSED SAMPLES

SAMPLE DESIGNATION	SAMPLE TYPE/DEPTH	ANALYSIS	RATIONALE
6-MW-1-2, 6-MW-2-2, 6-MW-3-2, 6-MW-4-2, 6-MW-5-2 6-TB-1-2, 6-TB-2-2 6-TB-3-2, 6-TB-4-2 6-TB-5-2, 6-TB-6-2 6-TB-7-2	Soil 0-2 Feet	TCL Organics and Metals, TCLP Metals: CLP	To determine horizontal extent of near surface contamination across the site, as well as to establish background conditions (MW-5-2).[1] Health and environmental risk data, remediation data. TB-6 & TB-7 in area of fill based on aerial photographs.
6-MW-1-X[2], 6-MW-2-X[2] -MW-3-X[2] -MW-4-X[2] 6-MW-5-X[2] 6-TB-1-X[2] 6-TB-2-X[2] 6-TB-3-X[2] 6-TB-4-X[2] 6-TB-5-X[2] 6-TB-6-X[2] 6-TB-7-X[2]	Boring/to be determined in the field	TCL Organics and Metals, TCLP Metals: CLP	To determine vertical extent of soil contamination across the site for remediation evaluation, as well as to establish background conditions (MW-5-X).[1] Remediation data.
6-SS-C1 6-SS-C2	Composite Surface/soil 0-6 inches	TCL Organics and Metals, TCLP Metals: CLP	To determine health and environmental risk for direct contact exposure assessment.[1]
6-SS-3 6-SS-4	Surface soil 0-6 inches	TCL Organics and Metals, TCLP Metals: CLP, pH	To assess impact of possible leaking battery acid on surface soils. Health and environmental risk data, remediation data.

(continued)

TABLE 4-13 (CONTINUED)

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

DPDO AREA (Site No. 6)
SUMMARY OF PROPOSED SAMPLES

SAMPLE DESIGNATION	SAMPLE TYPE/DEPTH	ANALYSIS	RATIONALE
6-GW-1, 6-GW-2 6-GW-3, 6-GW-4 6-GW-5S, 6-GW-5D	Ground water	TCL Organics and Metals: CLP, Gross Alpha and Gross Beta, pH	To assess upgradient (GW-5) and onsite ground water quality for health and environmental risk evaluation and ground water remediation data.
6-SW-1	Surface water	TCL Organics and Metals: CLP, Gross Alpha and Beta, pH	To assess river water quality and determine affect on ground water quality.

. Disposed materials insufficiently documented, a full scan of contaminants is warranted.

2. X = a number representing the actual depth of the sample

Individual sample information will be logged in a field notebook, placed on the sample jar label, and recorded on a chain-of-custody form (A.P. 1041). The recorded data will include the following:

- sample number
- sample depth (if appropriate)
- date
- time
- analysis requested
- preservative
- project number
- name and initials of the collector

The samples will be preserved at a temperature of 4°C (A.P. 1040) prior to sample shipment (A.P. 1042) to the analytical laboratory. QA/QC samples will be collected as specified in the QA/QC Plan.

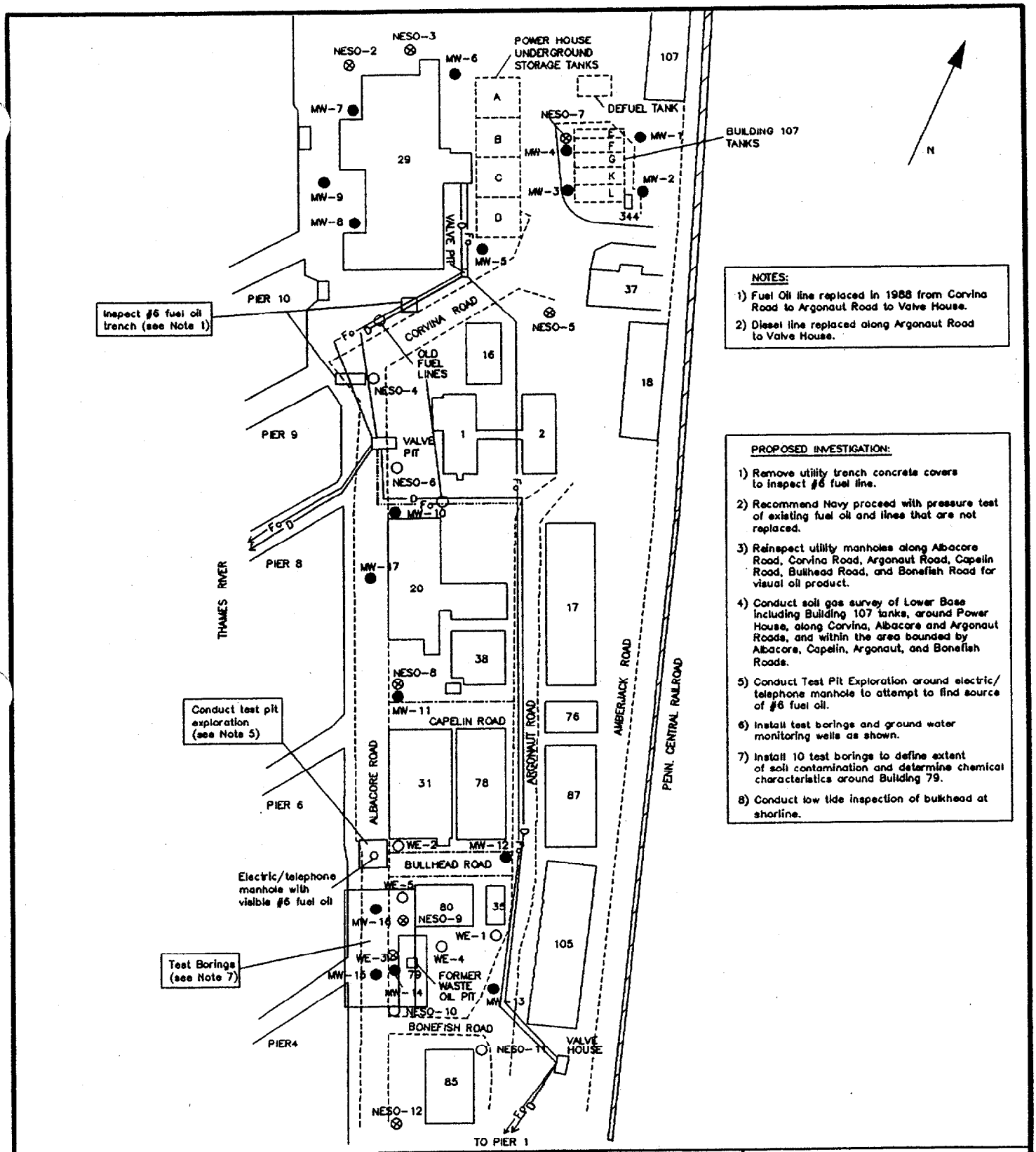
4.3.4 Lower Base

Prior reports by NESO (1979) and Wehran (1987) identified four areas of petroleum contamination on the Lower Subase as follows: Building 79 Waste Oil Pit, Power Plant Oil Tanks, Oil Tanks at Building 107, and the underground fuel distribution system. Petroleum products both in the soil and ground water were identified in a relatively widespread area of the Lower Subase.

The extent, compound specific chemical concentrations, and health and environmental risk associated with fuel leaks at the Power Plant Tanks, and the fuel tanks at Building 107 were not fully defined. The source of the contamination at Building 79 was also not conclusively identified and it is unknown if it is ongoing.

The proposed field investigation is summarized below. For further details refer to Figure 4-12 and Table 4-14.

1. Conduct a soil gas survey of the Lower Subase to identify any "hot spots" of volatile organic contamination and to assist in finalizing test boring/well locations. Although soil gas will be ineffective for #6 fuel oil, it has been shown to be moderately effective in identifying significant sources of subsurface diesel fuel. The survey would include the area around Building 107 tanks, around the Power House, along Corvina, Albacore, and Argonaut Roads, and within the area bounded by Albacore, Capelin, Arogonaut, and Bonefish Roads.



NOTES:

1) Fuel Oil line replaced in 1988 from Corvina Road to Argonaut Road to Valve House.
2) Diesel line replaced along Argonaut Road to Valve House.

PROPOSED INVESTIGATION:

1) Remove utility trench concrete covers to inspect #6 fuel line.
2) Recommend Navy proceed with pressure test of existing fuel oil and lines that are not replaced.
3) Reinspect utility manholes along Albacore Road, Corvina Road, Argonaut Road, Capelin Road, Bullhead Road, and Bonefish Road for visual oil product.
4) Conduct soil gas survey of Lower Base including Building 107 tanks, around Power House, along Corvina, Albacore and Argonaut Roads, and within the area bounded by Albacore, Capelin, Argonaut, and Bonefish Roads.
5) Conduct Test Pit Exploration around electric/telephone manhole to attempt to find source of #6 fuel oil.
6) Install test borings and ground water monitoring wells as shown.
7) Install 10 test borings to define extent of soil contamination and determine chemical characteristics around Building 79.
8) Conduct low tide inspection of bulkhead at shoreline.

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

LEGEND

PROPOSED	EXISTING
● MW-1 – Monitoring Well	—D— Diesel Line
● TB-1 – Test Boring	—Fo— Fuel Oil Line
	—Fo— Out of Service Fuel Oil Line
	○ NESO-1 – NESO Well
	○ WE-1 – Wehran Well
	⊗ Destroyed Well

FIGURE 4-12
FIELD SAMPLING PLAN
LOWER SUBASE

ATLANTIC ENVIRONMENTAL SERVICES, INC.

TABLE 4-14

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

LOWER BASE
SUMMARY OF PROPOSED SAMPLES

SAMPLE DESIGNATION	SAMPLE TYPE/DEPTH	ANALYSIS	RATIONALE
LB-MW-1, LB-MW-2, LB-MW-3, LB-MW-4	Soil/To be determined in the field	TCL Volatile Organics and Metals, TCLP Metals: CLP, Total Petroleum Hydrocarbons, 418.1, fluorescence fingerprint analysis.	Evaluate extent and source of soil contamination around Building 107 fuel tanks.[1]
LB-GW-1, LB-GW-2, LB-GW-3, LB-GW-4	Ground water	TCL Volatile Organics and Metals: CLP, Total Petroleum Hydrocarbons, 418.1, fluorescence fingerprint analysis.	Evaluate ground water contamination around Building 107 fuel tanks.[1]
	Floating product	Direct measurement[2]	Evaluate need for oil recovery remediation.
LB-MW-5, LB-MW-6, LB-MW-7, LB-MW-8	Soil/to be determined in field	TCL Volatile Organics and Metals, TCLP Metals: CLP, Total Petroleum Hydrocarbons, 418.1, fluorescence fingerprint analysis.	Evaluate extent and source of soil contamination around Power Plant.[1]
LB-GW-5, LB-GW-6, LB-GW-7, LB-GW-8	Ground water	TCL Volatile Organics and Metals: CLP, Total Petroleum Hydrocarbons, 418.1, fluorescence fingerprint analysis.	Evaluate ground water contamination around Power Plant (Building 29).[1]
	Floating product	Direct Measurement[2]	Evaluate need for oil recovery remediation.

(continued)

TABLE 4-14 (CONTINUED)

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

LOWER BASE
SUMMARY OF PROPOSED SAMPLES

SAMPLE DESIGNATION	SAMPLE TYPE/DEPTH	ANALYSIS	RATIONALE
LB-MW-9	Soil/to be determined in field	TCL Volatile Organics and Metals, TCLP Metals: CLP, Total Petroleum Hydrocarbons, 418.1, fluorescence fingerprint analysis.	Evaluate soil contamination is sand manhole near Power Plant.[1]
LB-GW-9	Ground water	TCL Volatile Organics and Metals: CLP, Total Petroleum Hydrocarbons, 418.1, fluorescence fingerprint analysis.	Evaluate ground water contamination below relieving platform near Power Plant.[1]
	Floating product	Direct Measurement[2]	Evaluate need for oil recovery remediation.
LB-MW-10, LB-MW-11, LB-MW-12, LB-MW-13, LB-MW-14, LB-MW-15, LB-MW-16, LB-MW-17	Soil/to be determined in field	TCL Volatile Organics and Metals, TCLP Metals: CLP, Total Petroleum Hydrocarbons, 418.1, fluorescence fingerprint analysis.	Evaluate extent and type of soil contamination potentially associated with Building 79.[1]
LB-GW-10, LB-GW-11, LB-GW-12, LB-GW-13, LB-GW-14, LB-GW-15, LB-GW-16, LB-GW-17 NESO-4, NESO-6, NESO-10,NESO-11, WE-1 WE-2,WE-4,WE-5	Ground water	TCL Volatile Organics and Metals: CLP, Total Petroleum Hydrocarbons, 418.1, fluorescence fingerprint analysis.	Evaluate ground water contamination potentially associated with Building 79.[1]
	Floating product	Direct measurement[2]	Evaluate need for oil recovery.

1. Due to long operational, yet poorly documented history of the Lower Subase, a full scan of parameters will be made.
Analysis will be of product thickness in the well.

2. Conduct a GPR survey of portions of the Lower Subase to follow buried utility lines and confirm that there are no abandoned utility lines (that are unmapped) that intersect existing utility lines. This survey will only be performed if the other subsurface investigations indicate that contamination is following along a buried utility trench, but the source, or discharge, of the contamination remains unknown.

3. Install eight test borings to be converted to monitoring wells around the Building 107 tanks and near Power Plant Tanks and on the west side of the Power Plant Building near the Thames River. Four test borings/wells (MW-1, MW-2, MW-3, MW-4) will be installed around the Building 107 tanks and four test borings/wells (MW-5, MW-6, MW-7, MW-8) around the Power Plant.

   The test boring/wells will extend to approximately 10 feet below the ground water table; 20-25 foot wells are anticipated.

   Soil borings will be drilled at each location, to a depth of 20-25 feet, with 4 inch I.D. hollow stem augers and split-spoon samples will be collected continuously in accordance with ASTM D-1586. The split-spoons will be decontaminated between each use to prevent cross-contamination according to the following procedure:

   1. Aclonox detergent tap water wash
   2. Tap water rinse
   3. 10% nitric acid rinse (only if sample is to be analyzed for metals)
   4. Distilled/deionized water rinse (only if sample is to be analyzed for metals
   5. Methanol rinse
   6. Final distilled/deionized water rinse
   7. Air dry

   The soil samples from the monitor wells will be screened with a HNu PI101 for both health and safety monitoring, as well as an indication of volatile organic contamination. A soil sample from each boring will be selected for TCL Organics and Metals analysis by CLP for TCLP Metals, and petroleum hydrocarbons and fluorescence. The samples will be selected on the following basis:

   - the highest HNu readings within the boring
   - visible contamination, or
   - from just above the water table

Drill rods and augers will be steam cleaned after each boring is completed. The drill rig will be steam cleaned prior to entering the site and after completing the drilling at the site. Auger cuttings may be collected and drummed in DOT approved 55 gallon drums for possible offsite disposal as specified in Section 4.1.

The wells will be constructed of 2 inch I.D. Schedule 40 PVC screen and riser with flush threaded joints. The well screen will be a minimum of 10 feet with a slot size of 0.020 inches. The top of the screen will be placed a minimum of four feet above the water table to allow for ground water and tidal fluctuations. A washed silica sand will be backfilled around the screen and to at least one foot above the screen. A bentonite pellet seal, at least one foot thick, will be placed directly on top of the sand backfill. The remainder of the annulus will be backfilled with a cement/bentonite (6 to 1 ratio, respectively) slurry. A protective steel 6-inch diameter casing, with locking cap, will be installed so that at least three feet of casing is set below ground. A flush mounted curb box will be installed with the well number painted on the top of the cap. A 2-foot by 2-foot concrete seal sloped away from the well will be installed around the curb box.

In addition, a monitoring well (MW-9) will be installed in a sand manhole to the west of Building 29 to determine if a floating phase of oil exists below the relieving platform. The monitoring well will be installed similar to as described above, however, it will have a ten foot sump (riser pipe below the screen) and extend approximately five feet into original ground for stability. The well will be installed with a locking curb box installed under the manhole cover. Sand can continue to be applied to the manholes by Navy maintenance personnel for replenishments below the relieving platform. Due to the nature of the well construction, the well will not be sealed; a construction detail is provided in Appendix B.

4. An inspection will be conducted of the #6 fuel line concrete lined utility trench along Corvina Road. It is assumed that the removal of the concrete covers will be provided by Navy personnel. The inspection will be coordinated so that it occurs during a time when the fuel lines are pressurized. Video documentation will be provided of the inspection. The purpose of this task is to identify potential leaks in this segment of #6 fuel line which is the last remaining unreplaced line within the study area.

5. Atlantic recommends that the Navy proceed with the hydrostatic testing of the existing oil distribution lines along Corvina Road. The specifications for this testing have been prepared by the Navy.

6. Reinspect and videotape the utility manholes within the study area for evidence of oil.

7. A visual inspection of the bulkhead along the waterfront of the Lower Subase will be conducted at low tide to check for visual seeps.

8. Conduct a test pit excavation around the electric/telephone manhole where fuel oil contamination has been observed previously and most recently during Atlantic's site inspection.

9. Install eight test borings to be converted to monitoring wells (MW-10 through MW-17) along Albacore Road, Argonaut Road and around Building 79 to delineate the extent of soil and ground water contamination and to assist in documenting the source of previously identified fuel oil contamination in this area. The test borings and wells will extend to approximately 10 feet below the ground water table; 20 foot wells are anticipated in this area. The test boring, soil sampling, and well installation procedures are as defined above in Item No.2.

   All ground water wells will be sampled including existing wells NESO-4, NESO-6, WE-2, WE-5, WE-1, WE-4, NESO-10, NESO-11, NESO-12.

   Also, three wells (MW-15, MW-16, MW-17) will be installed in sand manholes to the west of Building 79 to determine if a floating phase of oil exists below the relieving platform. The wells in the sand manholes will be installed as defined above and discussed in Item No.2.

10. Drill ten test borings in area of soil contamination at Building 79 to define extent and assist in defining source.

11. Conduct an elevation survey of all ground water monitoring wells within the study area (existing and proposed). Conduct 48 hours of ground water monitoring to determine the direction of ground water flow and tidal influence.

12. Based on past evidence of subsurface oil product on the ground water at the Lower Subase, a ground water pump test is proposed in an area of the thickest identified product, to evaluate product recovery remedial alternatives. Recall that

the previous product recovery system reportedly did not work due to improper design. A 48 hour pump test is proposed to evaluate aquifer characteristics and the movement ability of oil product through subsurface soils. The specifics of the pump test locations and methodology will be determined based on the single well hydraulic tests.

Ground water samples will be collected from all of the new and existing wells and analyzed for TCL Organics and Metals in accordance with latest CLP. Table 4-14 summarizes the specifics of the site sample type, analysis, and rational.

Individual sample information will be logged in a field notebook, placed on the sample jar label, and recorded on a chain-of-custody form (A.P. 1041). The recorded data will include the following:

- sample number
- sample depth (if appropriate)
- data
- time
- analysis requested
- preservative
- project number
- name and initials of the collector

The samples will be preserved at a temperature of 4°C (A.P. 1040) prior to sample shipment (A.P. 1042) to the analytical laboratory. QA/QC samples will be collected as specified in the QA/QC Plan.

5.0 SAMPLE PRESERVATION AND SHIPPING

Precleaned sample containers will be provided by the analytical laboratory for a to use in the field.

Sample preservation standards for solid and liquid matrices are outlined in Atlantic Procedure No. 1040. Typical preservation standards are listed below for parameters to be analyzed during the field sampling plan. It is noted that soils rarely require preservation and the laboratory will be consulted prior to soil samples collection.

PARAMETERS	PRESERVATION
Metals	HNO_3 to PH below 2 (water)
TCL Organics	Cool to $4^{o}C$

The preservation method will be noted on the sample jar and reported with designated sample number in the field notebook. A Chain-of-custody from (A.P. 1041) will also record the preservation technique prior to shipment to the analytical laboratory. All samples and appropriate QA/QC samples will be shipped via Federal Express to the laboratory. Sample shipment will occur at least every other day.

6.0 RECORD KEEPING AND DOCUMENTATION

A record keeping and site documentation plan is required due to the number of soil and water samples, involvement of different field technicians and QA/QC procedures for document control. The following documents will be utilized for recordkeeping:

DOCUMENT	PURPOSE
1. Field Notebook	A designated notebook will be issued to each field technician and used during field activities.
2. Master Sample Log	Laboratory notebook which will remain in site office and record every sample collected. The field operations manager will log in all samples and those sent to analytical laboratory with waybill number at the end of each day.
3. Chain-of-Custody Record	Document custody of all samples from field to laboratory.
4. Waybills	Waybill receipt is obtained at time of accepted sample shipment by Federal Express and will be attached to the Master Sample Log.
5. Accident Report Daily First Aid Report Employer's First Report of Injury OSHA 100 Forms	Data sheets that will document any accident occurring onsite during field activities. The sheets are attached to HASP and located in the site trailer.

Field logs and master sample log will be copied and added to the project file at Atlantic, at the conclusion of each week of field sampling.

7.0 SCHEDULE

The schedule to begin the field sampling plan is based on approval of the Navy. Other factors to consider are availability of drilling equipment and analytical laboratory turn around time. The following sections discuss the overall operations schedule and sampling schedule.

7.1 Operations Schedule

The project schedule is summarized below on Figure 7-1.

figure 7-1

APPENDIX A

ATLANTIC TECHNICAL PROCEDURES

APPLICABLE TECHNICAL PROCEDURES
ATLANTIC ENVIRONMENTAL SERVICES, INC.

PROCEDURE NUMBER	PROCEDURE TITLE
1020	Field Procedures for Collection of Surface Soil Samples
1021	Field Procedures for Collection of Subsurface Soils
1022	Field Procedures for Collection of Surface Water and Sediment Samples for Hazardous Waste Determination
1023	Field Procedures for Collection of Ground Water Samples for Hazardous Waste Determination
1030	Field Procedures for Logging Subsurface Conditions During Test Boring and Well Logging
1040	Sample Preservation for Solid and Liquid Matrices
1041	Sample Chain-of-Custody Procedure
1042	Shipping Procedures for Environmental Field Samples
1051	Operation and Calibration of the HNu Systems Photoionizer Model PI-101
1060	Cleaning Procedure for Sampling Devices used in Environmental Site Investigation

ATLANTIC PROCEDURE NO. 1020

FIELD PROCEDURES FOR COLLECTION OF SURFACE SOIL SAMPLES

Prepared By: John A. Ripp — JOHN A. RIPP — Principal — TITLE

Reviewed By: Edmund J. Burke — EDMUND J. BURKE, P.E. — QA. Manager — TITLE

Approved By: Paul Burgess — PAUL BURGESS, P.E. — Chief Engineer — TITLE

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SECTION 1.0: PURPOSE

To insure a standard procedure for collection of surface soil samples for the indentification of chemical parameters.

SECTION 2.0: SCOPE

The following procedure describes the logistics, chain-of-events, collection techniques and documentation requirements for collecting surface soil samples designated for chemical analysis.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Chemist, Geologist or Engineer - Second

SECTION 4.0: SUPPORTING PROCEDURES

Atlantic Procedure No. 1041 Sample Chain-of-Custody Procedure

SECTION 5.0: REQUIRED FORMS

Field Notebook No. 351, published by J.L. Darling Corp., Tacoma, Washington

SECTION 6.0: PROCEDURE

6.1 Selection of Sampling Locations

The selection of sampling locations in and around a project site will be based on a review of existing site data, the site topography and surface features, results of preliminary site surveys using portable geophysical and air monitoring equipment and the initial estimates as to the extent of and migration pathways of the waste present. At the start of the investigation, a number of surface soil samples are usually allocated. Only after initial field reconnaissance are the final locations selected. At a minimum, the following should be included as sampling points:

- Upgradient soil surfaces to determine background levels.
- Soil surfaces within the immediate area of contamination.
- Downgradient soil surfaces to determine any spread of contamination resulting from storm water runoff.

Sampling locations may be selected in the following areas at the site:

- Areas where chemicals may have been stored, handled or disposed.
- Areas where motor vehicles hauling chemicals may have traveled on the site.
- Areas where water may have ponded during storm events.

6.2 Equipment List

The following is to be considered a minimum listing of required field equipment for collecting soil samples. Other tools required for accessing soils beneath paved area, etc. should be included when necessary.

- Boots, latex gloves, chemical resistant gloves, appropriate level of protection.
- Sample container - 1 each 1 liter glass jar with a teflon lined cap.
- Teflon coated or stainless steel sample spoons.
- Wooden stakes and spray paint (highly visible)
- Field notebook
- Sample bottle labels
- Chain-of-custody forms

6.3 Order of Samples

Surface soil samples should be taken in all locations prior to all other site sampling events. This is to prevent the possibility of cross-contamination between sampling points by site personnel or equipment (backhoe, drill rigs, equipment vehicles, etc. . .). For consistency with other sampling programs, the upgradient samples should be collected first.

6.4 Location and Collection of Samples

Surface soils, depending upon the contaminants of interest, can be either individual or composite samples. Composites represent samples taken from a number of individual locations which are equally blended to form a sample representing a larger area. Certain state agencies are discouraging the use of composite samples when looking for aromatic volatile and halogenated volatile organic compounds because of dilution and the difficulty of forming a "true" composite. Therefore prior to sampling, the use of composites should be checked with the agency which will have final approval of actions regarding a site in which surface soil samples are used in developing certain actions regarding clean up.

If statistical techniques are to be employed in collecting surface soil samples using a random grid, the procedure provided in Chapter 5 of Methods of Soil Analysis, Part I by C.A. Black et al, American Society of Agronomy, Academic Press, N.Y. 1965 and Section I of EPA-SW 846 Test Methods for Evaluating Solid Waste. Physical Chemical/Methods are suggested protocols.

Once the general locations have been chosen, sampling can begin. Normally a sample representing the top 3 to 6 inches of soil is taken. Samples are collected using a dedicated, precleaned stainless steel or Teflon spoon and immediately stored in the glass jar. Organic debris (ie.

leaves, twigs, bark) along with large pieces of gravel should be avoided. The sample should be representative of the area soil; it is best represented by the finer grains of the topsoil. The jars must be filled completely so as to avoid creating a head space where volatiles may escape. After each jar is filled the threads should be wiped clean so that the cap can be threaded on with out creating an air gap.

Latex or rubber gloves should be worn to protect the sampling person and to avoid cross contamination through handling.

All filled jars must be labelled with the following as a minimum:

- o project number
- o sampling time and date
- o sample number
- o analysis
- o collector's initials

The sample chain-of-custody form is then immediately filled out and kept with the sample. The sample is then stored in a refrigerated container until delivery to the analytical lab.

The location, depth of sample, sample type, time of sample, and other associated data (ie. organic vapor readings, color of the ground, odors, texture, etc.) will be documented in the field notebook when the sample is taken. If sampling is performed under a paved area or in fill, a description of these unique areas will also be included.

6.5 Sample Verification

After each sample of soil is taken, an indicator should be used to mark the location in the event it will be surveyed at a later time. Once all the surface soils are collected, the sample numbers and locations should be reviewed before leaving the site or progressing to other tasks in a program. All used sampling devices will be kept together, separate from clean tools, so that they can be cleaned according to appropriate decontamination and cleaning procedure. In no event will a used sampling device be used for two or more samples without full cleaning between samples.

ATLANTIC PROCEDURE NO. 1021

FIELD PROCEDURES FOR COLLECTION OF SUBSURFACE SOILS

Prepared By: John A. Ripp — Principal
JOHN A. RIPP — TITLE

Reviewed By: Edmund J. Burke — Q.A. Manager
EDMUND J. BURKE, P.E. — TITLE

Approved By: Paul Burgess — Chief Engineer
PAUL BURGESS, P.E. — TITLE

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SECTION 1.0: PURPOSE

To insure a standard procedure for collection of subsurface soil samples during site contamination studies for the determination of chemical parameters.

SECTION 2.0: SCOPE

The following procedure describes the method, materials and documentation requirements for collection of subsurface soils from test pits and split spoon samplers for eventual analysis by a chemical laboratory.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Operations Manager - Second

Field Staff - Third

SECTION 4.0: SUPPORTING PROCEDURES

Atlantic Procedure No. 1041 Sample Chain-of-Custody Procedure

SECTION 5.0: REQUIRED FORMS

Field Notebook No. 351, published by J.L. Darling Corp., Tacoma, Washington

SECTION 6.0: PROCEDURE

6.1 Introduction

During a site investigation where test pits, exploratory borings, monitoring wells, test trenches and other forms of excavation are performed it is often planned that soils or buried waste materials are to be collected. For most drilling operations split spoon samples are used to collect discrete samples from known depths using samplers ranging in length from 2 feet to 5 feet. Usually not all samples from these split spoons are designated for analysis, therefore the containerization and handling of samples from split spoons may be different depending on their ultimate purpose.

Samples from test pits and test trenches may also be collected for chemical analysis. These samples can only be taken using a remote sampler from the side walls of each pit. Samples taken from the bucket of the backhoe are harder to identify especially regarding their actual vertical position beneath the ground surface. Some state regulatory agencies may not even allow test pits to be used for collecting samples due to the fact that discrete sampling across a soil profile is more difficult.

The following is to be used as a general guide in collecting samples from either test pits or split spoons.

6.2 Split Spoon Sampling

After logging a split spoon sample following Atlantic Procedure No. 1030 the sample is then identified for either analysis by a laboratory or storage until further decisions are made. If the sample is to be stored, a clean glass jar, preferably new one liter size, will be used to store the sample. In many cases the driller will provide these to the field team. However in no case shall used or dirty soils jars be used to hold samples. If the driller does not have the proper jars, new clean "Mason type" jars may be used. A label must be affixed to these storage jars identifying the boring, depth, time of sample and project number on it for future reference. If soil samples are to be sent for analysis then only properly cleaned or laboratory supplied sample containers are to be used.

The collector must take the following steps when preparing the samples:

1. Always follow designated safety precautions in terms of level of protection. At a minimum samples must always be handled using latex or chemical resistant gloves. This protects the collector and prevents cross-contamination between samples.

2. Do not use the top one to two inches of recovered sample in the spilt spoon. This usually consists of washings and cave-in soils from higher in the boring that fell into the bottom of the augers.
3. Use a properly cleaned stainless steel spoon (tablespoon size) to remove the soils from the spilt spoon.
4. When possible, try to fill each sample container so that no air space is allowed. This will prevent volatiles from escaping. If a number of containers are to be used then evenly divide the sample between containers.
5. Avoid getting soils on the threads of the soils containers. Use a clean paper towel to wipe off the threads to insure a good seal.
6. Fill out the sample labels on each jar including the following:

   - sample number
   - sample depth
   - date and time of sample
   - analysis
   - preservation
   - initials of the sample collector

7. Fill in the chain-of-custody form (Atlantic Form No. 1041) for each sample. If a confining layer is to be sampled to determine whether contamination from a shallower zone is migrating down, care should be exercised in collecting these samples. In many instances groundwater will fill the auger and the spilt spoon will travel through the water before being pushed into a deeper zone, there is no guarantee that soils in the spilt spoon haven't been contaminated with standing water in the auger. To insure a "pure" sample, the drilling procedure may have to be modified to seal off the upper zone from the lower zone using casing and washing the interior of the casing clean. These operations must be detailed in the site sampling plan.

After each spilt spoon sample is collected Atlantic personnel will maintain custody and keep them refrigerated (when necessary) until shipment to the laboratory. The stainless steel sampling spoon is then properly cleaned before the next sample is taken.

6.3 Sampling Soils from Test Pits

As mentioned before, soils designated for analysis must be collected directly from the side walls of the test pits. A remote sampler is basically a stainless steel scoop that can swivel so that it can be pushed against the side wall and hold soils in a trap at its base. The scoop is attached to a light weight telescoping aluminum rod which will have a maximum 10 foot reach.

The depth of sample must be noted in the field notebook. The sample is then handled much the same as the split spoon samples following the same safety precautions. After the sample is taken, the remote sampling tool will be washed before obtaining the next sample.

ATLANTIC PROCEDURE NO. 1022

FIELD PROCEDURES FOR COLLECTION OF SURFACE WATER AND SEDIMENT SAMPLES FOR HAZARDOUS WASTE DETERMINATION

Prepared By: John A. Ripp — JOHN A. RIPP — Principal — TITLE

Reviewed By: Edmund J. Burke — EDMUND J. BURKE, P.E. — Q.A. Manager — TITLE

Approved By: Paul Burgess — PAUL BURGESS, P.E. — Chief Engineer — TITLE

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1.0 PURPOSE

To insure a standard procedure for collection of surface water (streams, ponds, lakes, impoundments) and sediments for the identification of chemical composition.

2.0 SCOPE

The following procedure describes the logistics, chain-of-events, collection techniques and documentation requirements for collecting surface water and sediment samples designated for chemical analysis.

3.0 RESPONSIBILITY

Project Manager - First

Field Supervisor - Second

Field Sampling Technicians - Third

4.0 SUPPORTING PROCEDURES

Atlantic Procedure No. 1060 Decontamination Procedure for Sampling Devices

Atlantic Procedure No. 1041 Sample Chain-of-Custody Procedure.

5.0 REQUIRED FORMS

Field Notebook No. 351, published by J.L. Darling Corp., Tacoma, Washington

6.0 PROCEDURE

6.1 Selection of Sampling Locations

The selection of sampling locations in and around an project site will be based on a review of existing site data, the site topography and surface features, results of preliminary site surveys using portable geophysical and air monitoring equipment and the initial estimates as to the extent of the waste. At the start of the investigation, a number of surface water and sediment samples are usually allocated. Only after initial field reconnaissance are the final locations selected. At a minimum the following should be included as sampling points.

- Upstream and upgradient of the waste site to determine background levels of pollutants.
- In leachate, runoff or intermittent flow paths passing through or from the site.
- In downgradient streams, swales, runoff channels or sewers draining the site to determine limits of surficial deposition.

6.2 Equipment List

The following lists are examples of equipment to be used for sampling. Site specific checklists of equipment should be designed based on the characteristics of each sample and location.

6.2.1 Surface Water Sampling

- o Boots, latex gloves, chemical resistant gloves, appropriate level of protection.
- o Sample containers (depending on sample requirements of the analytical laboratory) may include for each location:
  - 4 each 1 liter glass jars with teflon lined caps.
  - 8 each 40 ml. glass vials with teflon lined septas.
  - 1 each 500 ml. plastic containers for metals analysis.
  - 1 each 500 ml. plastic containers for mercury analysis.
- o Wooden stakes and spray paint.
- o Stainless steel Kemmerer bottle, Van Dorn bottle or sterile glass samplers (if required)
- o Remote samplers
- o Field Notebook
- o Sample bottle labels
- o Chain-of-custody forms

6.2.2 Sediment Sampling

- o Boots, latex gloves, chemical resistant gloves, appropriate level of protection.
- o Dedicated stainless steel spoons (tablespoon size)
- o Dedicated teflon spoons (if required)
- o Sample containers for each sample
  - 1 each 1 liter glass jars with teflon lined caps
- o Wooden stakes and spray paint.

- Field Notebook
- Sample bottle labels
- Chain-of-custody forms

6.3 Order of Samples

If both stream sediment and water samples are to be collected concurrently, the water samples should be taken first in order to avoid introducing pollutants in the water column from sediment collection activities.

In flowing streams or runoff channels samples should be collected from the furthest downstream point first. The remaining samples will be taken progressing upstream.

6.4 Sample Collection

6.4.1 Surface Water Samples

Surface water samples are collected in a manner to be representative of the water column from which the samples are taken. A two man team is required for the collection as a safety precaution. The person collecting the samples in most cases will have entered the water body. For flowing streams this will necessitate the donning of boots or waders and wearing latex inner gloves and chemical resistant outer gloves. All samples in flowing water bodies will be taken facing upstream. Samples taken from small lakes or ponds should be taken from a

small boat using a Kemmerer or teflon lined Van Dorn bottle. Samples taken from standing puddles, pools, drainage ditches should be taken without disturbing the sediments. This may be accomplished by the use of a remote sampler, e.g. a sample bottle held on along pole with a gimballed yoke.

For pre-preserved sample containers the following procedure will be followed:

- Prior to collecting any water samples place a waterproof sample label on each container which specifies the following:

  Sample number
  Date
  Time
  Analysis
  Preservative
  Project number
  Initials of the collector

  Fill in the information with a waterproof ink pen. This will prevent difficulty in filling out the labels on a wet jar after it is filled.
- Face upstream, wearing gloves, take a 1 liter glass container with no preservative and submerge it closed to mid-depth.
- Open the jar with the mouth facing upstream; fill it and; close it while submerged.
- Take the filled jar and use it to fill the 40 ml. vials making sure no air is trapped in the vials.

- Repeat steps 1 and 2 with the same container and fill those containers having preservative avoiding any overflow since this will dilute the preservative.
- Repeat steps 1 and 2 with the same container and fill the remaining sample containers. The last container filled, will be the original container used to fill the other jars.
- If dissolved metals analysis are required, an extra bottle (no preservative) will be filled and the metals container (pre-preserved with nitric acid) will remain empty. Only after the water sample is field filtered will it be poured into the pre-preserved metals container.
- Place all sample containers into a sample shipping container, cool with ice packs and fill in the chain-of-custody form.
- Detail in the field notebook the following:
  - sample identification number
  - location of the sample (sketch of the sample point)
  - time and date sample was taken
  - personnel performing the task
  - visual or sensory description of the sample (color, odor, turbidity, etc.)
  - weather conditions during sampling
  - runoff conditions
  - other pertinent observations

- o Place a wooden stake at the edge of the stream or near the sample point with sample number on it. The stake may be located by survey for inclusion on a site map.

Note:

- o It is understood that all sample containers and collection devices will be cleaned prior to field use following the appropriate cleaning procedures depending on the type of analysis to be performed.
- o If sampling devices are to be dedicated to a particular sample location, they will be placed in a plastic bag after its use and marked or tagged "DEDICATED TO PROJECT NO. _____ SAMPLE LOCATION NO. _____".

6.4.2 Sediment Samples

Stream sediment samples are collected in a manner to be representative of deposits of sediment carried off of a site. Again the use of protective boots, and gloves will be necessary. All priority pollutant and organic analysis of sediments can be performed on a 1 liter sample. The following procedure will be followed:

- o Select a sample location that is representative of sediment depositional areas. This might mean a sandbar in the middle of a stream, the inside corner of a stream bed in a meander, or a deep pool where water velocities are reduced.

- Place a waterproof sample label on the glass container which specifies the following:

  Sample number
  Date
  Time
  Preservative
  Project number
  Initials of the collector

  Fill in the information with a waterproof ink pen prior to collecting the sample.

- Use either a pre-cleaned dedicated stainless steel spoon or teflon coated spoon, that will fit inside the sample jar, to collect a sample.

- All samples should be taken within the top 3 inches of the stream bed. Remove any vegetation debris (leaves, roots, bark) along with any large stones from the sample so that only the finer soil material is collected.

- Fill out the chain-of-custody form and place the sediment sample into the shipping container. Cool as required.

- Detail in the field notebook the following:

  - sample identification number
  - location of the sample (sketch of the sample point)
  - time and date sample was taken
  - personnel performing the task

- visual or sensory description of the sample
- brief sediment descriptions (color, texture, appearance)
- weather conditions during sampling
- runoff or flow conditions
- other pertinent observations

o Place a wooden stake at the edge of the stream or near the sample point with the sample number on it. This stake will be located by survey for inclusing on a site map.

6.4.3 General Site Rules

Surface water and sediment samples, depending on the particular site, can be collected from a variety of locations. Instead of having a procedure for each type of location, the following general rules should be used for any site.

o The sample must be representative of the water body or sediments deposited in an area.

o Avoidance of cross contamination between sampling points can be accomplished by the use of dedicated sampling devices.

o Care must be taken to not disturb the sample location conditions or chemistry, e.g. facing upstream in a river, collecting sediments from areas not stepped on by the collectors.

- In lakes or ponds, samples of the water column, at a minimum, will be a composite of surface, mid-depth and bottom (1 foot above floor) samples. Sediments need only be sampled by grab method.
- Only pre-cleaned sampling devices and sample containers are to be used.
- Proper field documentation and chain-of-custody procedures must be followed.

ATLANTIC PROCEDURE NO. 1023

FIELD PROCEDURES FOR COLLECTION OF GROUND WATER SAMPLES FOR HAZARDOUS WASTE DETERMINATION

Prepared By: John A. Ripp — JOHN A. RIPP — Principal — TITLE

Reviewed By: Edmund J. Burke — EDMUND J. BURKE, P.E. — Q.A. Manager — TITLE

Approved By: Paul Burgess — PAUL BURGESS, P.E. — Chief Engineer — TITLE

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SECTION 1.0: PURPOSE

To insure a standard procedure for collection of ground water samples for the identification of chemical constituents.

SECTION 2.0: SCOPE

The following procedure describes the logistics, chain of events, collection techniques and documentation requirements for collecting ground water samples designated for chemical analysis.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Supervisor - Second

Field Sampling Technicians - Third

SECTION 4.0: SUPPORTING PROCEDURES

Atlantic Procedure No. 1041 Sample Chain-of-Custody Procedure.

SECTION 5.0: REQUIRED FORMS

Field Notebook No. 351 published by J.L. Darling Corp., Tacoma, Washington

SECTION 6.0: PROCEDURE

6.1 Selection of Sampling Locations

Ground water sampling locations in and around a project site are typically obtained from existing domestic, production and monitoring wells, and newly installed ground water monitoring wells which were part of the site hydro-geological investigation. The location of new ground water monitoring wells will be based upon the review of existing site hydrogeological data, the results of preliminary site surveys, and the initial estimates of the extent of the waste. The ground water sampling locations will be chosen by the project manager. At a minimum one upgradient and three downgradient water samples from the uppermost aquifer will be taken.

6.2 Equipment List

The following is to be considered a guide for groundwater sampling preparation.

1. Latex gloves, and any other personal safety equipment specified in the site health and safety plan.

2. Sample containers (depending on sample requirements of the analytical laboratory) may include for each location:

   - 4 each 1 liter glass jars with Teflon lined caps
   - 8 each 40 ml. glass vials with Teflon lined septas
   - 1 each 500 ml. plastic containers for metals analysis
   - 1 each 500 ml. plastic containers for mercury analysis

3. Device to measure water levels in wells to within .01 feet. Typically a cloth tape with a "plopper" or an electronic water level indicator is used.

4. Field Notebook No. 351

5. Sample bottle labels

6. Chain-of-custody forms

7. A large volume bailer or pump to evacuate the wells.

8. Dedicated Teflon bailer with stainless steel cable, or a peristaltic pump with dedicated Teflon tubing.

6.3 Sample Collection

Prior to the extraction of any ground water, the depth to water shall be measured to the nearest .01 feet. A cloth tape with a "plopper", or an electronic water sensing device (i.e. Slope Indicator Water Mark) shall be used for this purpose. The device used must be clean to avoid contamination of the well. The depth to water is typically measured from a reference point established on the top of the well casing. This value is recorded in the field notebook along with the length of casing stick-up above the ground surface. If both an inner and outer casing are present, the one used as the measurement reference point shall be identified (normally the inner), and any distance between the two, measured and recorded. If the depth of the well is unknown the bottom shall be sounded and the depth recorded.

Ground water samples are to be collected in a manner to be representative of the formation from which the samples were taken. To insure against sampling stagnant water in a well, a minimum of four well volumes must be evacuated from the well prior to sampling. In the case of monitoring wells that will not yield water at a rate adequate to be effectively flushed, one of the two procedures must be followed. The first procedure includes purging water to the top of the screened interval at a sufficiently slow rate to prevent the exposure of the gravel pack or formation to atmospheric conditions. The sample is then taken at a rate that would not cause rapid drawdown. The second procedure would be to pump the well dry and allowed it to recover. The samples should be collected as soon as a volume of water sufficient for the intended analytical scheme reenters the well. Exposure of water entering the well for periods longer than 2 to 3 hours may render samples unsuitable and unrepresentative of water contained within the aquifer system. In these cases, it may be desirable to collect small volumes of water over a period of time, each time pumping the well dry and allowing it to recover. Whenever full recovery exceeds 3 hours, samples should be collected in order of their volatility as soon as sufficient volume is available for a sample for each analytical parameter or compatible set of parameters. Parameters that are not pH-sensitive or subject to loss through volatilization should be collected last.

Evacuation is accomplished by bailing with a large volume (1.5 liter) bailer, or by pumping. Whichever method is used, it must be assured that any materials (hose, bailer, tubing, pumps, rope, etc.) entering the well must be clean. If the same device is being used to evacuate a number of wells, the device must be cleaned with the appropriate cleaners between each well to prevent cross-contamination.

For pre-preserved sample containers the following procedure will be followed:

1. Prior to collecting any water samples, place a waterproof sample label on each container which specifies the following:

   Sample Number
   Date
   Time
   Preservative
   Project Number
   Initials of the Collector

   Fill in the information with a waterproof ink pen. This will prevent difficulty in filling out labels on a wet jar after it is filled.

2. Extract the ground water sample using either a dedicated Teflon bailer or a peristaltic pump with dedicated Teflon tubing. Latex gloves shall be worn during this procedure.

3. When using the peristaltic pump or bailer first fill the 40 ml. vials making sure no air is trapped in the vials. This sample is normally taken for volatile analysis and therefore should be sampled prior to further disturbance of water in the well.
4. Fill all the remaining jars directly from the pump discharge or bailer. With the containers containing preservative, avoid overflow since this will dilute the preservative.
5. If dissolved metals analysis are required an extra bottle (no preservative) will be filled and the metals container (pre-preserved with nitric acid) will remain empty. Only after the water sample is field filtered will it be poured into the pre-preserved metals container. This will constitute a sample for dissolved metals.
6. Place all sample containers into a sample shipping container, cool with ice packs and fill out the chain-of-custody form.
7. Detail in the field notebook the following:

- sample identification number
- location of the sample
- time and date of sampling
- personnel performing task
- depth to water table, reference mark, casing(s) stick-up, and horizontal distance between inner and outer casing
- Amount evacuated from well and device used for evacuation
- Visual or sensory description of the sample (color, odor, turbidity, etc.)
- Weather conditions both present and previous to sampling
- Other pertinent observations

8. Make sure the well is secured after sampling.

Note:

1. It is understood that all sample containers and collection devices will be cleaned prior to field use following the appropriate cleaning procedures.
2. If sampling devices are to be dedicated to a particular sample location, they will be placed in a plastic bag after its use and marked or tagged

"DEDICATED TO PROJECT NO. _____

SAMPLE LOCATION NO. _____

ATLANTIC PROCEDURE NO. 1030

FIELD PROCEDURE FOR LOGGING SUB-SURFACE CONDITIONS DURING TEST BORINGS AND WELL LOGGING

Prepared By: John A. Ripp — JOHN A. RIPP — PRINCIPAL (TITLE)

Reviewed By: Edmund J. Burke — EDMUND J. BURKE, P.E. — QA MANAGER (TITLE)

Approved By: Paul Burgess — PAUL BURGESS, P.E. — CHIEF ENGINEER (TITLE)

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SECTION 1.0: PURPOSE

To insure a standard procedure for the documentation of sub-surface conditions encountered during test borings and well drilling.

SECTION 2.0: SCOPE

The following procedure details a method for recording sub-surface conditions in test borings and well drill holes during site contamination, hydrogeological, and geotechnical investigations. An optional procedure for photographing samples is included.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Supervising Field Geologist/Engineer - Second

SECTION 4.0: SUPPORTING PROCEDURES

ASTM Designation D 1586 - Standard method for Penetration Test and Split-Barrel Sampling of Soils.

ASTM Designation D 2488 - Standard practice for Description and Identification of Soils (Visual-Manual Procedure)

SECTION 5.0: REQUIRED FORMS

Field Notebook No. 351 (published by J.L. Darling Corp., Tacoma, Wash.)

Atlantic Boring Log Form

SECTION 6.0: PROCEDURE

6.1 Predrilling Requirements

When conducting borings at any location, local or on-site buried utilities must be cleared through the appropriate engineering departments of each utility serving the area. At least a 48 hour notification shall be made to the utilities prior to drilling. The ticket number or call number given by the utility must be logged in the field notebook. This will protect the drilling supervisor from any liability associated with damaging a public utility.

The supervising geologist/engineer shall record the name of the drilling firm and the names of the driller and his assistant. The date, project location, project number, and weather conditions shall also be recorded.

An accurate time log of drilling activities shall be kept. This log shall be kept in the field notebook and shall include, at least the following:

- o Time driller and rig on-site
- o Time drilling begins
- o Any delays in the drilling activities, and the cause of such delays.
- o Time drillers leave the site.

6.2 Test Borings and Well Drilling Subsurface Sampling Methods

Test borings and monitoring well drilling can be conducted by a variety of drilling methods. The drilling method is not as critical to the documentation of the subsurface conditions as the soil and rock sampling techniques. However, the drilling method and type of drill rig shall be documented.

Where details of subsurface conditions are necessary, soil sampling shall be conducted using a split spoon penetration sampler driven with a 140 pound hammer at a height of 30 inches. The standard method of soil sampling as described in ASTM Designation D 1586 shall be used as a guide.

The supervising geologist/engineer shall record, at a minimum, the weight of the hammer, the length of the split spoon sampler, and the number of hammer blows on the spoon per 6 inches of penetration. Upon removal of the sampler the earth materials shall be logged in accordance with Section 6.3 of this document.

Rock sampling will be conducted using a double barrel core sampler. The supervising geologist/engineer shall record the length of the core barrel, the diameter of the barrel, the rate of penetration, and the down pressure torque and rotation of the sampler.

6.3 Logging of Unconsolidated Deposits

Vertical measurements in a boring shall be made from the original ground surface. Split spoon samples are typically taken in 2-foot intervals, or at changes in lithology through unconsolidated materials. The supervising geologist/engineer shall monitor drill cuttings and maintain communication with the driller (Re: down pressures, drilling rates, resistance, etc.) to determine where changes in lithology occur.

During the sampling, the hammer blows per 6 inches of sampler penetration, and the depth of the sample was taken shall be recorded. Blow counts over 50 per 6 inches of penetration shall constitute sampler refusal. Upon extraction of the sampler moisture conditions on the drill rods shall be noted. Upon opening the sampler the percent recovery shall be recorded as the length of sample retained over the length of sampler penetration. Changes in lithology, color, or moisture conditions in the spoon are measured and recorded prior to emptying the spoon. If the sample is to be retained, a sample number is assigned and recorded in the field log and on the sample container. The sample container will also include the project name, boring number, location, depth, date, and person collecting the sample.

The supervising geologist/engineer will log the soil sample in the field notebook. The soil description shall include, at a minimum, the following information:

o Color

o Mineral or rock content

o Grain size, in order from most predominant to least predominate using the proportions;

- Trace = 0 to 10%
- Little = 10 to 20%
- Some = 20 to 35%
- And = 35 to 50%

o Density, descriptions based upon blow counts as follows:

- Cohesionless Soils (primarily sand and gravel)

0 - 10 blows = Loose
10 - 30 blows = Medium Compact
30 - 50 blows = Dense
50 plus blows = Very Dense

- Cohesive Soils (primarily silt and clay)

0 - 2 blows = Very soft
2 - 4 blows = Soft
4 - 8 blows = Medium
8 - 15 blows = Stiff
15 - 30 blows - Very stiff
30 plus blows = Hard

o Moisture Content

o Structure

o Other (mottling, odor, instrument readings, etc.)

A sample soil log is shown in Figure 6-1.

When the technical specifications of a soil sampling program require soil descriptions to conform to the "Unified Soils Classification" the soils shall also be classified according to ASTM Standard Designation D 2488. Figure 6-2 shows this classification.

6.4 Logging Bedrock Cores

The supervising geologist/engineer on a drilling program is responsible for logging and recording geologic and geotechnical information from rock cores. The following information shall be included in a rock core run log:

- The depth and length of the core run.
- The coring rate, down pressure, torque and rotation speed. This information can be obtained from the driller.
- The color of the core wash water. Any changes or loss of return water will be noted.
- The recovery of the core run recorded as length of rock recovered over the length of the core run.
- The Rock Quality Designation (RQD) of the run. RQD is reported as the sum of inches of all rock core pieces larger than four inches over the total number of inches in the run.
- The rock type(s) and their location in the core run, rotating color, minerology, texture, fossil content, effervescence in HCL and any other data of geologic significance.
- Any structure in the core, including fractures, clay seams, vuggs, bedding, fissility and any other data of geologic or geotechnical significance.

Tuesday 2/14/84
General Power Corp, 1243-01-01
Middletown, U.S.A. Power
Weather: Cold (~35°F) light rain
ATLANTIC Personnel on-site 0700
T. Brooks & J. Ryan
Drillers (Conn Borings) on-site 0650
Joe Smith and Bob Jones

Boring B-1 -
20' so. of pumphouse started 0730
using Mobile B-61
and 6 3/4" ID H.S.A.

Sample B-1-A 0-2'
Blows: 1, 1, 2, 7
Recovery: 1'9" / 2'
0-6" Dark br. top soil and roots
6-12" Light br. fine-med. sand with some silt, little organic loam very loose, dry, slight rust mottles at 1' 10"
OVA - < 1 ppm benzene

Figure 6-1
Example Boring Log

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

* Based on the material passing the 3-in. (75-mm) sieve.

Figure 6-2
Unified Soils Classification

Rock cores shall be stored in a core box in the exact sequence it was removed from the ground. Core runs will be separated by wooden blocks clearly marked with the depth of the run. The core box shall be marked with the project name, location, project number, boring number, data and the depths of the core runs in that box.

6.5 Photographing Rock and Soil Samples from Borings

Soil samples should be photographed while still in the split spoon sampler. If smearing of the sample has occurred a fresh exposure can be made by scrapping with a pen knife or other similar object. The spoon and sample should be placed in a good light preferable against a solid colored background. A ruler for scale, and a tag identifying the sample number, depth and project name or number written so as to be legible in the photograph. Any photographs taken must be recorded in the field notebook.

Rock core samples are photographed in the wooden core box. The rock should be wetted to enhance the color and textual changes in the rock. Due to the relatively large size of most core boxes it is the photographer (when possible) should stand up on a chair, tail gate, car bumper or other perch in order to photograph the box from directly above, and get the entire box in the camera's field view. Somewhere in the photograph must be an identifier tag indicating the project name or number, the boring number, the date, and the depths of the various core runs.

ATLANTIC PROCEDURE NO. 1040

SAMPLE PRESERVATION FOR SOLID AND LIQUID MATRICES

Prepared By: John A. Ripp — JOHN A. RIPP — Principal — TITLE

Reviewed By: Edmund J. Burke — EDMUND J. BURKE, P.E. — QA. Manager — TITLE

Approved By: Paul Burgess — PAUL BURGESS, P.E. — Chief Engineer — TITLE

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SECTION 1.0: PURPOSE

To insure a standard procedure for preservation of solid and liquid samples collected at a site for hazardous waste determination.

SECTION 2.0: SCOPE

The following procedure is established to provide a set of standards which follow recommended EPA preservation techniques and holding times for various analytical groups.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Operations Manager - Second

Field Staff - Third

SECTION 4.0: SUPPORTING PROCEDURES

Atlantic Procedure No. 1020 Field Procedures for Collection of Surface Soil Samples

Atlantic Procedure No. 1021 Field Procedures for Collection of Subsurface Soils

Atlantic Procedure No. 1022 Field Procedures for Collection of Surface Water and Sediment Samples for Hazardous Waste Determination

Atlantic Procedure No. 1023 Field Procedures for Collection of Groundwater Samples for Hazardous Waste Determination

Atlantic Procedure No. 1042 Shipping Procedure for Environmental Field Samples

SECTION 5.0: REQUIRED FORMS

1. Field Notebook No. 351. Published by the J.L. Darling Corp., Tacoma, Washington
2. Master Sample Log

SECTION 6.0: PROCEDURE

6.1 General Procedure

All sample preservations will be performed in the field as soon after sample collection as possible. In many instances sample containers supplied by the analytical laboratory will be pre-preserved so that no additional preservations will be required. In the event preservations are required, Atlantic personnel will use the following format:

1. For those water samples requiring priority pollutant analysis (i.e., the list of 128 compounds on EPA's list). The procedures in Table 6-1 will be followed.

2. All glass or plastic containers must be cleaned prior to sampling according to appropriate cleaning procedures. In no case will sample containers be rinsed with a sample before the actual sample is containerized.

3. In no case shall methylene chloride be used as a cleaning agent in any glassware or field equipment used on a site investigation. Methylene chloride is a listed waste and if used, cleaning may cause errors in evaluating field data.

4. All soils samples collected for priority pollutant analysis will be placed in a one liter glass jar with teflon lined cap. This jar also must be cleaned prior to sampling according to appropriate cleaning procedure. To avoid losing volatile organics to the head space within a jar, all soil jars will be filled completely. Care must taken to avoid getting soil on the threads of a sample jar. This can cause a faulty seal.

5. All samples will be held in insulated shipping containers and kept cool to a temperature of $4^{o}C$ until they are delivered to the analytical laboratory.

6. When samples are preserved in the field, the type of preservation will be listed on the label along with all other appropriate label information. Also the details of each sample will be logged in the Master Sample Log, maintained at the field office.

7. If Atlantic personnel plan to perform field preservations the analytical laboratory must be consulted to verify those particular procedures to be followed. In some instances different laboratories may require more sample volume those listed or wish no preservative be used.

8. Tables 6-1, 6-2 and 6-3 are provided as a general guidelines for preserving primarily water samples. Soils rarely require preservation and the laboratory should always be consulted before collecting soil samples. These tables are referenced to their EPA source. Occasionally EPA may update the holding times and this can be found by calling the EPA Quality Assurance Director for the region where sampling is to take place.

9. All field preservations should be performed using proper safety precautions especially when handling acids and caustics. A reference for proper chemical handling techniques is found in Basic Laboratory Skills for Water and Wastewater Analysis by Douglas W. Clark, New Mexico Water Resources Research Institute, Report No. 125, 1980. Also latex or chemical resistant gloves should be worn during all field preservations. Proper ventilation is necessary when performing preservations in enclosed areas.

6.2 Sample Preservation for Priority Pollutant Analysis

Table 6-1 provides a schedule for sampling, preservation, and holding times for samples being analyzed for complete priority pollutant determination. Here the organic analysis is performed using GC-MS. For large field programs it should be noted that cyanide and phenol have short holding times, therefore speed is essential when shipping samples to the laboratory.

TABLE 6-1

FIELD SAMPLING, PRESERVATION AND HOLDING TIME
FOR PRIORITY POLLUTANT ANALYSIS

Parameter	Sample Volume	Container	Preservation	Holding Time
Method 625 Base Neutrals Acid Extractables Pesticides and PCBs[1]	4 Liters	Clean glass bottle with teflon lined cap	Cool to 4°C	3 days
Method 624 Volatile Organics	2 each 40 ml[2]	Clear glass vials with teflon line septas	Cool to 4°C	14 days
Method 608 Organochlorine esticides and PCBs	Contained in the Method 625 sample containers			3 days
Flameless AAS Technique Metals	500 ml	plastic	HNO3 to pH <2	6 months
Cold Vapor Technique Mercury	500 ml	plastic	Potassium dichromate and HNO3	13 days
Method 335.3 Cyanide	40 ml	glass vial with teflon lined septa	10N NaOH to pH > 12	24 hours
Method 420.2 Phenol	40 ml	glass vial with teflon lined septa	Cool, 4°C H3 PO4 to pH<4 1.0g Cu SO4/l	24 hours
Total Organic Halogens	100 ml	glass	Cool 4°C	28 days
Total Organic Carbon	25 ml	plastic	H2SO4 or HCl to pH < 2	24 hours

1. For soil, sediment and surface water samples.
2. Fill each vial so that no air bubbles are trapped.

6.3 Sample Preservations for Organic Analysis Using GC

Samples collected for organics analysis using gas chromatography are usually handled differently from samples analyzed by GC/MS techniques. Note in this section holding times to the start of sample extraction are given in some cases and not for the start of analysis. The field personnel are only responsible for getting samples to the laboratory within the holding time for extraction.

If one sample is being analyzed for more than one group of parameters, then the sample containers within the one sample can be grouped according to preservation. For instance a water sample taken for Methods 8010 and 8020 analysis can be collected in one set of 40 ml. vials instead of one set for each method. Again the field personnel should consult with the laboratory regarding the final procedure prior to the start of sampling.

TABLE 6-2

FIELD SAMPLING, PRESERVATION AND HOLDING TIMES
FOR SAMPLES ACCORDING TO ANALYSIS FOR GC
METHODS FOR ORGANICS[1]

Parameter	Sample Volume	Container	Preservation	Holding Time
Method 8010 Halogenated Volatile Organics "solid or liquid"	2 each 40 ml	clear glass vials with teflon lined septas	Cool to 4°C[2]	14 days
Method 8015 Non halogenated Volatile Organics "solid or liquid"	2 each 40 ml	clear glass vials with teflon lined septas	Cool to 4°C[2]	14 days
Method 8020 - Aromatic Volatile Organics "solid or liquid"	2 each 40 ml	clear glass vials with teflon lined septas	Cool to 4°C[2]	14 days
Method 8030 - Acrolein Acrylonitrile Acetonitrile "solid or liquid"	2 each 40 ml	clear glass vials with teflon lined septas	Cool to 4°C[2]	14 days
Method 8040 - Phenols "solid or liquid"	1 each 500 ml	amber glass jar	Cool to 4°C	7 days
Method 8060 - Phthalate Esters "solid or liquid"	1 each 500 ml	glass jar	Cool to 4°C - - - Sodium Hydroxide - to pH of 6.0-8.0	48 hours (extract) 7 days

TABLE 6-2 CONT'D

Method 8080 - Organochlorine Pesticides and PCB's "solid or liquid"	1 each 500 ml	glass jar	Cool to $4^{o}C$ - - - 48 hours (extract) Sodium Hydroxide - 7 days to pH of 6.0-8.0	
Method 8090 - Nitroaromatics and Cyclic Ketones "solid or liquid"	1 each 500 ml	glass jar	Cool to $4^{o}C$ - - - 48 hours (extract) Sodium Hydroxide - 7 days to pH of 6.0-8.0	
Method 8100 - Polynuclear Aromatic Hydrocarbons "solid or liquid"	1 each 500 ml	glass jar	Cool to $4^{o}C$ - - - 48 hours (extract) Sodium Hydroxide - 7 days to pH of 6.0-8.0	
Method 8120 - Chlorinated Hydrocarbons "solid or liquid"	1 each 500 ml	glass jar	Cool to $4^{o}C$ - - - 48 hours (extract) Sodium Hydroxide - 7 days to pH of 6.0-8.0	
Method 8140 - Organophosphorus Pesticides "solid or liquid"	1 each 500 ml	glass jar	Cool to $4^{o}C$ - - - 48 hours (extract) Sodium Hydroxide - 7 days to pH of 6.0-8.0	
Method 8150 - Chlorinated Herbicides solid or liquid"	1 each 500 ml	clear glass jar	Cool to $4^{o}C$	7 days

1. Taken from Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, USEPA, April 1984.

2. If free chlorine is suspected in the sample matrix, the preservation method is different. Please refer to the written EPA procedure.

6.4 Sample Preservations for Conventional Pollutants

Water and wastewater samples collected for conventional parameters are listed in Table 6-3 taken from EPA Test Methods "Technical Additions to Methods for Chemical Analysis of Water and Wastes", EPA-600 14-82-055 December, 1982.

TABLE 6-3

Measurement	Vol. Req. (mL)	Container[2]	Preservative[3,4]	Holding Time[5]
100 Physical Properties				
Color	50	P,G	Cool, 4°C	48 Hrs.
Conductance	100	P,G	Cool, 4°C	28 Days
Hardness	100	P,G	HNO_3 to pH<2	6 Mos.
Odor	200	G only	Cool, 4°C	24 Hrs.
pH	25	P,G	None Req.	Analyze Immediately
Residue				
Filterable	100	P,G	Cool, 4°C	7 Days
Non-Filterable	100	P,G	Cool, 4°C	7 Days
Total	100	P,G	Cool, 4°C	7 Days
Volatile	100	P,G	Cool, 4°C	7 Days
Settleable Matter	1000	P,G	Cool, 4°C	48 Hrs.
Temperature	1000	P,G	None Req.	Analyze Immediately
Turbidity	100	P,G	Cool, 4°C	48 Hrs.
200 Metals				
Dissolved	200	P,G	Filter on site HNO_3 to pH <2	6 Mos.[8]
Suspended	200		Filter on site	6 Mos.
Total	100	P,G	HNO_3 to pH <2	6 Mos.
Chromium[+6]	200	P,G	Cool, 4°C	24 Hrs.
Mercury				
Dissolved	100	P,G	Filter HNO_3 to pH <2	28 Days
Total	100	P,G	HNO_3 to pH <2	28 Days
300 Inorganics, Non-Metallics				
Acidity	100	P,G	Cool, 4°C	14 Days
Alkalinity	100	P,G	Cool, 4°C	14 Days
Bromide	100	P,G	None Req.	28 Days
Chloride	50	P,G	None Req.	28 Days
Chlorine	200	P,G	None Req.	Analyze Immediately
Cyanides	500	P,G	Cool, 4°C NaOH to pH >12 0.6g ascorbic acid[6]	14 Days[7]
Fluoride	300	P,G	None Req.	28 Days
Iodide	100	P,G	Cool, 4°C	24 Hrs.
Nitrogen				
Ammonia	400	P,G	Cool, 4°C / H_2SO_4 to pH <2	28 Days
Kjeldahl, Total	500	P,G	Cool, 4°C H_2SO_4 to pH <2	28 Days
Nitrate plus Nitrite	100	P,G	Cool, 4°C H_2SO_4 to pH <2	28 Days
Nitrate[9]	100	P,G	Cool, 4°C	48 Hrs.
Nitrite	50	P,G	Cool, 4°C	48 Hrs.
Dissolved Oxygen				
Probe	300	G bottle and top	None Req.	Analyze Immediately
Winkler	300	G bottle and top	Fix on site and store in dark	8 Hours
Phosphorus				
Ortho-phosphate, Dissolved	50	P,G	Filter on site Cool, 4°C	48 Hrs.
Hydrolyzable	50	P,G	Cool, 4°C H_2SO_4 to pH <2	28 Days
Total	50	P,G	Cool, 4°C	28 Days

TABLE 6-3 CON'T

			H_2SO_4 to pH <2	-
Total, Dissolved	50	P,G	Filter on site Cool, 4°C	24 Hrs.
			H_2SO_4 to pH <2	
Silica	50	P only	Cool, 4°C	28 Days
Sulfate	50	P,G	Cool, 4°C	28 Days
Sulfide	500	P,G	Cool, 4°C add 2 mL zinc acetate plus NaOH to pH >9	7 Days
Sulfite	50	P,G	None Req.	Analyze Immediately
400 Organics				
BOD	1000	P,G	Cool, 4°C	48 Hrs.
COD	50	P,G	Cool, 4°C H_2SO_4 tp pH <2	28 Days
Oil & Grease	1000	G only	Cool, 4°C H_2SO_4 to pH <2	28 Days
Organic carbon	25	P,G	Cool, 4°C HCl or H_2SO_4 to pH <2	28 Days
Phenolics	500	G only	Cool, 4°C H_2SO_4 to pH <2	28 Days
MBAS	250	P,G	Cool, 4°C	48 Hrs.
NTA	50	P,G	Cool, 4°C	24 Hrs.

[1] More specific instructions for preservation and sampling are found with each procedure as detailed in this manual. A general discussion on sampling water and industrial wastewater may be found in ASTM, Part 31, p. 72-82 (1976) Method D-3370.

[2] Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.

[3] Sample preservation should be performed immediately upon sample collection. For composite samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4°C until compositing and sample splitting are completed.

[4] When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table 1, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

[5] Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time, and has received a variance from the Regional Administrator. Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.

[6] Should only be used in the presence of residual chlorine.

[7] Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before the pH adjustment in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

[8] Samples should be filtered immediately on-site adding preservative for dissolved metals.

[9] For samples from non-chlorinated drinking water suplies conc. H_2SO_4 should be added to lower sample pH to less than 2. The sample should be analyzed before 14 days.

ATLANTIC PROCEDURE NO. 1041

SAMPLE CHAIN-OF-CUSTODY PROCEDURE

Prepared By: John A. Ripp — JOHN A. RIPP — Principal — TITLE

Reviewed By: Edmund J. Burke — EDMUND J. BURKE, P.E. — Q.A. Manager — TITLE

Approved By: Paul Burgess — PAUL BURGESS, P.E. — Chief Engineer — TITLE

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ATLANTIC ENVIRONMENTAL SERVICES, INC.
COLCHESTER, CONNECTICUT

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SECTION 1.0: PURPOSE

To provide the project manager with a record of the custody of any environmental field sample from time of collection to final analysis. Once a sample has been submitted to the laboratory, internal laboratory chain-of-custody will take over in the form of "Request for Analysis" forms, analytical notebooks, and "Reports of Analysis" forms.

SECTION 2.0: SCOPE

This procedure details how a sample is traced through the Chain-of-Custody-Form.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Supervisor - Second

Field Technician - Third

SECTION 4.0: SUPPORTING PROCEDURES

None

SECTION 5.0: REQUIRED FORMS

Atlantic Chain-of-Custody Form No. 1041

SECTION 6.0: PROCEDURE

This procedure describes the use of a Chain-of-Custody Form to accompany all sample containers from the time of collection to submission to the analytical laboratory.

For sampling programs where a large number of samples are to collected or where various laboratories will be receiving the samples, a Chain-of-Custody Form is to accompany each group of samples (see attached form). This form presents general sample information in tabular form listing sample number, date and time of sampling, whether the sample was a composite or grab and information regarding the number of containers, size of container and preservative used for each. If for instance a sample consisted of two 40 ml. vials with no preservation and one 500 ml vial preserved with nitric acid, the number of containers box would designate three while the first diagonal box would list 40 ml vial/PRSV.-NONE and the box beneath listing two and the second diagonal box listing 500 ml glass jar/PRSV.-HNO2 and the box beneath listing one.

The bottom of the form is the chain-of-custody with dates and times of transfer indicated with the appropriate signatures. The sample collector is always the first signature while the analytical laboratory is the final. Theoretically all individuals handling the samples between collection and laboratory should sign the form. However if a common carrier (ie. Federal Express, Purolator) are used for shipping only one signature is required.

This form can be used as a legal document to guarantee samples were not mishandled and that they were delivered to the laboratory within the time frame necessary to start analysis.

On occasion, the analytical laboratory will provide their own Chain-of-Custody form. Usually the same information is included but in a different format from the Atlantic form. Chain-of-Custody forms from the analytical laboratories are acceptable documentation.

Since these forms are basically sample transmittal documents a copy of the form should remain with the sampling personnel. Upon completion of the analysis the laboratory will provide a complete set of all Chain-of-Custody forms for inclusion with analytical reports.

A ANTIC
ENVIRONMENTAL SERVICES, INC.

CHAIN O. CUSTODY FORM

FORM NO. 10

PROJECT NO.:	PROJECT NAME:				NO. OF CON-TAINERS	PRSV.	PRSV.	PRSV.	PRSV.	PRSV.	PRSV.	REMARKS
SAMPLERS (SIGNATURE):												
SAMPLE NO.*	DATE	TIME	COMP	GRAB								

*SOURCE CODES: Test Pit Soil...(TP) Boring Hole Soil...(BH) Surface Soil...(SS) Waste...(W) Ground Water...(GW) Surface Water...(SW) Sediment...(SD) Waste Water...(WW)

RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE/TIME:	REMARKS:	

Distribution: Original accompanies shipment; copy to coordinator field files.

ATLANTIC PROCEDURE NO. 1042

SHIPPING PROCEDURES FOR ENVIRONMENTAL FIELD SAMPLES

Prepared By: John A. Ripp — Principal
JOHN A. RIPP — TITLE

Reviewed By: Edmund J. Burke — Q.A. Manager
EDMUND J. BURKE, P.E. — TITLE

Approved By: Paul Burgess — Chief Engineer
PAUL BURGESS, P.E. — TITLE

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SECTION 1.0: PURPOSE

To insure a standard procedure for shipment of water, soil and other environmental samples that are controlled by chain-of-custody and strict analytical starting times.

SECTION 2.0: SCOPE

The following procedure is established to avoid mishandling, delays and mislabeling of samples normally collected and shipped from a field site to a designated analytical laboratory.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Supervisor - Second

Field Technicians - Third

SECTION 4.0: SUPPORTING PROCEDURES

Atlantic Procedure No. 1040 Sample Preservation for Solid and Liquid Matrices

Atlantic Procedure No. 1041 Sample Chain-Of-Custody Procedure

SECTION 5.0: REQUIRED FORMS

Receipt of Airweigh Bill or Weighbill Forms

Chain-of-Custody Form Standard Form No. 1041

SECTION 6.0: PROCEDURE

6.1 Prior to mobilization to a field site, the field operations manager or his designee will select a shipper based on proximity to the site and ability to ship overnight.

6.2 Upon selection of a shipper the following information will be gathered before any samples are shipped. This can be done over the phone or by correspondence.

1. Location of the shipping depot or local pickup office in case samples are to be delivered directly to the depot by the field team.
2. Name and phone number of a contact at the shipper.
3. Rates of shipping per package size and weight
4. Special instructions as to container sizes and weights.
5. A set of weighbills for the field team.
6. A copy of the shipper's brochure which will provide information on the format for the various types of weigh bills.
7. Times for calling in a pickup from the job site and normal pickup times.

6.3 The Atlantic field manager will give the shipper a street address where samples can be picked up by the courier near the job site.

6.4 Once all samples have been collected, preserved and containerized for shipment, the field supervisor will call the shipper to arrange for pick up.

6.5 All samples, unless so designated for ground transportation, will be shipped by air express for overnight delivery. This is the standard method since samples collected for Method 625 organics have only a 72-hour holding time between collection and the start of analysis.

6.6 The following steps will be followed in the field to prepare the sample shipping containers for pick up.

1. A standard chain-of-custody form will be filled-out, signed by the courier as a custodian, and placed inside each shipping container before final sealing.
2. The Atlantic field supervisor or his designee will insure that all weighbills have been filled-in properly for air express. If the contract laboratory is within ground transportation distance for overnight delivery, then the weighbills should reflect guaranteed overnight delivery.
3. A copy of all weighbills must be kept by the field supervisor and the weighbill number associated with each group of samples logged into the Master Sample Log. The name of courier must be written in this log also in case there is a problem in tracing samples.
4. If possible, to save shipping fees, the sample shipping containers can be strapped together.

5. An estimated time of delivery for the samples will be logged in the Master Sample Log, (e.g., ETA 12 noon 3/14/83).

6.7 Once the samples have been shipped, the field supervisor will call the analytical laboratory and provide a listing of samples to be delivered, the shipping company's name, and the weighbill numbers. As soon as the samples are delivered, the contract laboratory will inform Atlantic of their arrival and report, any damage associated with the samples or whether any sample containers are missing.

ATLANTIC PROCEDURE NO. 1051

OPERATION AND CALIBRATION OF THE HNu SYSTEMS PHOTOIONIZER MODEL PI-101

Prepared By: John A. Ripp — JOHN A. RIPP — Principal — TITLE

Reviewed By: Edmund J. Burke — EDMUND J. BURKE, P.E. — Q.A. Manager — TITLE

Approved By: Paul Burgess — PAUL BURGESS, P.E. — Chief Engineer — TITLE

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SECTION 1.0: PURPOSE

To insure a standard procedure for the calibration and operation of the HNu Systems Photoionizer Model PI-101.

SECTION 2.0: SCOPE

The following procedure details those steps necessary for the collection and operation in the survey mode of the HNu Photoionizer. A listing of calibration data needed for proper documentation is supplied at the end of this procedure.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Operations Manager - Second

Field Staff - Third

SECTION 4.0: SUPPORTING PROCEDURES

None

SECTION 5.0: REQUIRED FORMS

Field Notebook No. 351, published by J.L. Darling Corp., Tacoma, Washington (or equivalent), or a conventional paper, bound laboratory notebook (Nalge 6301 or equivalent).

SECTION 6.0: PROCEDURE

6.1 General Description

The HNu Photoionizer is a survey tool for determining general levels of organic vapors in air. The instrument is comprised of a readout module which contains all controls and the battery power supply and a photoionizer probe which contains the photo-cell. The readout module also contains terminals for connection to a recorder. This module is carried by a strap held across the shoulder while the probe is held by hand.

6.2 Instrument Startup

First connect the probe unit to the readout module by attaching and turning the connector terminal. Note this fitting is "keyed" and must be attached in only one orientation.

Second turn the main switch to battery. The needle should deflect to the upper end of the green scale. If it doesn't deflect into the green area or is at the low end of the scale, the instrument needs to be charged. A battery charger is located in the instrument cover and it plugs into the side of the readout module. For a full day's operation the battery should be charged overnight.

Third turn on the main switch to any range (ie. 0-2,000 ppm, 0-200 ppm or 0-20 ppm). Look into the probe through the sample tube and observe the violet light of the photo cell. If the light is not on, check the following:

1. Make sure the probe is attached properly to the readout module.
2. An etch mark should be scribed on the probe where it can be unscrewed to replace the photo cell. This mark shows the exact position that the top of the probe takes so that the air inlet ports are lined up. If not lined up,unscrew the probe and assemble it properly.
3. Check the photo cell lamp and replace it if necessary.

Once the battery and photo cell are operating, perform a calibration.

6.3 Calibration

The PI 101 Analyzer is designed for trace gas analysis in ambient air and is calibrated at HNu with certified standards of benzene, vinyl chloride and isobutylene.

Some general points to consider when calibrating the PI 101 are that the analyzer is designed for operation at ambient conditions and therefore the gas standards used for calibration should be delivered to

the analyzer at ambient temperatures and pressure and at the proper flow rates. The PI 101 is a non-destructive analyzer; calibrations using toxic or hazardous gases must be done in a well ventilated area.

The frequency of calibration should be twice daily as a minimum. The instrument should be calibrated at the beginning of the day (or when the instrument is first turned on) and at the end of the day (or when use of the instrument is completed). If the instrument is turned off during the day for any significant length of time, it should be calibrated when turned on. An accurate and reliable method of calibration check is to use analyzed gas cylinders of "hydrocarbon-free" air and isobutylene (prepared by HNu).

Step 1. Zero set - Turn the function switch to STANDBY. In this position the lamp is OFF and no signal is generated. Set the zero point with the ZERO set control. The zero can also be set with the function switch on the X1 position and using a "Hydrocarbon-free" air. In this case "negative" readings are possible if the analyzer measures a cleaner sample when in service.

Step 2. 0-20 or 0-200 range - For calibrating on the 0-20 or 0-200 range only one gas standard is required. Turn the function switch to the range position and note the meter reading. Adjust the SPAN control setting as required to read the ppm concentration of the standard. Recheck the zero setting (Step 1). If readjustment is needed, repeat Step 2. This gives a two-point calibration; zero and the gas standard point.

6.4 Documentation

In the field notebook, or in the bound laboratory notebook, at the start of the project (or if there is a change in instruments), record the following:

1. Site name
2. Instrument model and serial number S/N
3. Types of calibration gases
4. Note the size of the photo cell lamp used in the particular probe. This is useful to know which organic compounds the HNu is sensitive toward.

In the field notebook, or in the bound laboratory notebook, at the start of each calibration, record the following:

1. Date
2. Time
3. Name of person performing the calibration
4. Span setting before beginning calibration
5. That the instrument was zeroed, and whether the instrument was on standby or if "hydrocarbon-free" air was used.
6. The new span setting, if necessary, to calibrate instrument reading
7. Repeat Step 5 if span was adjusted during Step 6
8. Note that the second calibration reading was correct

ATLANTIC PROCEDURE NO. 1060

CLEANING PROCEDURE FOR SAMPLING DEVICES USED IN ENVIRONMENTAL SITE INVESTIGATIONS

Prepared By: John A. Ripp — Principal
JOHN A. RIPP — TITLE

Reviewed By: Edmund J. Burke — Qa. Manager
EDMUND J. BURKE, P.E. — TITLE

Approved By: Paul Burgess — Chief Engineer
PAUL BURGESS, P.E. — TITLE

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SECTION 1.0: PURPOSE

To insure a standard procedure for cleaning sampling devices for use on site investigations.

SECTION 2.0: SCOPE

This procedure is to be used during site investigations for the cleaning of split spoons, sampling spoons, well bailers, remote samplers, sampling dredges and all devices used to collect a sample or transfer a sample of soil or liquid into its shipping container. Following this general procedure will prevent the likelihood of cross-contamination between samples.

SECTION 3.0: RESPONSIBILITY

Project Manager - First

Field Operations Manager - Second

Field Staff - Third

SECTION 4.0: SUPPORTING PROCEDURES

None

SECTION 5.0: REQUIRED FORMS

None

SECTION 6.0: PROCEDURE

6.1 Materials Selection

All field sampling equipment that contacts the solid or liquid media being collected for eventual chemical analysis should be made of stainless steel or teflon. These materials are easily cleaned and relatively inert when containing the sample. Materials such as neoprene fittings, tygon tubing, silicon rubber bladders, PVC, polyethylene and vitron are not acceptable. Also, stainless steel aircraft cable should be used for raising and lowering bailers into monitoring wells. Sampling equipment should be cleaned beforehand and dedicated to individual samples taken in the field. If this is not possible, a cleaning procedure must be followed between each sample. The following presents the procedures for the sampling of organic and inorganic constituents:

6.2 Procedure for Materials in Contact with Media to be Analyzed for Organics

1. Scrub the device with nonphosphate/low sudsing detergent in a stainless steel basin. This type of basin is easily cleaned and thus prevents the buildup of organic contaminates.
2. Rinse it thoroughly with tap water to remove all suds.
3. Rinse it three times with distilled water using a plastic squeeze bottle.
4. Rinse it with acetone using a teflon squeeze bottle to remove water and other polar compounds.

5. Finally rinse it three times with chromatograph grade hexane using a teflon squeeze bottle to remove any acetone and nonpolar compounds. Allow to air dry and wrap in aluminum foil until use.

Note: Solvent resistant gloves should be worn when rinsing with organic solvents to prevent contamination of the equipment and for personal safety. Use aluminum foil to provide a clean surface if the equipment is set down during the cleaning procedure.

6.3 Procedure for Materials in Contact with Media to be Analyzed for Inorganics

1. Scrub the device with nonphosphate/low sudsing detergent in a HDPE (high density polyethylene) basin using a plastic brush.
2. Rinse it thoroughly with tap water to remove all suds.
3. Rinse it with dilute (0.1N) HCl and/or HNO3 using prerinsed plastic squeeze bottles.
4. Rinse three times with deionized distilled water. Air dry and wrap in plastic. Note: Any acid resistant disposable gloves can be used in this cleaning procedure. Plastic sheeting should be available to provide a clean surface if the equipment is set down during the cleaning procedure.

6.4 Sequence of Rinses

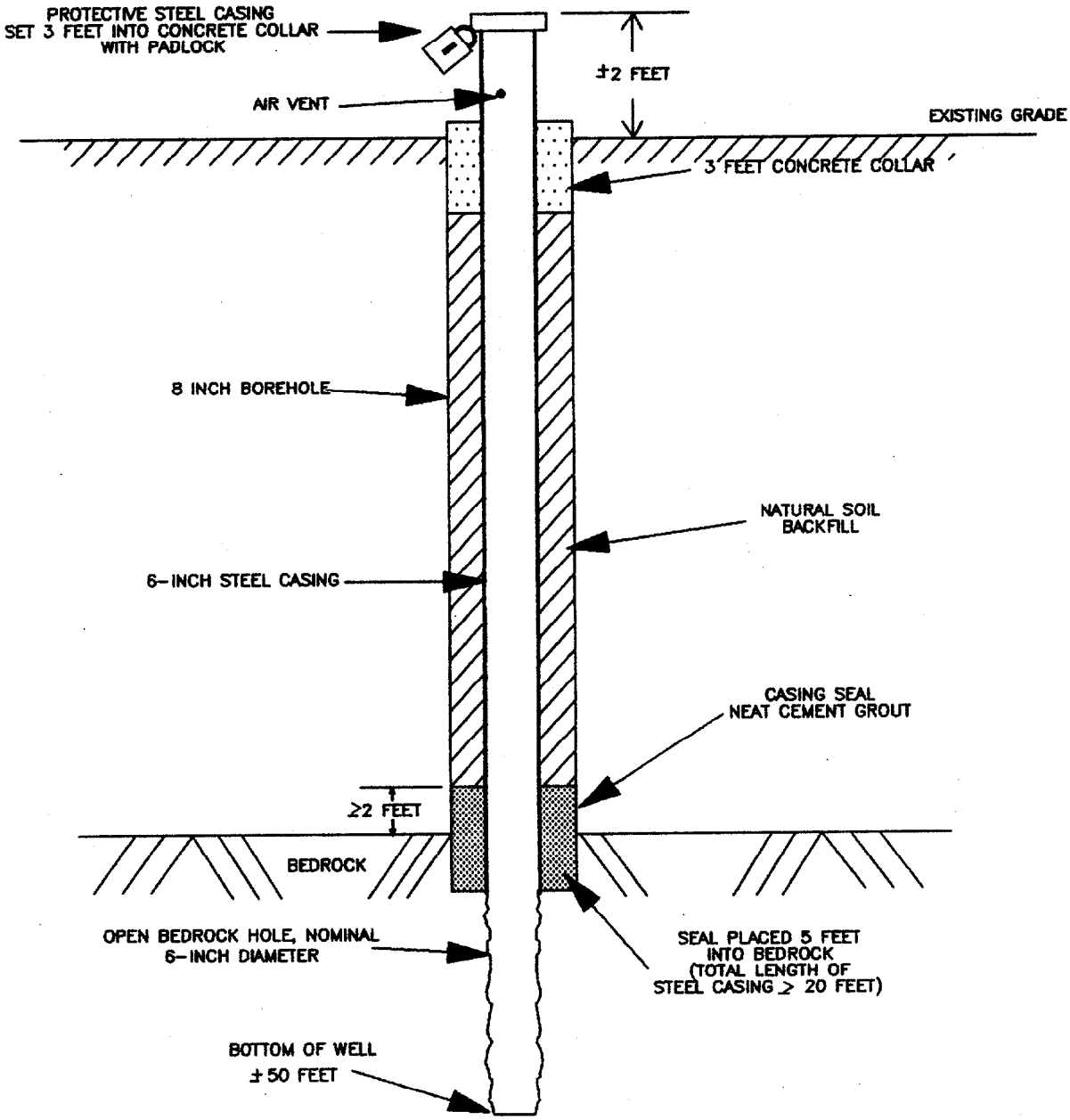
In field programs where a combination of water, methanol, acetone and hexane are to be used for rinsing off equipment the following guide should be followed:

Order of Rinsing	Polarity
1. Water	Hi
2. Methanol	↓
3. Acetone	
4. Hexane	Lo

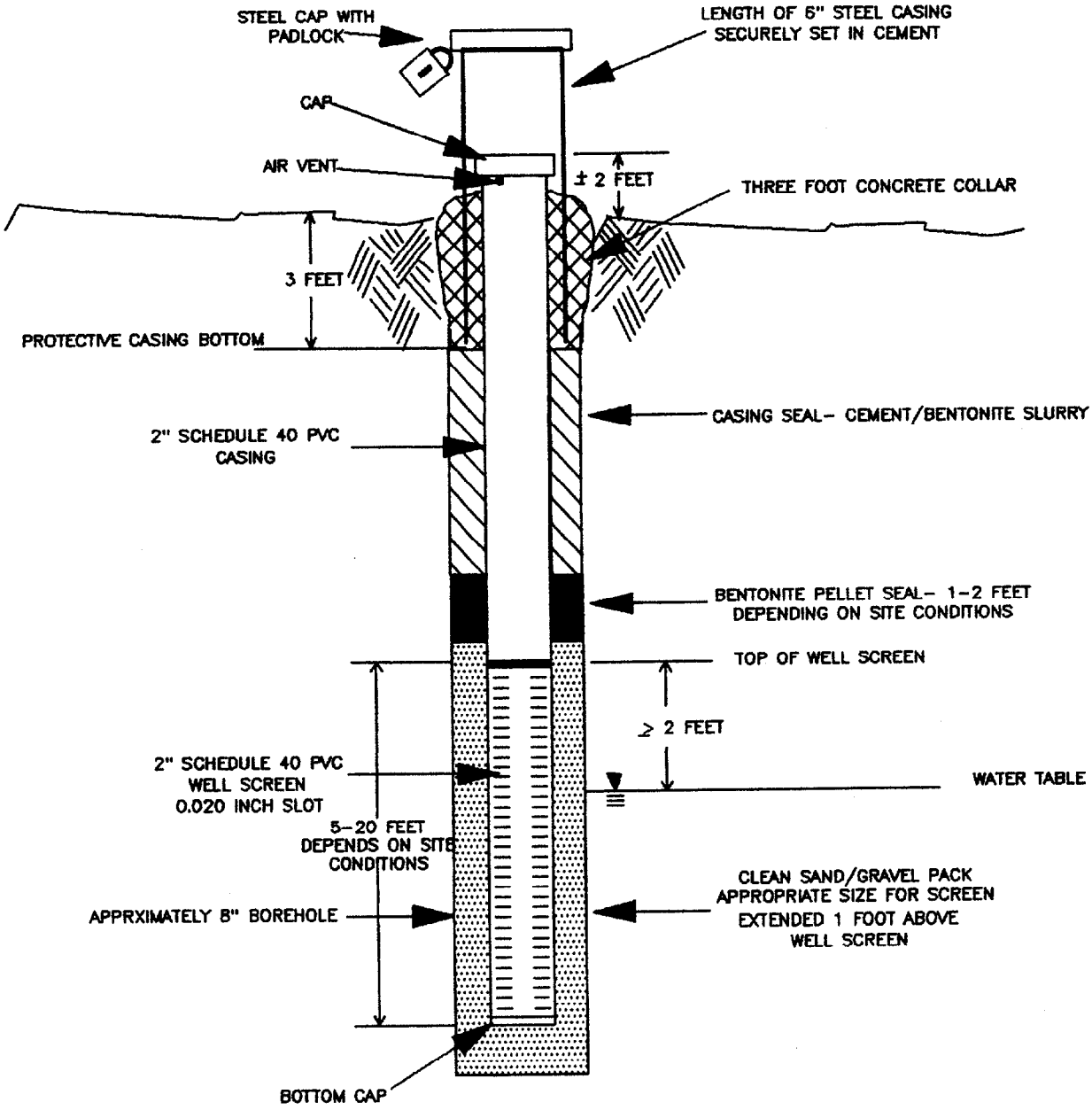
Water, methanol and acetone are all miscible with one another. Hexane however, is only miscible with acetone. Therefore if acetone needs to be driven off a device it should be allowed to either air dry or rinsed with hexane and then air dried. Hexane cannot be rinsed with water or methanol. Atlantic will specify chromatography grade solvents for use in rinsing field equipment. For instance Acetone, "OmniSolv" is pure enough for chromatography, residue analysis, glass distilled with the actual lot analysis on the label. This grade solvent, even though not reagent grade, is suitable for field cleaning purposes.

APPENDIX B

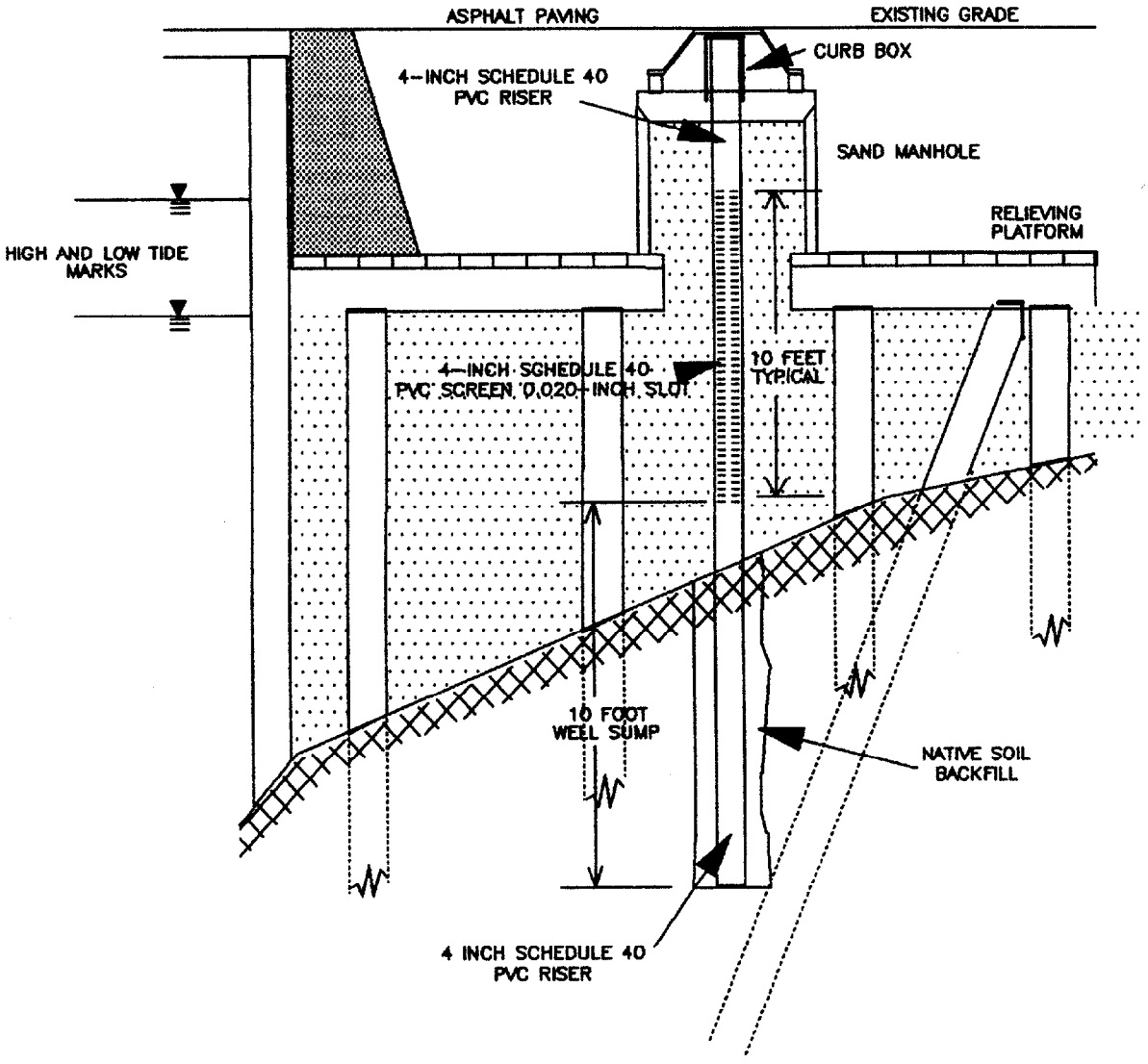
MONITORING WELL DETAILS



BEDROCK MONITRORING WELL CONSTRUCTION



OVERBURDEN MONITORING WELL CONSTRUCTION



SAND MANHOLE MONITORING WELL CONSTRUCTION

FINAL

HEALTH AND SAFETY PLAN

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

PREPARED FOR:

NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
PHILADELPHIA, PENNSYLVANIA

APRIL 1989

ATLANTIC PROJECT NO. 1256-03-01
NAVY CONTRACT NO. N62472-88-C-1294

ATLANTIC
ENVIRONMENTAL SERVICES, INC. 188 NORWICH AVENUE COLCHESTER, CONNECTICUT 06415 (203) 537-0751

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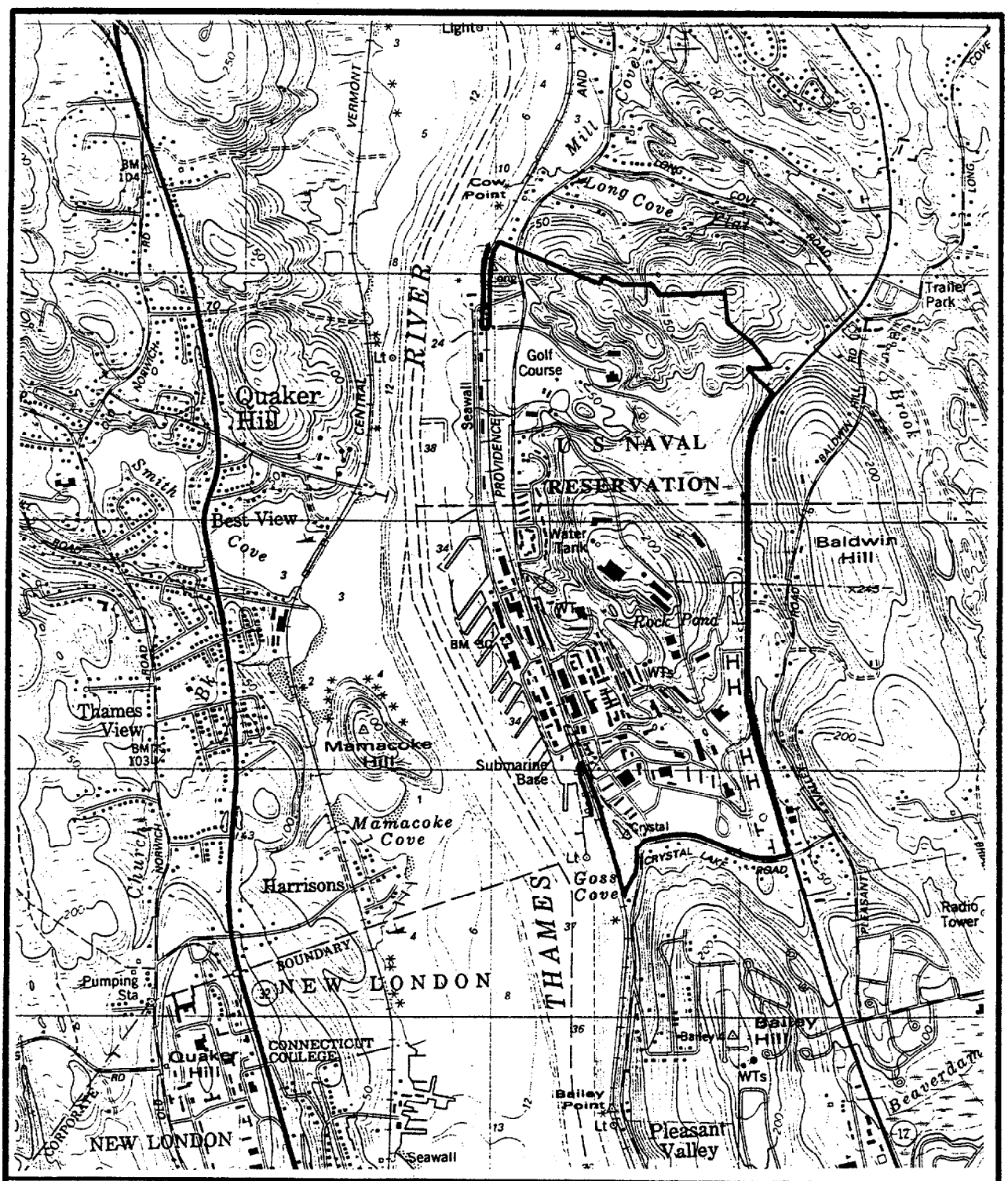
1.0 INTRODUCTION

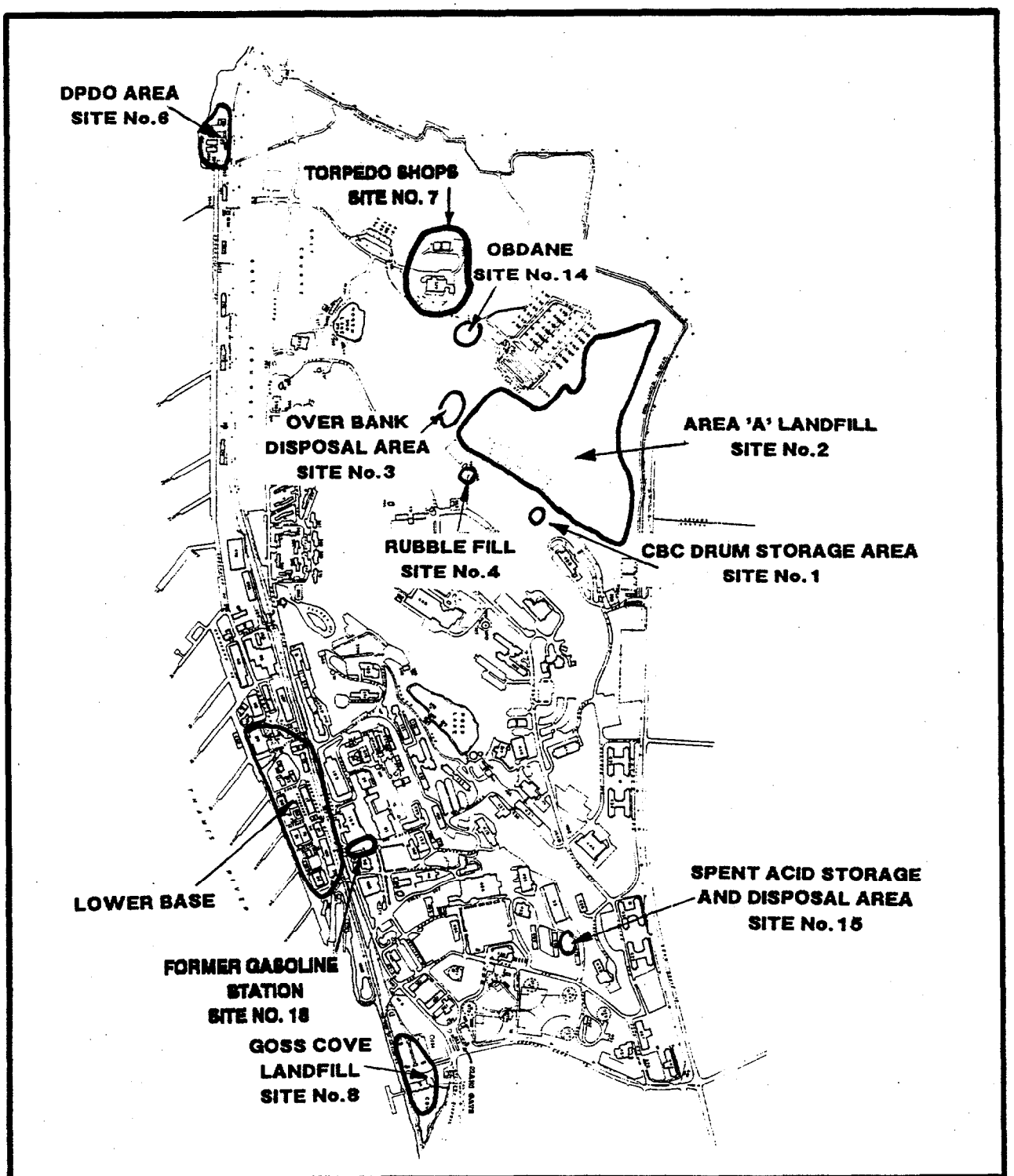
This Health and Safety Plan (HASP) addresses the health and safety practices that will be employed by all site workers participating in the Naval Installation Restoration Study. The study consists of an investigation and field sampling program of eleven identified sites at the Naval Submarine Base (Subase). Figure 1-1 shows the general location of the Subase in Groton and Ledyard, Connecticut and Figure 1-2 shows the locations at the Subase of all nine sites. The sites are classified by the Navy as Step I and Step II sites. The Step I sites include: CBC Drum Area (Site No. 1), Rubble Fill at Bunker A-86 (Site No. 4), Torpedo Shops (Site No. 7), Goss Cove Landfill (Site No. 8), OBDANE (Site No. 14), Spent Acid Storage and Disposal Area (Site No. 15), and Former Gasoline Station (Site No. 18). Step I involves a preliminary assessment of the site based on a screening level of field investigation in order to determine the presence of contamination and potential health and environmental risks. Step II involves a comprehensive field investigation in order to determine the extent of contamination, health and environmental risks, and evaluate remedial alternatives if appropriate. Earlier field investigations determined a presence of onsite contamination at the following Step II Sites: Area A Landfill (Site No. 2), Over Bank Disposal Area (Site No. 3), DPDO Area (Site No. 6), and Lower Base. The HASP takes into account the specific hazards inherent to each site and presents detailed procedures to be followed by Atlantic Environmental Services, Inc. (Atlantic) and its subcontractors in order to avoid and if necessary, deal with potential health and/or safety problems. All activities performed under this HASP will comply with OSHA Regulations 29 CFR Part 1910, 1925 and 1926 with amendments.

This plan is based on an initial assessment of health and safety risks associated with each site. The plan will be updated if additional information is obtained on the chemical nature of materials spilled, used or disposed at each site and their associated health and safety risks.

The HASP will be applicable to all of the field activities which are discussed in detail in the Field Sampling Plan. Elements of the field investigation include an environmental radiation survey, geophysical study, soil gas survey, utility inspections, installation of monitoring wells, drilling of test borings, well development, ground water and surface water sampling, soil and sediment sampling and biological sampling. The field sampling plan outlines which investigative measures are proposed for each site. Specific health and safety measures applicable to each activity will be discussed in the following sections of the HASP.



INSTALLATION RESTORATION STUDY **NAVAL SUBMARINE BASE** **NEW LONDON** **GROTON, CT**	SOURCE: Uncasville, CT U.S.G.S. Topographic Map 1984 N	**FIGURE 1-1** **SUBASE LOCATION**
		ATLANTIC ENVIRONMENTAL SERVICES, INC.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	Source: Naval Submarine Base Existing Conditions April 1985 Loureiro Engineering Associates	FIGURE 1-2 INSTALLATION RESTORATION STUDY SITES ATLANTIC ENVIRONMENTAL SERVICES, INC.

Included in this HASP are four general sections covering the Medical Surveillance Program, Emergency Procedures, Safety Training Programs, and the Site Safety Plan. The Site Safety Plan is written in a format such that it can be separated from this HASP and posted at the site field office for general use.

John Ripp or Curtis Kraemer of Atlantic have been designated site safety engineers for the investigation of the Subase site. When referred to in the following plan, site safety engineer refers to Mr. Ripp, Mr. Kraemer or their designee.

2.0 MEDICAL SURVEILLANCE PROGRAM

Atlantic maintains a continuous in-house medical surveillance program designed specifically for field personnel engaged in work at sites where hazardous or toxic materials may be present. Atlantic employs the services of Physiciancare and Dr. Howard Johnston who are specialists in occupational health and conduct yearly comprehensive examinations of all field personnel on Atlantic staff. The medical results of the examinations aid in determining the overall fitness of employees participating in field activities.

The addresses for these specialists are:

Physiciancare
28 Main Street
East Hartford, CT 06118
203-569-8644

Dr. Howard Johnston
60 Gillett Street
Hartford, CT 06106
203-247-4538

Under Physiciancare and Dr. Johnston's supervision, all field personnel undergo a complete physical examination including a detailed medical and occupational history before they participate in hazardous waste site investigations. The following tests are performed as part of the examination:

- Complete blood workup (38 analyses), including screens for particular toxicants anticipated at the Subase sites (see Appendix A for list of recommended blood tests).
- Urine analysis, including screens for metals and indicators of proper kidney and liver function.
- Pulmonary Function
- Electrocardiogram
- Chest x-ray
- Hearing and Eye exam

Upon completion of these tests, personnel are certified whether they are fit for field work, in general, and fit to use all levels of respiratory protection, in particular.

In the event that an employee of Atlantic is exposed to some form of hazardous substance or wishes to be rechecked because he/she shows symptoms of exposure, he/she immediately will be sent to Physiciancare or Dr. Johnston. Physiciancare and Dr. Johnston also act as consultants to the subcontractors participating in Atlantic's field teams providing information on health risks associated with various chemical substances.

Atlantic's proposed subcontractors for this project also engage in a similar medical surveillance program. The contractors and their company physicians are presented below.

1. East Coast Drilling and Boring, Inc.
   Company doctor's address and telephone number are:
   Physiciancare
   60 Church Street
   Yalesville, CT 06492
   Telephone: 203-284-9099

2. LaFramboise Well Drilling, Inc.
   Company Doctor's address and telephone number are:
   Dr. Philip Goyette
   330 Pomfret Street
   Putnam, CT 06260
   Telephone: 203-938-2746

3. Weston Geophysical
   Company Doctor's address and telephone number are:
   Fallon Clinic
   630 Plantation Street
   Worcester, MA
   Telephone: 508-852-0600

4. Radiation Safety Associates, Inc.
   Company Doctor's address and telephone number are:
   Dr. William Kober
   61 East Main Street
   Hebron, CT
   Telephone: 203-228-4660

3.0 EMERGENCY SUPPORT AND PROCEDURES

3.1 Communications

A telephone will be located in the field office trailer located in the contractor's lay down area at Area A Landfill. A mobile telephone will be provided with the field vehicles used at each sampling activity. Walkie-talkies may be used to communicate during field investigations of the larger sites.

3.2 Local Emergency Support Units

In order to be able to deal with any emergency that might occur during the site investigations, the following information has been obtained and will be posted prominently in the field office. Field teams working away from the site office will carry a copy of these emergency numbers:

1. Local emergency medical team located at the Subase (ambulance/fire dispatcher):
   Dial 449-3333
2. Nearest emergency room (Subase Hospital): 449-3666
   Emergency Room at Lawrence Memorial Hospital (New London): 442-0711
3. Groton Police: 445-2451
4. Groton Fire Department: 445-2456
5. Toxicological Consultant (Physiciancare): 569-8644
   (Dr. Johnston): 247-4538
6. Utility Emergencies (electric, gas, water and sewer)
   Subase Public Works: (phone number)
7. Authorized Navy Site Personnel:

   William Mansfield: 449-4481
   James Fitzpatrick: 449-4481
   Adrienne Townsell: (215) 877-6432

8. Subase Security: 449-3224

9. National Information Centers:

   Chemtrel: (800) 424-9300
   National Response Center:
   (800) 424-8802

Before the field investigations begin, the Subase fire department will be notified of the field activities planned and the potential materials that are thought to exist at each site so that they will be able to respond in case of an emergency.

3.3 Preparation For Medical Emergencies

Atlantic will contact and meet with supervisory staff at the Subase fire department who will be the point of contact for all emergencies, i.e., chemical, fire, or injury, while working at the Subase. The fire department will be able to provide ambulance and paramedic support to any incident, and they will make the critical decisions regarding where an injured person would be transported. In case of immediate threat to life, the Naval Hospital on the Subase would be used, otherwise all cases would be directed to Lawrence and Memorial Hospital in New London.

Before field work on each site commences, personnel who will be working there or observing the operations will complete a brief medical history data sheet that includes the following information:

1. Name, address, home phone
2. Age, height, weight
3. Name of person to be notified in case of emergency
4. All prescription and non-prescription medications currently being used
5. Allergies
6. Particular sensitivities
7. Need for and type of corrective lenses
8. Short medical history including list of previous illnesses
9. Name of personal physician and phone

These data sheets will be filled out during an initial site safety training meeting before any field work begins. They will be filed in the field office, and their maintenance will be the responsibility of the designated site safety engineer or his designee (see Appendix C for sample medical data sheet).

In the event of an incident where a team member becomes exposed to or suffers from an acute symptom of exposure to site materials and has to be taken to a hospital, a copy of his/her medical data sheet will be presented to the attending physician.

3.4 First Aid for Injuries Incurred During Field Work

All injuries will be reported to the site safety engineer immediately. An accident report (Appendix D) will be completed by the safety engineer for all incidents.

A permanent first-aid station will be available at the field office trailer. A portable first aid station will accompany each field sampling team. During the site safety briefing, project personnel will be informed of the location of the first aid station(s).

When possible, site workers will refrain from administering first aid for serious injury or illness and await for the arrival of Subase professional paramedics at the site to take the appropriate action. Unless they are in immediate danger, injured persons will not be moved until paramedics can attend to them. Some injuries, such as severe cuts and lacerations or burns, may require immediate treatment. Any first aid instructions that can be obtained from doctors or paramedics, before an emergency-response squad arrives at the site or before the injured person can be transported to the hospital, will be followed closely.

3.4.1 First Aid Equipment List:

The first aid kits that will be kept at the site will consist of a weatherproof container with individually sealed packages for each type of item. The kit will include at least the following items:

- Gauze roller bandages, 1 inch and 2 inch
- Gauze compress bandages, 4 inch
- Gauze pads, 2 inch
- Adhesive tape, 1 inch
- Bandaids, 1 inch
- Butterfly bandages
- Triangular bandages, 40 inch
- Ampules of ammonia inhalants
- Antiseptic applicators or swabs
- Burn dressing and sterilized towels
- Surgical scissors
- Eye dressing
- Emergency eye wash
- Emergency Oxygen Supply
- Tourniquet
- Alcohol
- Hydrogen peroxide

3.4.2 Other Emergency Equipment

One portable fire extinguisher having a rating of 20-BC and one having a rating of 2A, will be conspicuously and centrally located at the site office. In addition, extinguishers will be located at the drilling rig during subsurface sampling activities.

Portable extinguishers will be properly tagged indicating inspection dates and maintained in accordance with "Maintenance and Use of Portable Fire Extinguishers". As presented in the manual, field personnel will be trained in fire extinguisher use before field operations begin.

An emergency at any site, such as a fire or chemical release, might require that some appropriately trained site workers direct traffic on or near the site. Atlantic would be equipped to do this before Subase emergency support arrives. Reflective vests, flares, and flashlights to be used for traffic control will be kept readily available in the field office.

3.5 Record of Injuries Incurred Onsite

3.5.1 Occupational Injuries and Illnesses Form (OSHA 200)

All occupational injuries and illnesses that are required to be recorded under the Occupational Safety and Health Act will be registered on OSHA Form 200 (Appendix E). Occupational injuries and illnesses will be recorded by the site safety engineer within 48 hours of occurrence as is required by statute.

3.5.2 Employer's First Report of Injury

This form (Appendix F) will be completed by the site safety engineer for all accidents involving worker injury at the site. Follow-up procedures will include investigation of each accident or near-miss by the safety engineer to assure that no similar accidents that may lead to injuries occur.

3.6 Emergency Site Evacuation Procedures

In order to mobilize the manpower resources and equipment necessary to cope with a fire or other emergency, a clear chain of authority has been established. The site safety engineer will take charge of all emergency response activities and dictate the procedures that will be followed until Subase personnel arrive. The safety engineer will report immediately to the scene of the emergency, assess the seriousness of the situation, and direct whatever efforts are necessary until the emergency response units arrive. At his/her discretion, the safety engineer also may order the closure of the site activity for an indefinite period.

All project personnel will be instructed on proper emergency response procedures and locations of emergency telephone numbers during the initial site safety meeting.

If an emergency occurs, including but not limited to fire, product spill, explosion, or significant release of gas into the atmosphere, an air horn will be sounded on the site. For those sites where only two or three people are working side by side, the air horn will not be necessary. For those operations where hearing is impaired or personnel are spread out, the horn will sound continuously for approximately 15 seconds, signaling that immediate evacuation of all personnel is necessary as a result of some immediate or impending danger. All heavy equipment will be shut down, and all personnel will

evacuate the work areas and assemble at a predetermined area, where the site safety engineer will give directions for implementing whatever actions are necessary. The site safety engineer will attend a mobile telephone and call for backup assistance.

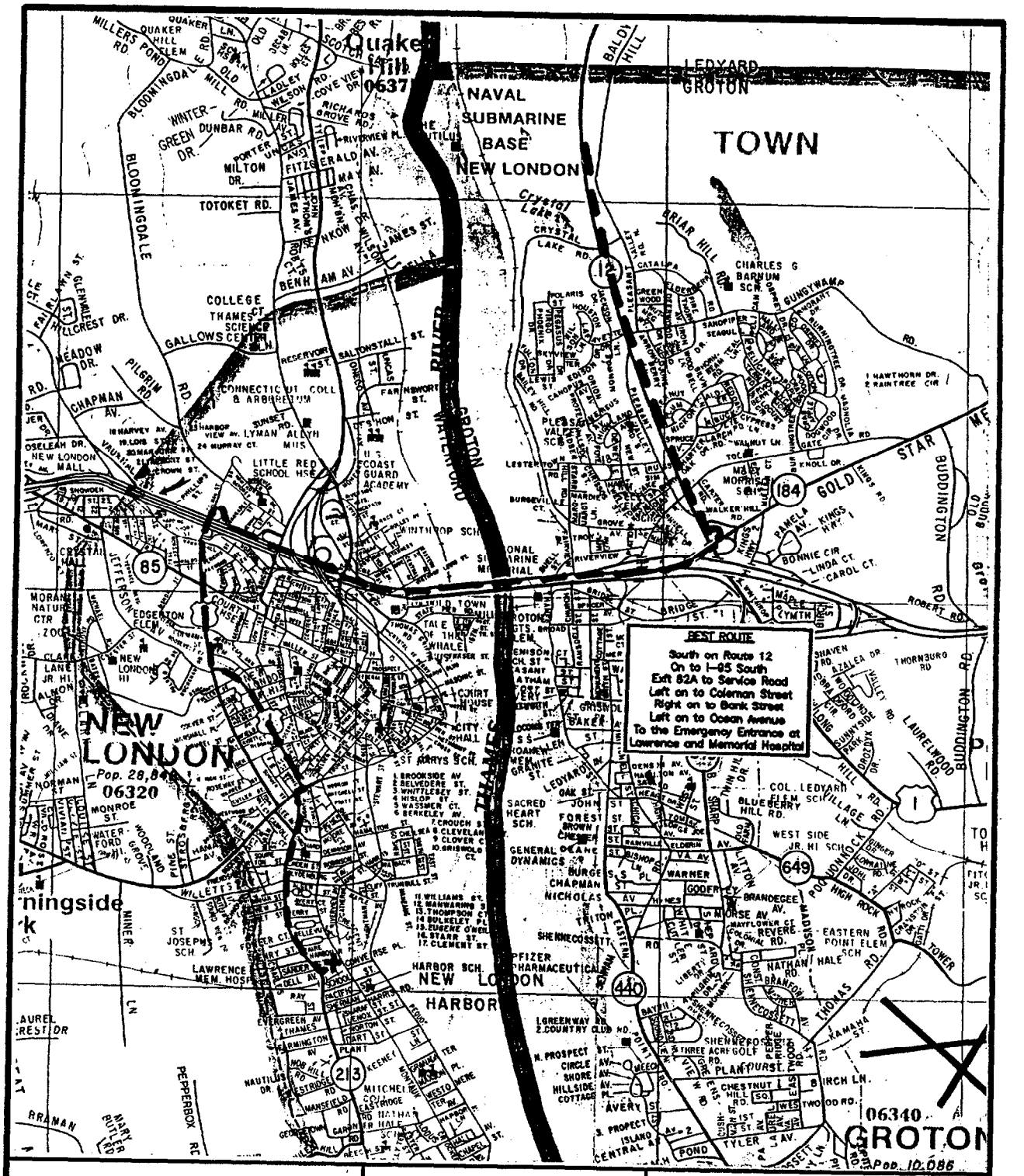
If a toxic-gas release has occurred, the safety engineer will determine whether it is upwind of the meeting place. If the gas poses a danger to the health and safety of those assembling, an alternative meeting location will be established. Under no circumstances will incoming visitors be allowed to enter a site while an emergency is occurring. Visitors or observers present in the area of the emergency will be instructed to evacuate the area immediately.

After sounding the alarm and initiating emergency response procedures, the site safety engineer will check and attempt to ensure that access roads are not obstructed. If traffic control is necessary, as in the event of a fire or explosion, one of Atlantic's personnel who has been trained in these procedures and designated at the site safety meeting will take over these duties until emergency units arrive. Appropriate reflective warning vests will be worn by personnel involved with traffic control.

The site safety engineer will remain on the site to provide any assistance requested by emergency-response squads as they arrive to deal with the situation.

The site safety engineer will have the authority to cease the field investigation after an emergency until he/she deems it safe to continue the investigation. He will dictate any changes in site safety practices which are made necessary by specific aspects of the emergency that has occurred or are required for preventing further emergencies.

The location of the Subase Naval Hospital is provided in Figure 1-2. The route to Lawrence and Memorial Hospital (New London) is shown on Figure 3-1.



INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

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FIGURE 3-1
ROUTE TO LAWRENCE AND MEMORIAL HOSPITAL

ATLANTIC ENVIRONMENTAL SERVICES, INC.

4.0 TRAINING PROGRAMS

4.1 Health and Safety Training

All of Atlantic's field personnel assigned to this project and its major subcontractors have attended at the minimum a 40 hour health and safety training course as required by OSHA standards. Also, a number of Atlantic's supervisory personnel have completed the required eight hour Supervisory Training Course required by OSHA. A list of Atlantic personnel identified to work at the Subase sites and titles and dates of the safety courses that they have attended are provided below.

ATLANTIC PERSONNEL	COURSE	DATE
Paul Burgess Project Manager	Waste Site Worker Protection and Supervisor Training-HST (Hygiene Site Training Company)	5/88
John Ripp Site Safety Engineer	Health And Safety Operations at Hazardous Materials Sites-GeoEnvironmental Consultants Supervisory Training (pending)	6/84, 7/85
Curtis Kraemer Field Supervisor	Safety at Hazardous Materials Sites GeoEnvironmental Consultants Supervisory Training (pending)	10/86, 10/87
Charles Pierce Environmental Scientist	Personal Protection and Safety For Hazardous Waste Site Activities-HMM Associates, Inc.	9/88
James L. Cutler Geologist	Safety at Hazardous Materials Sites-GeoEnvironmental Consultants	10/86 10/87
Terry Taylor Geologist	Waste Site Worker Protection HST (Hygiene Site Training Company)	5/88
Malcolm Webster	Health and Safety Operations at Hazardous Materials Sites - Columbia-Greene Community College	1/89
Carol Roberson	Health and Safety Training for Hazardous Waste Activities - Geraghty and Miller Inc.	11/88
Lynn Metcalf	Health and Safety Operations at Hazardous Materials Sites - Columbia-Greene Community College	1/89

These training courses have been comprised of classroom instruction, field demonstrations, use of respirators, use of appropriate protective clothing, and written and field tests. They cover the following topics:

1. Identification of hazardous substances
2. Properties of hazardous substances
3. Routes of exposure
4. Toxicity of different substances and their synergistic effects
5. Practical considerations in health and safety management
6. Physical properties of chemicals
7. References for threshold limit values (TLV), lower explosion limits (LEL), toxicity data, cross references
8. Technical assistance organizations
9. Air monitoring and survey instruments
10. Site entry and egress procedures
11. Heat stress monitoring
12. Levels of personnel protection
13. Controlling access to work zones and other contaminated areas
14. Personnel decontamination
15. Equipment decontamination
16. Site/area safety planning

Everyone attending the courses were tested for the fit of their personal respirator and were trained in using self contained breathing apparatus (SCBA) both with and without level A suits. The courses also emphasized the importance of, and discussed the procedures for, decontamination.

Health and safety training is an ongoing activity at Atlantic. Yearly refresher courses or site-specific training programs are presented as needed to keep field personnel up-to-date with proper health and safety practices.

The drilling, geophysical and radiation survey firms contracted by Atlantic also provide OSHA safety training to their staff. The contractors and the names and dates of the safety courses are presented below.

LAFRAMBOISE WELL DRILLING PERSONNEL	COURSE	DATES
Gerald Keroauck	Hazardous Materials Health and Safety Training - National Well Water Association	12/87

Howard Barber	Hazardous Materials	12/87
	Health and Safety Training - National Well Water Association	
Brian Warren	Hazardous Materials Health and Safety Training - Corporate Environmental Advisors	10/88
Donald Donovan	Various courses at nuclear power plants in the Northeast	40 Hour OSHA Course Scheduled for 11/88

<u>East Coast Drilling Personnel</u>

Larry Cheeseman	40 Hour Health and Safety Training Course Corporate Environmental Advisor	3/88
Tom Cotter	40 Hour Health and Safety Training Course Corporate Environmental Advisor	3/88
Jim Cutler	40 Hour Health and Safety Training Course Corporate Environmental Advisor	3/88
Larry Fredricks	40 Hour Health and Safety Training Course Corporate Environmental Advisor	3/88
Bret Swiatek	40 Hour Health and Safety Training Course Corporate Environmental Advisor	3/88

Weston Geophysical Corporation and Radiation Safety Associates, Inc. will provide the names of anticipated field workers with safety course names and dates prior to mobilization to the Subase.

4.2 Onsite Training Program

After the Atlantic field office has been set up and initial site mobilization has taken place, but before any drilling, surveying or sampling activities, the Atlantic site safety engineer will conduct an onsite training meeting for all personnel and observers who will be involved in the various site investigations. This program will cover specific practices and potential problems inherent to each site. No person will be allowed to work at the site unless he has attended this training meeting. During the meeting, the Site Safety Plan will be reviewed and copies given to all attending. Copies will be kept in the field office throughout the investigation. The major components of the onsite training are:

1. Review the scope of activities for each site.

2. Review of suspected chemical hazards for each site, their forms (e.g. vapor, gas, liquid), and the warning signs of their presence.

3. Review of potential hazards posed by drilling and sampling in the presence of underground utilities and other unidentified hazards.

4. Operational Procedures:
   - o control of site activities
   - o control of site access and perimeter
   - o zones of hazard
   - o levels of protection
   - o detection equipment
   - o decontamination procedures
   - o specific precautions for drilling near buried tanks, utilities, and medical waste

5. Emergency Procedures:
   - o first aid
   - o emergency communications
   - o local response groups and their phone numbers
   - o evacuation procedures

6. Fit testing of all personnel on their personal respirator prior to commencing work at the site.

7. Complete reading of the Site Safety Plan followed by initialing of the document to confirm the effort.

Any new personnel who join the field investigation team later in the study are required to go through a similar health and safety briefing before they may participate in any aspect of the field program.

Site-specific rules and regulations will be emphasized during the onsite safety meeting. The following rules will also be posted in the Atlantic office trailer:

1. No smoking, drinking, eating within restricted (contaminated) zones. A half face respirator is required to be worn at all times within this zone, unless toxic vapor/gas levels are determined to be within recommended safe limits based on organic vapor meter readings near the subsurface work zones and thus do not pose a health hazard to workers.

2. All rest, refreshment, and sanitary facility use will take place in "clean areas" outside of restricted zones and decontamination zones.

3. Those in contact with contaminated soils or other materials that are thought to be contaminated must go through decontamination upon egress from the restricted area based on the level of contamination and before they may enter a "clean area" or non-restricted area. Decontamination procedures are detailed in Section 5.8.

4. The site safety engineer has full authority over start-up and shutdown of operations from a safety standpoint. He will determine whether conditions are too extreme for work, and he will establish the working hours at the site.

Additional meetings will be held if necessitated by changing site conditions, new operation procedures, or the entry of new personnel unfamiliar with important daily safety topics. A record will be kept of safety meeting dates and topics discussed (see Appendix G).

5.0 SITE SAFETY PLAN

The nature of contaminants present at the Subase sites vary from site to site. This place establishes policies and procedures to protect workers, base personel, and other contractors and the public from the potential hazards posed by investigation activities at the Subase. General Subase information is presented and specific site descriptions and potential hazards are given for each of the eleven identified sites.

5.1 Introduction

Location: U.S. Naval Submarie Base (Subase) Groton and Ledyard, CT	Plan Prepared By: John Ripp Atlantic Corporate Safety Officer
Date Prepared: November 1988	Plan Use: 01/01/89 - 12/31/89

The Subase consists of approximately 547 acres of land and is located off Route 12 in the Towns of Ledyard and Groton. The area surrounding the Subase consists of primarily residential dwellings, undeveloped land, and some commercial establishments. The site is easily accessible to emergency response groups, both within the Subase and from area municipalities. A Naval hospital is located on the Subase, and the New London Hospital is located within four miles of the subject property.

Envirodyne Engineers, Inc. (Envirodyne) performed an Initial Assessment Study (IAS) for the Subase and recommended sites for further study based on past records of waste disposal and potential impacts to health and the environment. The sites ultimately included for study as part of this project have been added and modified from the Envirodyne recommendation based on further Navy deliberations. Wehran Engineers (Wehran) concluded confirmation level investigations at the DPDO, Area A Landfill, and Over Bank Disposal Site, and based on collected analytical data, recommended further investigation to fully assess risks and potential remediation alternatives.

This HASP is developed in conjunction with the Field Sampling Plan which describes the field investigation program which will be performed by Atlantic Environmental Services, Inc. (Atlantic) as part of the Naval Installation Restoration Study. The program consists of two distinct phases. Step I is applicable to seven of the eleven identified sites and involves a preliminary assessment and initial field sampling program to identify if contamination is present and warrants a remedial investigation. The Step I sites to be investigated include:

1. CBC Drum Area (Site No. 1)
2. Rubble Fill at Bunker A-86 (Site No. 4)
3. Torpedo Shops (Site No. 7)
4. Goss Cove Landfill (Site No. 8)
5. Over Bank Disposal Area Northeast (OBDANE) (Site No. 14)
6. Spent Acid Storage and Disposal Area (Site No. 15)
7. Former Gasoline Station (Site No. 18)

Step II is applicable to the remaining four sites, where contamination was identified by earlier investigations. It involves investigations in order to determine the extent of contamination, assess health and environmental risks and evaluate remediation alternatives. The Step II sites to be investigated include:

1. Area A Landfill (Site No. 2)
2. Over Bank Disposal Area (Site No. 3)
3. DPDO Area (Site No. 6)
4. Lower Base (no number designated)

Below are specific descriptions of each of the seven Step I sites to be investigated. The location of all sites is provided in Figure 1-2 while specific site maps are provided below.

5.1.1 <u>CBC Drum Area</u> - <u>Site Description</u>

1. Location and Access: The site is located in the northeastern section of the Subase, adjacent to the Area A Landfill. Access is available via a dirt road from Area A landfill off Wahoo Avenue. Figure 5-1 depicts a general site plan showing field sampling locations and work zones.

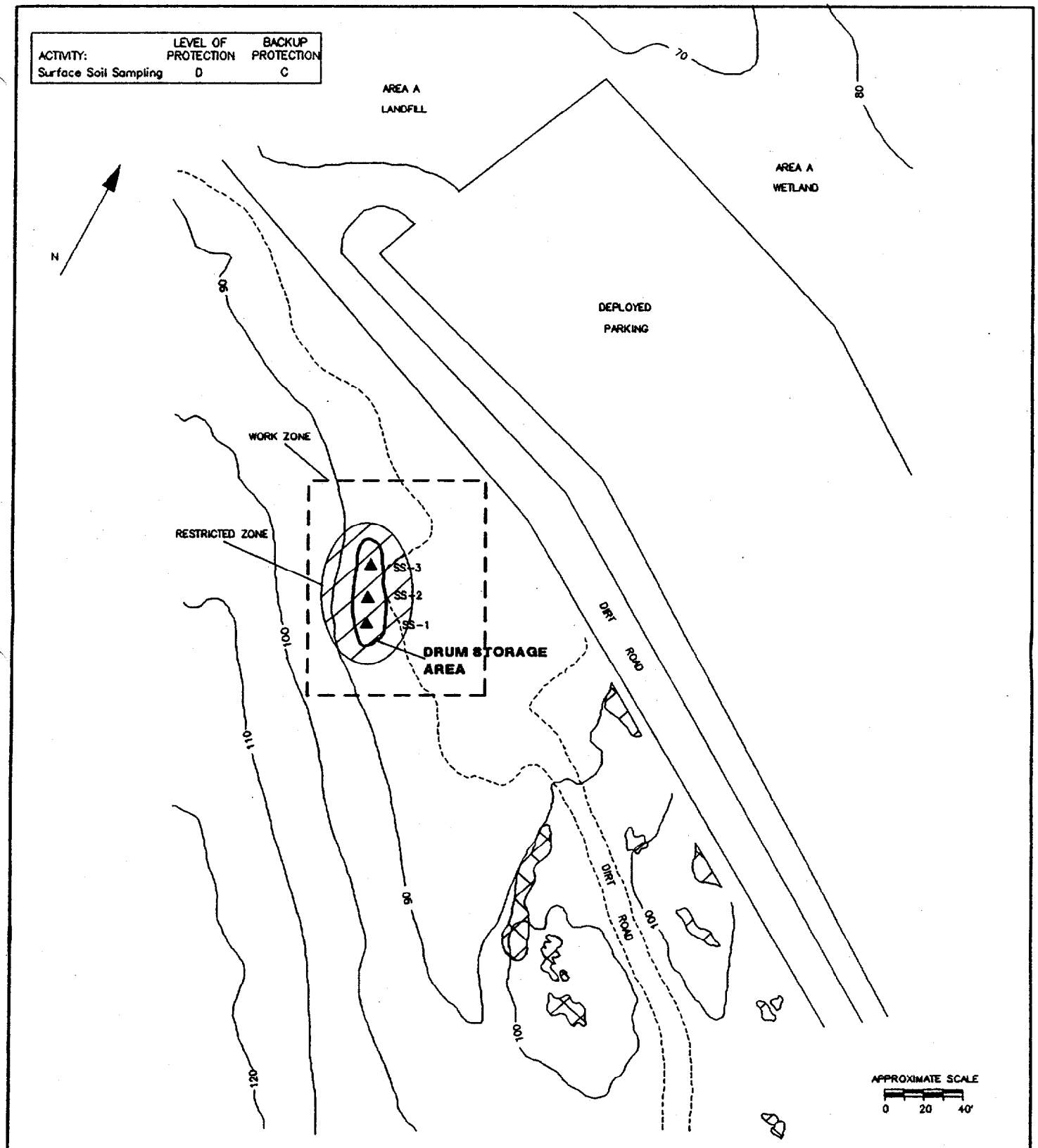
2. Existing Information For Site: Detailed _____ Preliminary __X__ Sketchy _____ None _____

3. Site History/Status: The IAS identified 26 55-gallon drums of waste oil, lube oil, and paint materials. Some of the drums were observed leaking.

   Atlantic performed a visual site inspection on October 20, 1988. Two empty 55 gallon drums labelled as engine oil were observed behind a contractor's trailer. According to the Subase Point of Contact (POC), William Mansfield, drums previously stored in this area were removed and properly disposed by the Navy.

4. Facilities on Site: There are no structures onsite.

5. Buried Utilities: Underground utility maps have been reviewed from available mapping at the Navy Department of Public Works office. No utilities were identified at the site itself.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 5-1 SITE SAFETY PLAN CBC DRUM STORAGE AREA
	PROPOSED	EXISTING	
	▲ SS-1 – Surface Soil Sample	—95— Existing Grade Exposed Bedrock	ATLANTIC ENVIRONMENTAL SERVICES, INC.

6. Topography: The site is located on a generally level area and surface drainage flows north towards a wetland north and adjacent to Area A Landfill.

7. Potential Hazardous Chemicals Onsite: Materials which may be encountered include waste oil, petroleum products, solvents, lube oil, paints, and PCBs. The hazards associated with these waste materials is summarized in Section 5.5.

5.1.2 Rubble Fill at Bunker A-86 - Site Description

1. Location and Access: The site (Figure 5-2) is located in the north central section of the Subase on a hillside just south of the Area A landfill. Access is available off Wahoo Avenue. A dirt road leading into Bunker A-86 allows access to the top of the disposal area. The site is also located just south of Building 496 located at the Area A Landfill.

2. Existing Information for Site: Detailed _____ Preliminary ___X___ Sketchy _____ None _____

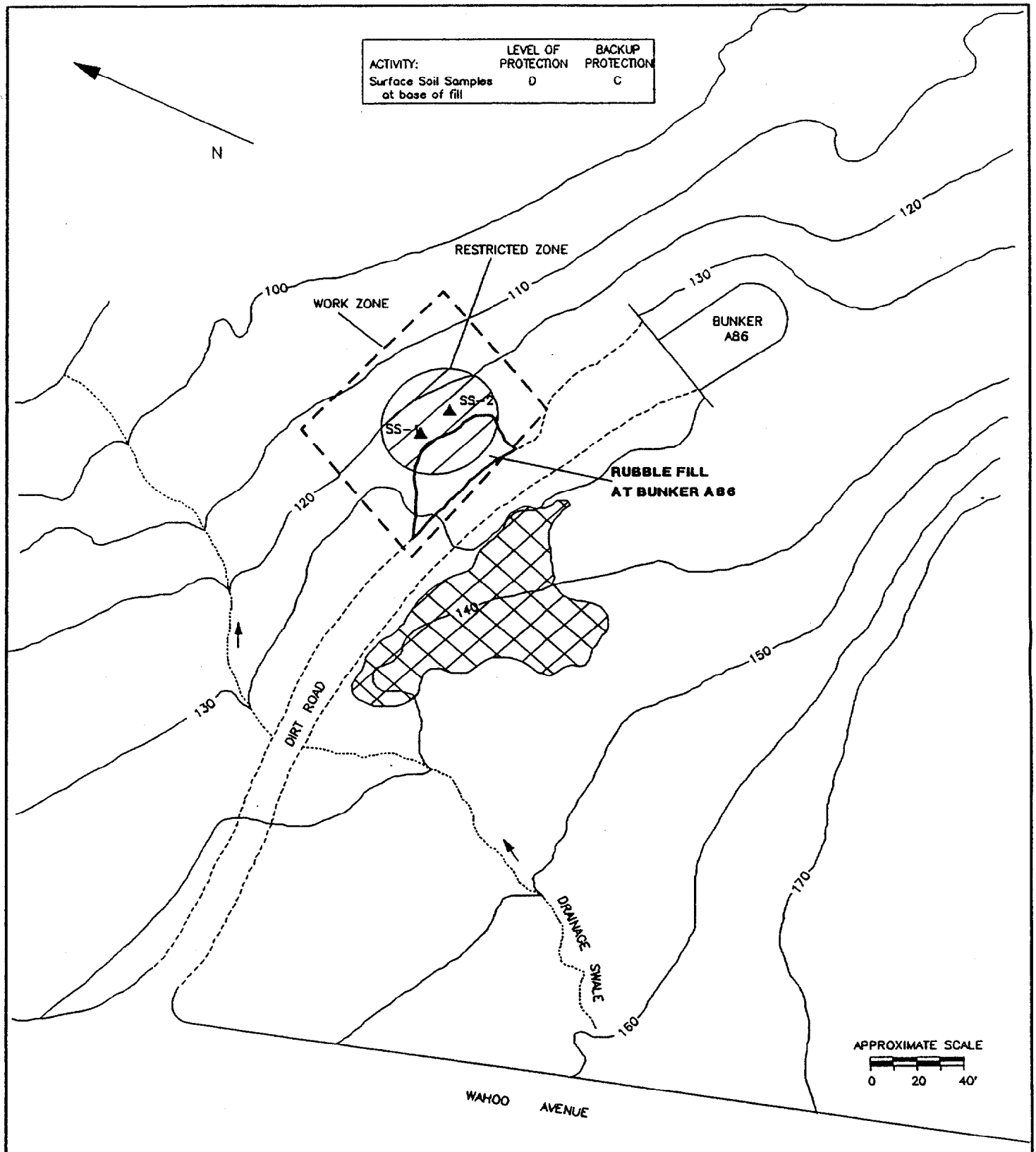
3. Site History/Status: Construction waste materials were deposited at this site. The IAS reported the material to be concrete, asphalt, tar buckets and fill.

   During Atlantic's walkover inspection (October 20, 1988), current waste disposal was observed. The waste material primarily consisted of wood chips, ash, and rubble. The fill area sloped downhill and an empty 5 gallon can of monoethanolamine (corrosive), an empty 5 gallon can of thorite (non shrinking compound for patching concrete), and a partial full 55 gallon drum of lube oil were observed at the base of the fill.

4. Facilities Onsite: There are no structures associated with the site.

5. Topography: The site is located on a fairly steep slope. The Area A Landfill is located offsite just to the north. Bunker A86 is located just to the east at the top of the slope.

6. Additional Information: When approaching the site from the north, personnel should plan on clearing a path through dense undergrowth.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 5-2 SITE SAFETY PLAN RUBBLE FILL AT BUNKER A86
	PROPOSED	EXISTING	
	▲ SS-1 – Surface Soil Sample	—95— Existing Grade Exposed Bedrock	ATLANTIC ENVIRONMENTAL SERVICES, INC.

7. Potential Hazardous Chemicals Onsite: Potential hazardous materials may include solvents, petroleum products, waste oil, and ash.

5.1.3 Torpedo Shops

Site Description:

1. Location and Access: The site is located in the northern section of the Subase near the North Lake Recreation Area. Site access is available from Triton Avenue and the site plan is shown on Figure 5-3.

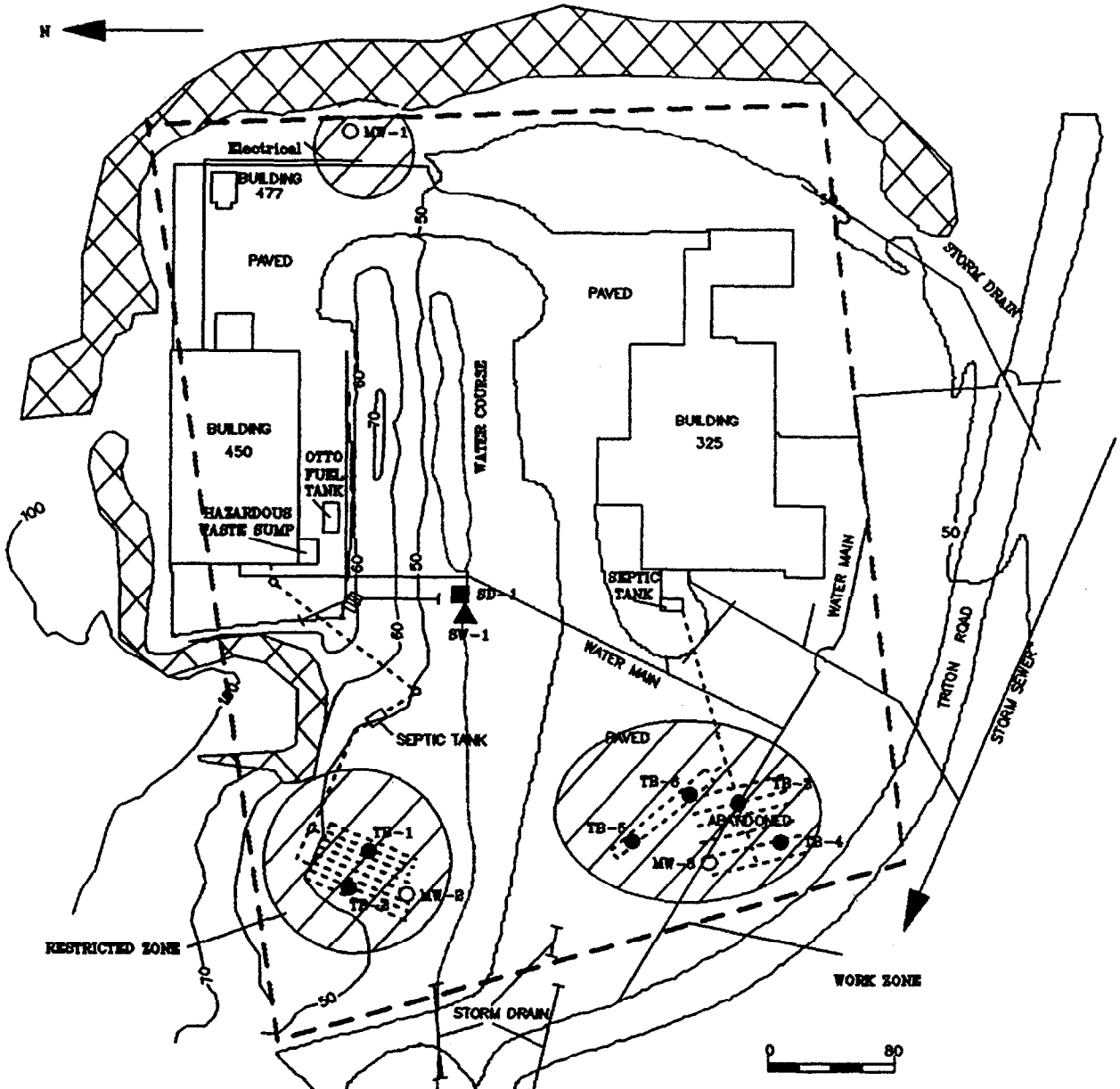
2. Existing Information for Site: Detailed __X__ Preliminary __X__ Sketchy _____ None _____

3. Site History/Status: The site is used as a torpedo overhaul and undersea weapons administrative and quality assurance facility. Building 325 was built in 1955 and Building 450 was built in 1974. Prior to 1983 when municipal sewers were installed, both buildings used septic leachfields for wastewater disposal. Building 450, however, was built to retain hazardous waste in a special waste tank and reportedly only domestic sewage entered the septic system. Accidental discharges or various torpedo fuels, solvents and petroleum products may have occurred via floor drains, sinks and lavatory facilities.

4. Facilities Onsite: Buildings 325, 450 and 477 are located on the site. An access road enters the site on the southwestern corner from Triton Road. The access road and paved parking areas occupy most of the level area around Buildings 325 and 450. Building 477, on the northeast portion of the site is a storage building.

5. Buried Utilities: A water main is located in the center of the site from the southern side of Building 450 to the southwestern side of Building 325. An electrical line extends easterly from the north side of Building 450 to the east side of Building 477. Sanitary sewer lines exist but could not be located. The utilities will be located and marked prior to field activities and are shown on Figure 5-3.

6. Topography: The area was previously a quarry and is relatively flat in the building and parking areas with a steep 60 foot bedrock face to the north and east. Drainage enters storm catch basins around the buildings and passes through numerous downstream culverts.



ACTIVITY	LEVEL OF PROTECTION	BACKUP PROTECTION
SOIL GAS SURVEY	D	C
SOIL BORINGS AND WELL INSTALLATION	C	B
WELL DEVELOPMENT	D	C
GROUNDWATER SAMPLING	D	C
SURFACE WATER SAMPLING	D	C
SEDIMENT SAMPLING	D	C

NOTE: 1. UTILITY LOCATIONS ARE APPROXIMATE AND MUST BE VERIFIED.

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

LEGEND

PROPOSED	EXISTING
▲ SD-1 Sediment Sample	—95— Existing Grade
■ SW-1 Surface Water Sample	Exposed Bedrock Face
● TB-1 Test Boring	----- Former Septic System
○ MW-1 Monitoring Well	

FIGURE 5-3
SITE SAFETY PLAN
TORPEDO SHOPS

ATLANTIC ENVIRONMENTAL SERVICES, INC.

7. Potential Hazardous Chemicals Onsite: Typical waste materials may include various fuels, solvents and petroleum products, specifically, Otto fuel, alcohol, jet fuel, mineral spirits, 1,1,1-trichloroethane, trichloroethylene, toluene, MEK, freon, hydraulic and motor oils.

5.1.4 Goss Cove Landfill

Site Description

1. Location and Access: The site is located in the southwestern section of the Subase adjacent to Goss Cove and the Thames River. Access is available via the main entrance to the Subase on Crystal Lake Road. A site map is shown in Figure 5-4.

2. Existing Information for Site: Detailed _____ Preliminary ___X_____ Sketchy _____ None _____

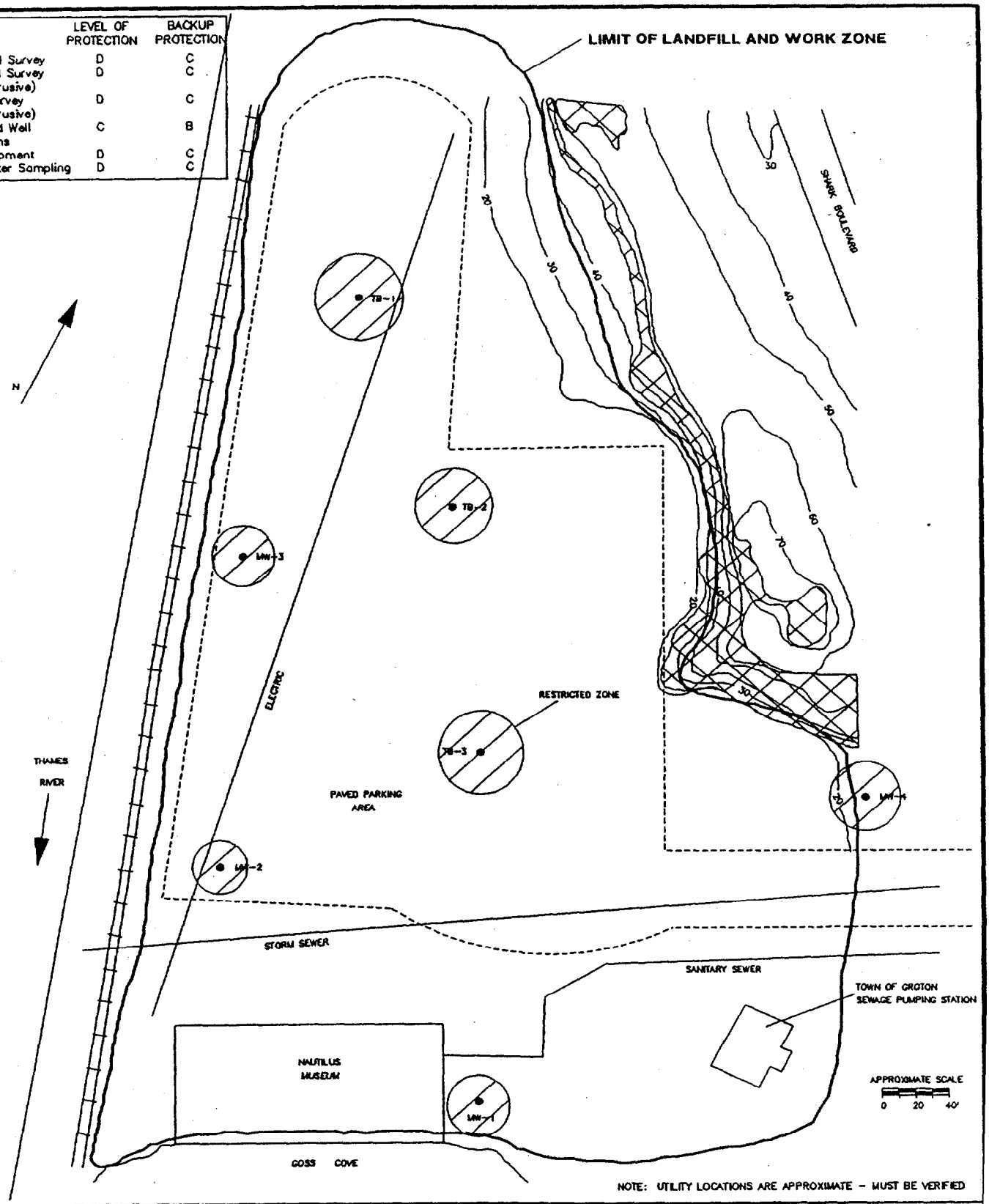
3. Site History/Status: The Goss Cove Landfill operated from 1946 until 1957. The IAS report stated that the majority of the disposed material consisted of incinerator ash and inert rubble. No visible surface contamination was documented at the time of this study. According to the POC approximately 14 gas holders (gas cylinders) were found at the site during the excavation of a utility trench in the museum access road. One tank was found to be leaking propane. The contents of the remaining gas cylinders is not known. Based on the finding of the gas cylinders in the landfill, and the fact that it served as the landfill for the Subase for ten years from 1946-1957, the exact nature of the disposed materials is not defined.

4. Facilities Onsite: The Nautilus Museum (Building 571) is located at the site. Potable water and power is available from this structure. Approximately 60% of the site is paved parking, 10% of the site is occupied by the museum, and the remaining area is the old Providence/Worcester railroad line which forms the western boundary of the site.

5. Buried Utilities: Approximate utility locations are shown on Figure 5-4. Utilities include water, sewer, storm drainage and electric. A storm sewer main which serves the southern portion of the base is located in the driveway area of the museum and discharges into the Thames River.

6. Topography: The site slopes gently to the west, towards the Thames River. Rock ledge was observed in the northeastern section of the site. Goss Cove is located to the south of the museum.

ACTIVITY:	LEVEL OF PROTECTION	BACKUP PROTECTION
Radiological Survey	D	C
Geophysical Survey (non-intrusive)	D	C
Soil Gas Survey (non-intrusive)	D	C
Borings and Well Installations	C	B
Well Development	D	C
Ground Water Sampling	D	C



INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

LEGEND

PROPOSED	EXISTING
● TB-1 - Test Boring	—95— Existing Grade
● MW-1 - Monitoring Well	Exposed Bedrock
	○ TB-1 - Test Boring

FIGURE 5-4
SITE SAFETY PLAN
GOSS COVE LANDFILL

ATLANTIC ENVIRONMENTAL SERVICES, INC.

7. Additional Information: The Town of Groton Sewage Pumping Station is located offsite to the east.

8. Potential Hazardous Chemicals Onsite: Typical hazardous wastes present may include: petroleum products, medical wastes, ash, compressed gas cylinders and solvents.

5.1.5 OBDANE - Site Description

1. Location and Access: The site (Figure 5-5) is located in a heavily wooded area northwest of Area A landfill on the sidewall of a natural ravine. A dirt road off Triton Avenue near the weapons storage area allows limited access to the site.

2. Existing Information for Site: Detailed _____ Preliminary ___X___ Sketchy _____ None _____

3. Site History/Status: The OBDANE (Over Bank Disposal Area Northeast) site is located below a very steep hillside. According to the Envirodyne Report, the site has not been used for disposal purposes since 1972. Decayed fiber drums were observed during the Envirodyne initial inspection.

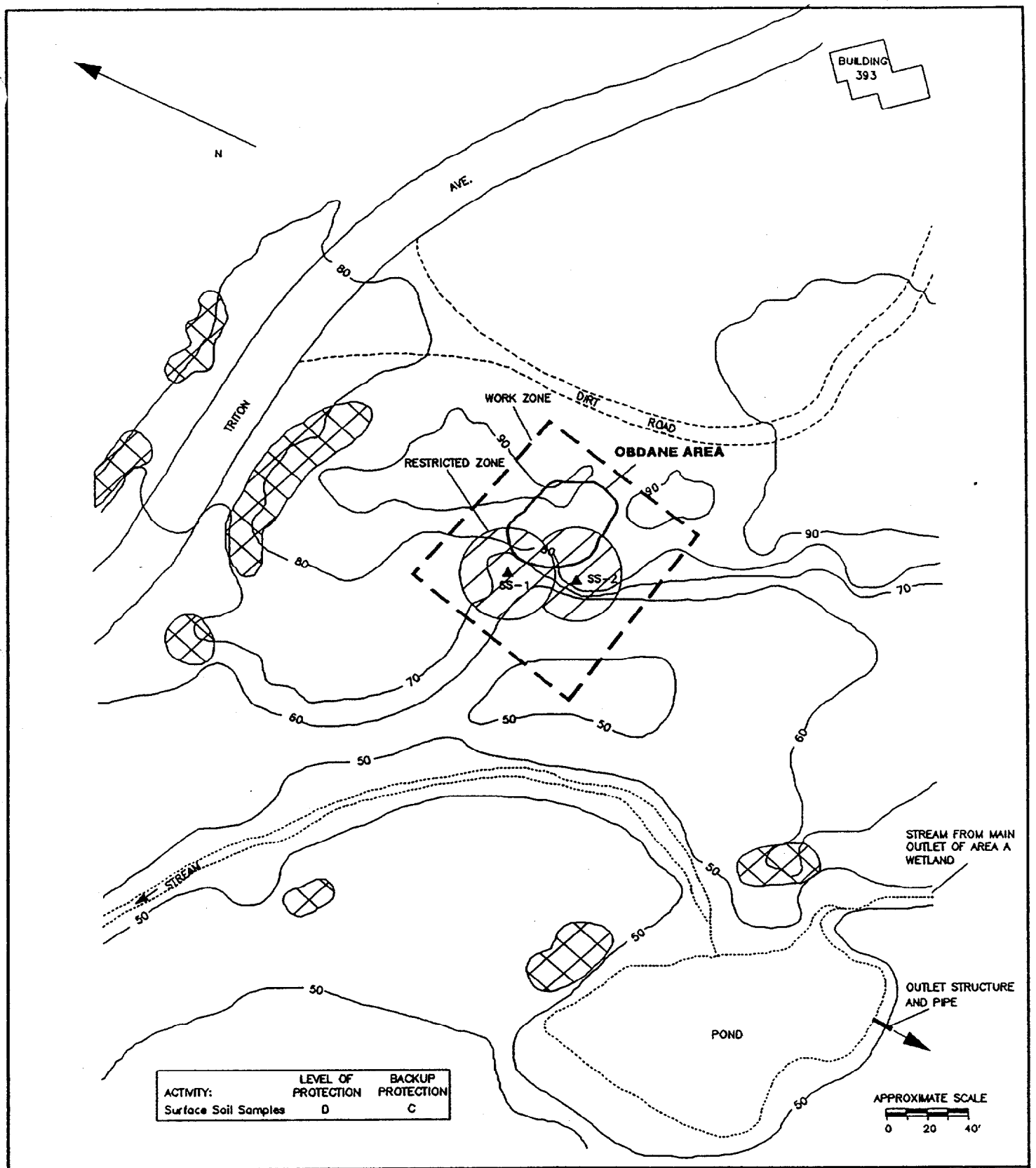
   A visual site inspection was performed by Atlantic personnel. Fiber drum covers and one metal drum were observed onsite. A dry stream bed is situated to the south and west of the site which flows from the Area A Wetland.

4. Facilities Onsite: No structures are located onsite.

5. Buried Utilities: No buried utilities are near the site.

6. Topography: The site is situated on a steep slope and drains to the south and west towards the Thames River.

7. Potential Hazardous Chemicals Onsite: Hazardous materials which may be encountered onsite include: waste oil, petroleum products and solvents.



ACTIVITY:	LEVEL OF PROTECTION	BACKUP PROTECTION
Surface Soil Samples	D	C

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

LEGEND

PROPOSED	EXISTING
▲ SS-1 – Surface Soil Sample	—95— Existing Grade
	Exposed Bedrock
	Stream

FIGURE 5-5
SITE SAFETY PLAN
OBDANE AREA

ATLANTIC ENVIRONMENTAL SERVICES, INC.

5.1.6 Spent Acid Storage and Disposal Area

Site Description:

1. Location and Access: The site is located in the southeastern section of the Subase adjacent to Building 410. Site access is available from Tang Avenue and the site plan is shown in Figure 5-6.

2. Existing Information for Site: Detailed _____ Preliminary ____X____ Sketchy _____ None _____

3. Site History/Status: The IAS reports that this site was used prior to and for several years after World War II for the overhaul of submarine batteries and the storage of waste battery acids in a rubber lined underground tank. The batteries were placed on a concrete pad next to the tank where some acids reportedly leaked. The acid batteries were placed in the tank and when full, it was pumped to a tank truck for disposal at Area A Landfill.

4. Facilities Onsite: Buildings 409 and 410 are located adjacent to the site. Potable water is available from both of these structures. Storm sewers are also located to the north and south of these structures. Underground sewer, water main, and electric lines are shown on Figure 5-6.

5. Buried Utilities: A 12 inch water main is located adjacent to the northeast corner of Building 409. Sanitary sewer lines are located to the south of Building 410 and 409. An electrical line is situated between the structures. The utilities will be marked prior to field activities and are shown on Figure 5-6.

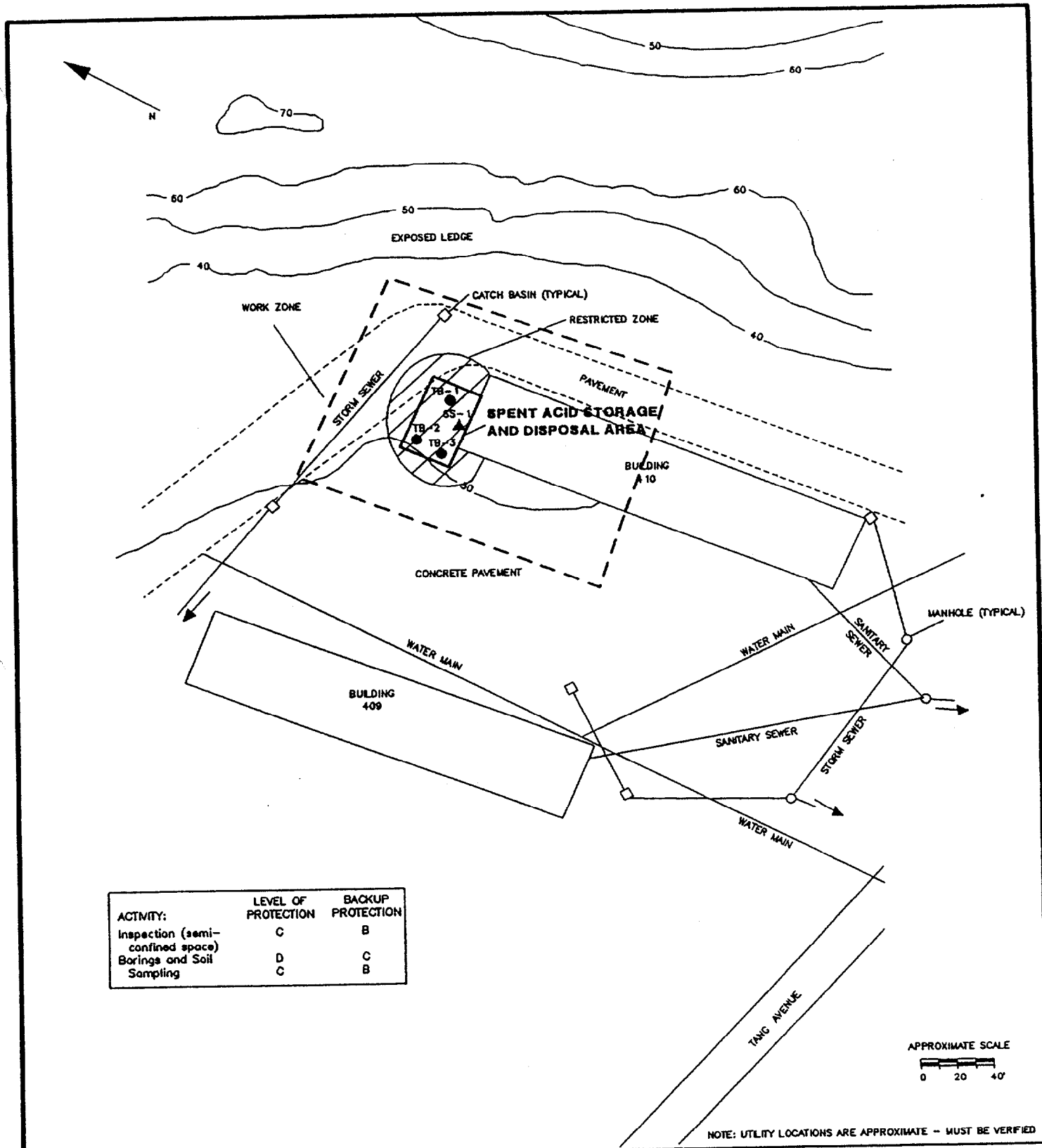
6. Topography: The site is paved and relatively flat. Drainage enters storm catch basins in and around the site.

7. Potential Hazardous Chemicals Onsite: Typical waste materials may include acids and metals (lead).

5.1.7 Former Gasoline Station

Site Description:

1. Location and Access: The site is located in the roadway and parking area just south of Building 164 in the central western section of upper base. Site access is available from Grenadier Avenue and the site plan is shown on Figure 5-7.



ACTIVITY:	LEVEL OF PROTECTION	BACKUP PROTECTION
Inspection (semi-confined space)	C	B
Borings and Soil	D	C
Sampling	C	B

NOTE: UTILITY LOCATIONS ARE APPROXIMATE – MUST BE VERIFIED

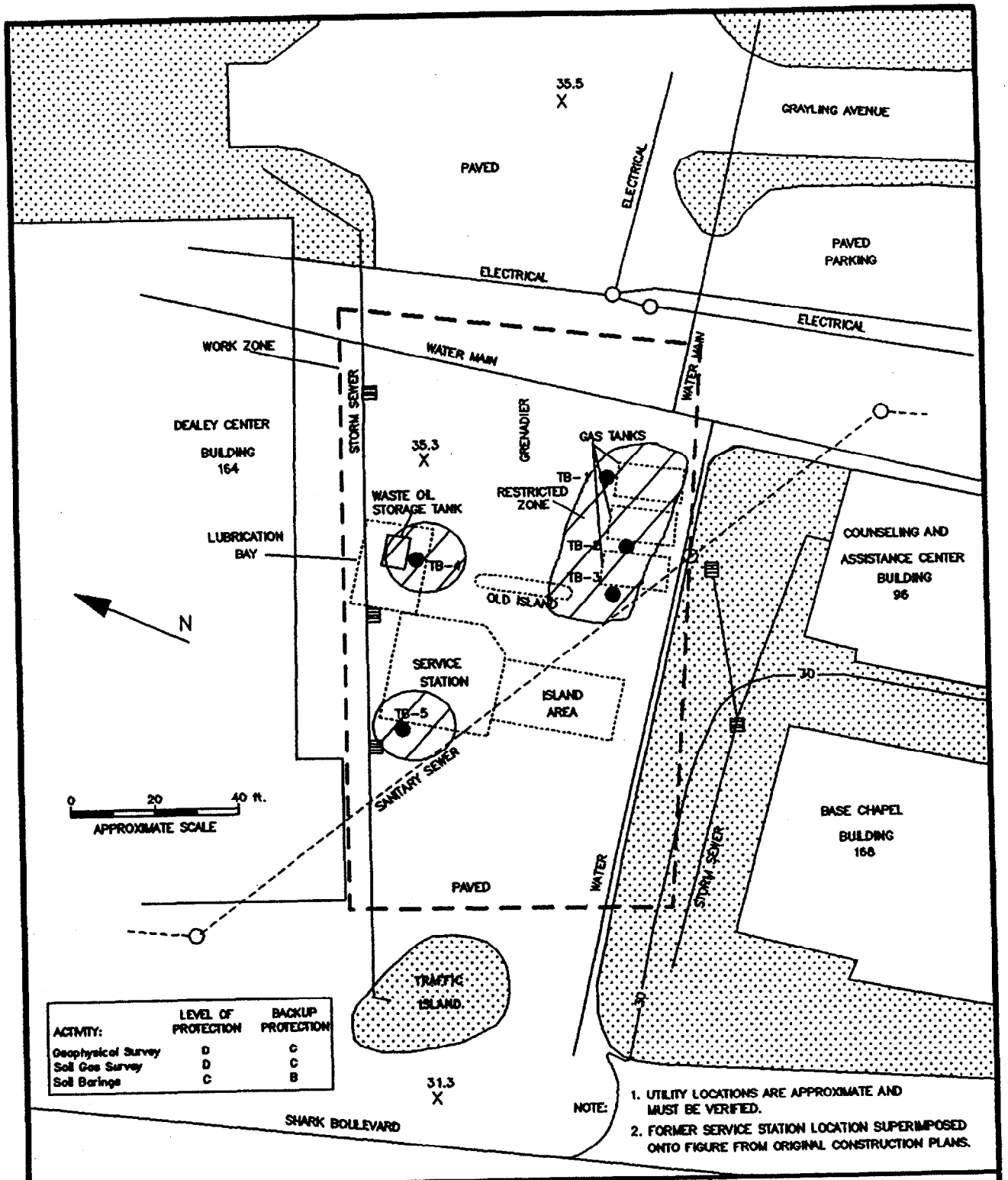
INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

LEGEND

PROPOSED	EXISTING
● TB-1 – Test Boring	—95— Existing Grade
▲ SS-1 – Surface Soil Sample	

FIGURE 5-6
SITE SAFETY PLAN
SPENT ACID STORAGE AND DISPOSAL

ATLANTIC ENVIRONMENTAL SERVICES, INC



ACTIVITY:	LEVEL OF PROTECTION	BACKUP PROTECTION
Geophysical Survey	D	C
Soil Gas Survey	D	C
Soil Borings	C	B

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

LEGEND

PROPOSED	EXISTING
● TB-1 – Test Boring	----- Former Structure
	—95— Existing Grade
	Sidewalk/Island
	78.2 X Spot Grade

FIGURE 5-7
SITE SAFETY PLAN
FORMER GASOLINE STATION

ATLANTIC ENVIRONMENTAL SERVICES, INC.

2. Existing Information for the Site: Detailed _____

   Preliminary __X__ Sketchy _____ None _____

3. Site History/Status: The gasoline station was in operation from 1940 to the early 1960's. According to old site plans, two 8,000 and one 10,000 gallon underground gasoline tanks were located on the southeastern portion of the site. In addition to the gas tanks, an underground waste oil tank was located under the northernmost lubrication bay floor. The gasoline station was demolished between 1962 and 1964.

4. Facilities Onsite: Building 164 (Dealey Center), 168 (Base Chapel) and 96 (Counseling and Assistance Center) are located adjacent to the site. The site is presently completely paved and serves as parking for the surrounding buildings, as well as a portion of Grenadier Avenue. There are no evidence or remnants of the former gasoline station.

5. Buried Utilities: A water main is located adjacent to the south side of Grenadier Avenue. A sanitary sewer line crosses the site diagonally from the northeast corner of Building 96 to the southwest corner of Building 164. An underground electrical line crosses the eastern edge of the site from the southeast corner of building 164 through the central portion of the parking lot on the east side of Building 96. The utilities will be marked prior to field activities and are shown on Figure 5-7.

6. Topography: The site is relatively flat and is entirely paved. Drainage enters the storm catch basins in and around the site and drains to the Thames River.

7. Potential Hazardous Chemicals Onsite: Typical waste materials may include petroleum products, waste oils, solvents and metals (waste oil).

The four Step II sites are described as follows:

5.1.8 <u>Area A Landfill</u> - <u>Site Description</u>

1. Location and Access: The landfill site is located in the northeastern section of the Subase west of the deployed personnel parking area. Because the drainage from Area A Landfill flows into a large wetland directly to the north, this entire wetland will be considered for the purposes of

health and safety as part of Area A Landfill. Also, the downgradient drainage way which includes North Lake and two stream beds is considered part of this site. Figures 5-8A and 5-8B show the areas associated with Area A Landfill. It should be noted that Atlantic's base of operations will be located in the contractor laydown area which is on Area A Landfill.

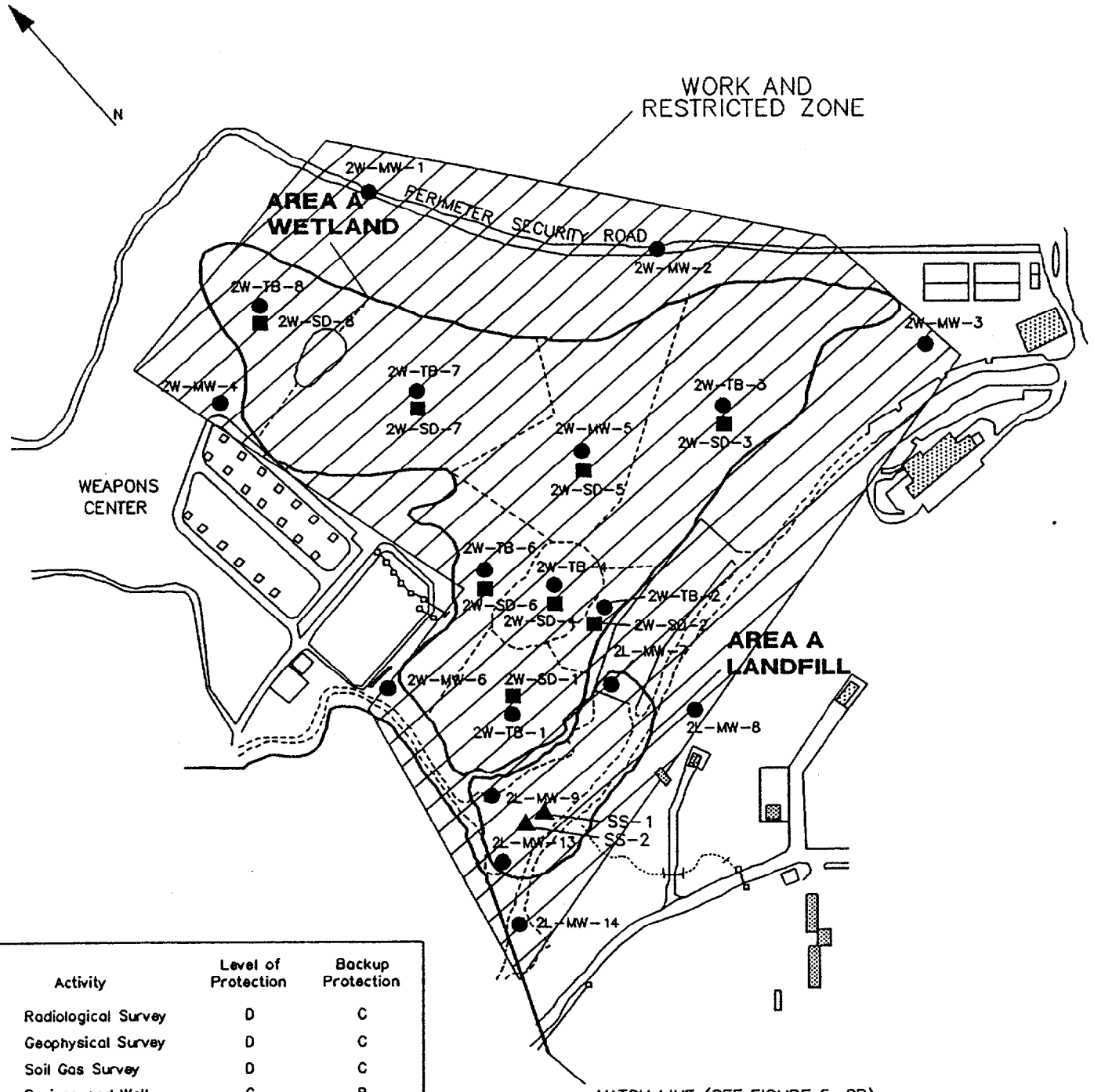
Access to the landfill, wetland and base of operations is available off Wahoo Avenue. Access to the drainage ways and North Lake is from Triton Avenue and Shark Boulevard.

2. Existing Information for Site: Detailed _____ Preliminary ____X____ Sketchy _____ None _____

3. Site History/Status: The site operated as a landfill prior to 1957 until 1973. Typical wastes disposed onsite included scrap wood, metal and waste chemicals. A concrete pad was located on the former landfill along the woodland to the south. This pad was used to store "hazardous" industrial waste. According to the IAS report, 42 steel drums, 87 transformers, and 60 to 80 electric switches were observed on the pad. Leaks were evident coming from two transformers (minerals and PCB) and several switches. The report also identified orange stained sediments present in the marsh, a petroleum slick on the surface water, and an iridescent green hue was observed on the edge of the marsh. The IAS report stated that at the edge of the landfill, which borders the wetland, steel drums, oxygen candles, wood, metal, concrete and tires were observed.

   Wehran Engineering conducted a field sampling program which involved the analysis of surface water and surface sediments in and around the wetland. Methylene chloride, phenols and metals were noted in surface water near the landfill. Polynuclear aromatic hydrocarbon compounds (PAH) were identified in the wetland across from the landfill adjacent to the weapons storage area and in downgradient streams. Sediments in the wetland near the landfill had methylene chloride, metals and toluene. Pesticides were noted in all the sediment samples taken in the wetland. PAH were also found in sediments across the wetland from the landfill as well as elevated cyanide levels.

   Atlantic personnel inspected the site on September 30, 1988. Orange colored landfill leachate was observed along the toe of the slope of the landfill extending from the dike to and including areas along the deployed parking



Activity	Level of Protection	Backup Protection
Radiological Survey	D	C
Geophysical Survey	D	C
Soil Gas Survey	D	C
Borings and Well Installation	C	B
Well Development	D	C
Ground Water Sampling	D	C
Sediment Sampling	D	C
Surface Soil Sampling	D	C

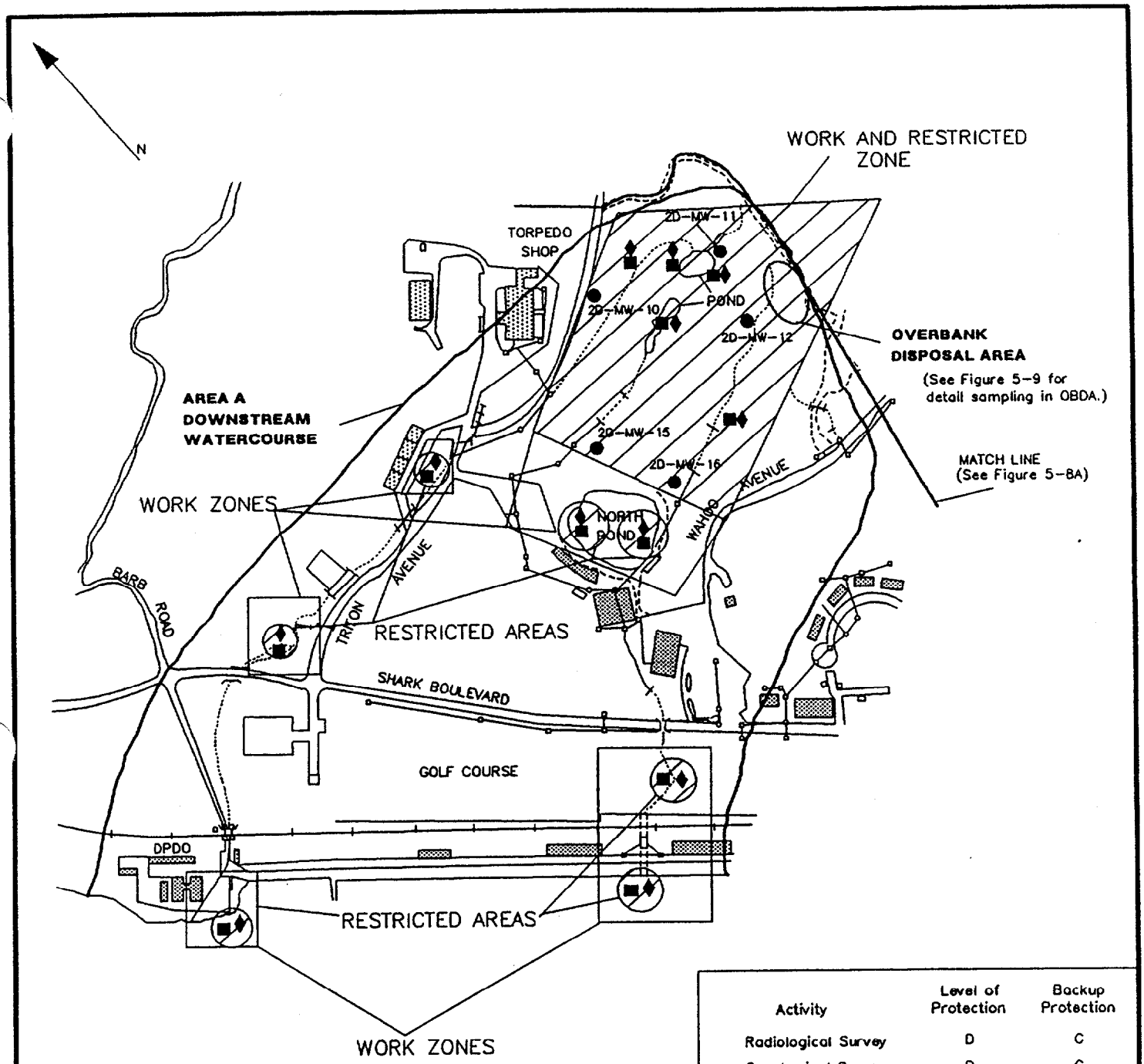
INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

LEGEND

PROPOSED	EXISTING
● TB-1 – Test Boring Sample	▩ Buildings
● MW-1 – Monitoring Well	
■ SD-1 – Sediment Sample	
▲ SS-1 – Surface Soil	

FIGURE 5-8A
SITE SAFETY PLAN
AREA A LANDFILL
AND WETLAND

ATLANTIC ENVIRONMENTAL SERVICE, INC.



Activity	Level of Protection	Backup Protection
Radiological Survey	D	C
Geophysical Survey	D	C
Soil Gas Survey	D	C
Borings and Well Installation	C	B
Well Development	D	C
Ground Water Sampling	D	C
Sediment Sampling	D	C
Surface Soil Sampling	D	C

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

LEGEND

PROPOSED	EXISTING
● MW-1 – Monitoring Well ■ SD-1 – Sediment Sample ♦ SW-1 – Surface Water Sample	

FIGURE 5-8B
SITE SAFETY PLAN
AREA A LANDFILL

ATLANTIC ENVIRONMENTAL SERVICE, INC.

area. The side slope face of the landfill had been covered with fill (therefore, the material in the landfill was not visible). Sand bags and contractor's equipment is currently stored on the landfill. Other equipment, several transformers, and removed underground storage tank are located on the concrete area.

4. Facilities Onsite: Power is available at the landfill in Building 496 and in numerous locations around North Lake.

5. Topography: The topography of Area A Landfill is flat apparently a man-made area which has a hillside sloping down to the site from the south and a slope down from the site to the north. The wetland to the north is also flat as a result of the creation of an earthen dike to hold dredge spoil. The drainage from both the wetland and the landfill flows west towards the Thames River through two small watersheds; one flows past North Lake and eventually into a flat open space where the Subase golf course and recreational areas are located and the other flows to the DPDO site.

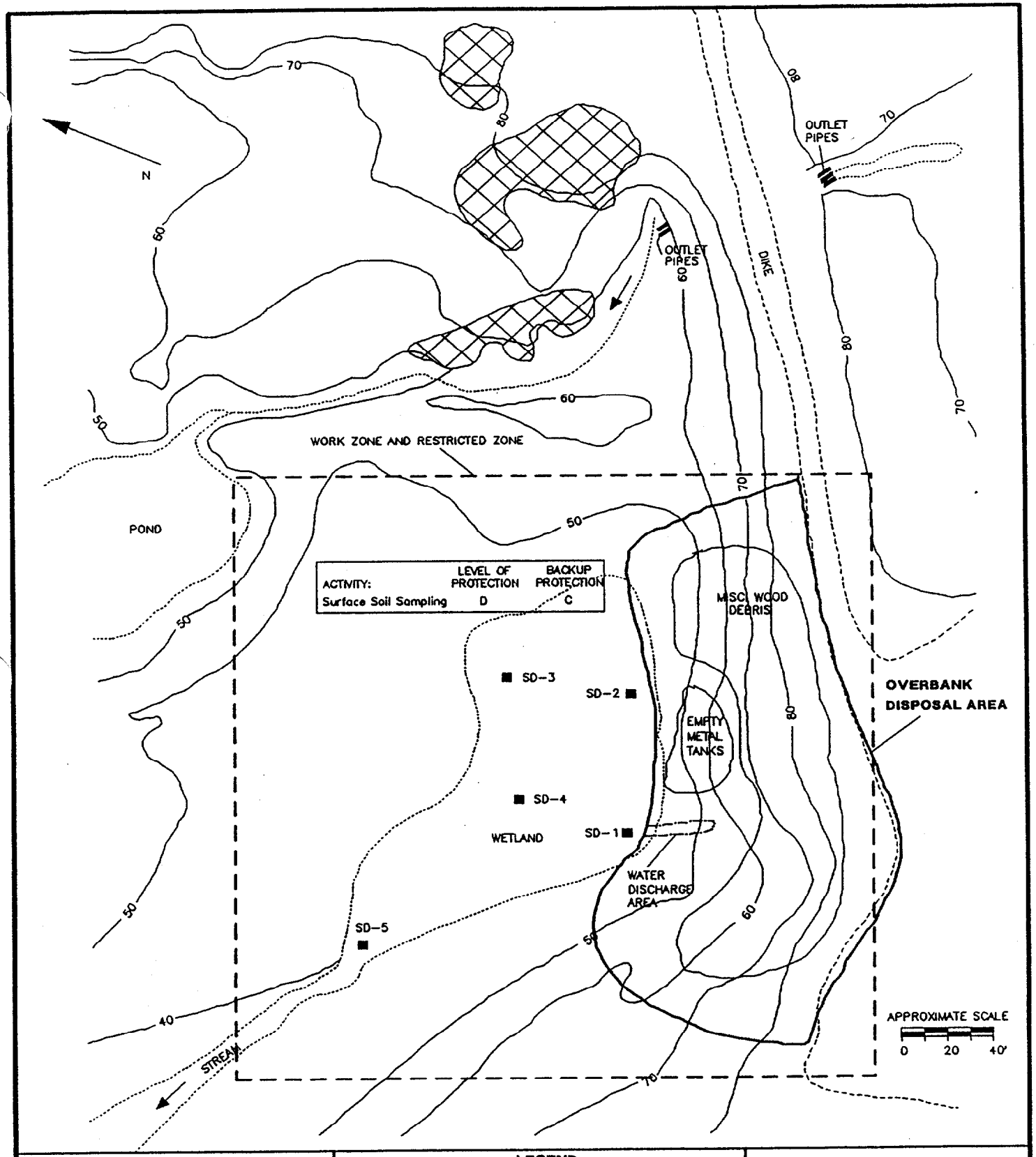
6. Potential Hazardous Chemicals Onsite: Potential hazardous wastes may include solvents, acids, petroleum products, medical wastes, pesticides, waste oils, PCBs and miscellaneous construction materials. PAHs in the sediment of the wetland may be from coal tar in dredge spoil.

5.1.9 Over Bank Disposal Area (OBDA) - Site Description

1. Location and Access: The site is located in the northeastern section of the property adjacent to Area A Landfill. Access is available via a dirt road off Wahoo Avenue. The disposal area is situated to the southwest of the earthen dike. Figure 5-9 depicts a site plan.

2. Existing Information for Site: Detailed _____ Preliminary ___X___ Sketchy _____ None _____

3. Site History/Status: According to the site history, the area was used as a disposal site from 1957 until approximately 1975. The IAS identified 30, 200-gallon steel fuel tanks onsite with no markings. Bright orange organic sediments were observed at the time of the investigation in the stream emanating from beneath the disposal area.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 5-9 SITE SAFETY PLAN OVERBANK DISPOSAL AREA
	PROPOSED	EXISTING	
	■ SD-1 – Sediment Sample	—95— Existing Grade Exposed Bedrock Stream	ATLANTIC ENVIRONMENTAL SERVICES, INC.

Previous sampling efforts in the areas just downgradient of the OBDA detected methylene chloride, phthalates, and metals in the surface water. Sediments contained benzene, methylene chloride, toluene, pesticides (4,4 DDD, 4,4 DDE and 4,4 DDT) and metals.

Atlantic personnel visually inspected the site on September 30, 1988. Old telephone poles with creosote, 200 gallon steel tanks, scrap wire rolls, several empty 55 gallon drums and other metal and wood material were observed at the base of the disposal area. A water discharge runs through the base of the dike to the wetland below the disposal area forming a stream which drains towards the Thames River. The stream sediments had a bright orange rust color.

4. Facilities Onsite: There are no structures or facilities directly onsite.

5. Topography: A man-made dike abuts the property to the east. The site slopes steeply from this point into a low-lying wetlands.

6. Potential Hazardous Chemicals Onsite: Due to its relationship with Area A Landfill, hazardous wastes which may be encountered would include petroleum products, solvents, pesticides, PCBs, PAHs and metals.

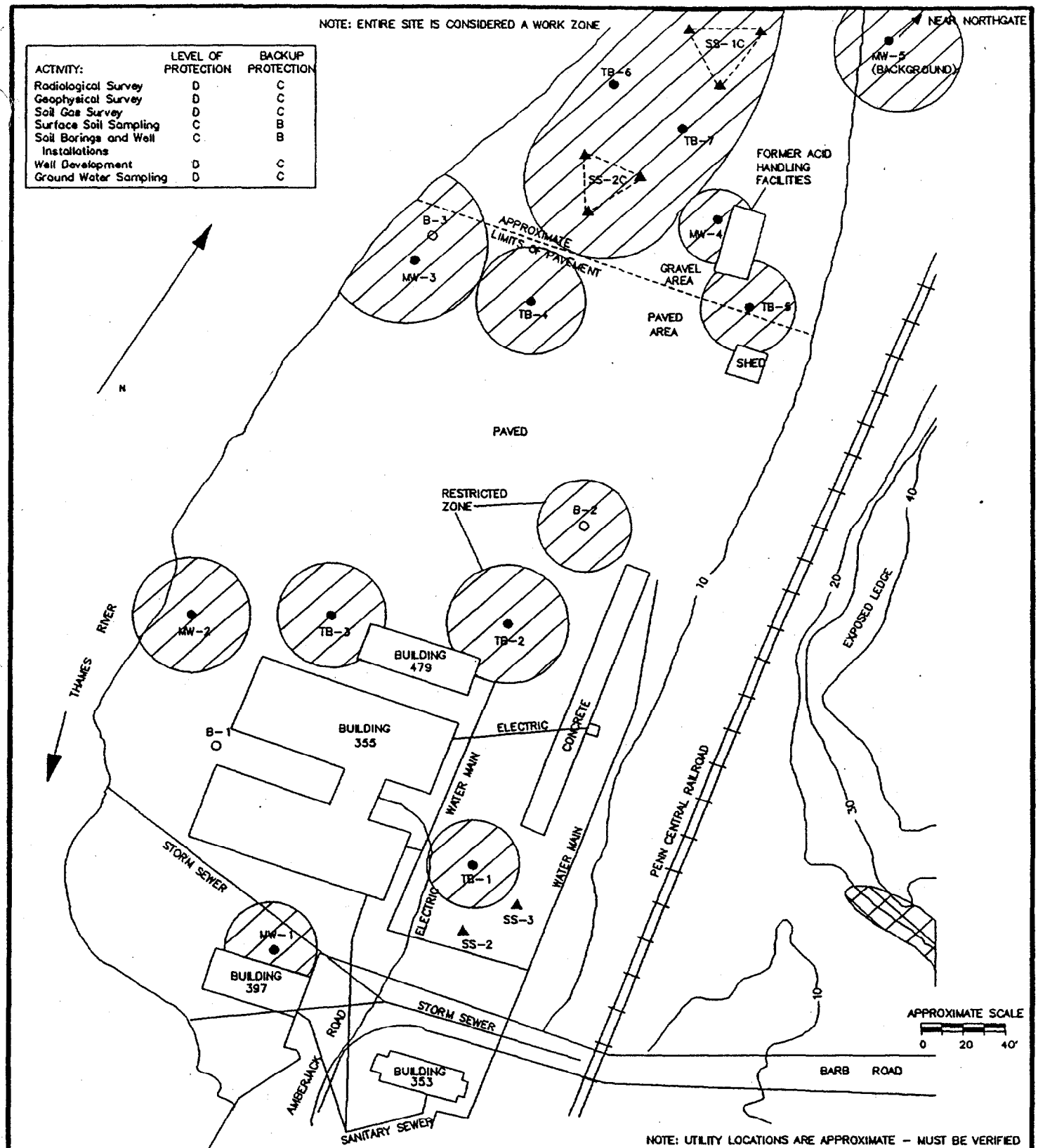
5.1.10 <u>DPDO Area</u> - <u>Site Description</u>

1. Location and Access: The site is located in the northwestern section of the property (Figure 5-10), adjacent to the Thames River. Access is available from Amberjack Road.

2. Existing Information for Site: Detailed _____ Preliminary ___X___ Sketchy _____ None _____

3. Site History/Status: The site operated as a landfill and waste burning ground area from 1950 until 1969. The materials which reportedly were burned and landfilled were primarily construction materials and non-salvagable waste items. Presently, it operates as the Subase salvage yard. According to the IAS report, surrounding surface soils may have become contaminated by leaks or spills of petroleum or waste chemicals during onsite operations.

   The Wehran sampling program consisted of drilling three borings in the DPDO area. The soil samples showed PAHs, metals and chloroform, 1,1 dichloroethane, 1,2 dichloroethene, methylene chloride, toluene, 1,1,1 trichloroethane and trichloroethylene.



ACTIVITY:	LEVEL OF PROTECTION	BACKUP PROTECTION
Radiological Survey	D	C
Geophysical Survey	D	C
Soil Gas Survey	D	C
Surface Soil Sampling	C	B
Soil Borings and Well Installations	C	B
Well Development	D	C
Ground Water Sampling	D	C

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

LEGEND

PROPOSED	EXISTING
● TB-1 – Test Boring	—95— Existing Grade
● MW-1 – Monitoring Well	Exposed Bedrock
▲-- SS-1 – Surface Soil Sample	○ B-1 – Test Boring

FIGURE 5-10
SITE SAFETY PLAN
DPDO AREA

ATLANTIC ENVIRONMENTAL SERVICES, INC.

A visual site inspection was performed by Atlantic personnel on September 30, 1988. An oil tank was observed adjacent to the northern section of Building 479. Submarine batteries are stored adjacent to the railroad tracks. Buildings 479 and 355 are located on a paved area. Building 491, a concrete structure which is used for miscellaneous storage, and a metal bailing operation are situated on a gravel area. Structure 385 no longer exists onsite. A former waste acid handling facility for battery acids was located on the north portion of this site as shown on Figure 5-10. It consisted of a below grade, rubber lined metal tank with piping leading to the south. This information was determined from building plans reviewed by Atlantic.

4. Facilities Onsite: There are six structures located onsite (Buildings 353, 355, 385, 397, 479, and 490). Potable water is available from structures 353, 355, 385, and 479. Sanitary sewer access is available from Buildings 353, 355, and 379. Storm sewer lines are located to the south of Buildings 355 and 397.

5. Buried Utilities: Electric utilities are located onsite they will be marked prior to drilling activities in locations approximately shown on Figure 5-10.

6. Topography: The property is generally level and is located along the shoreline of the Thames River.

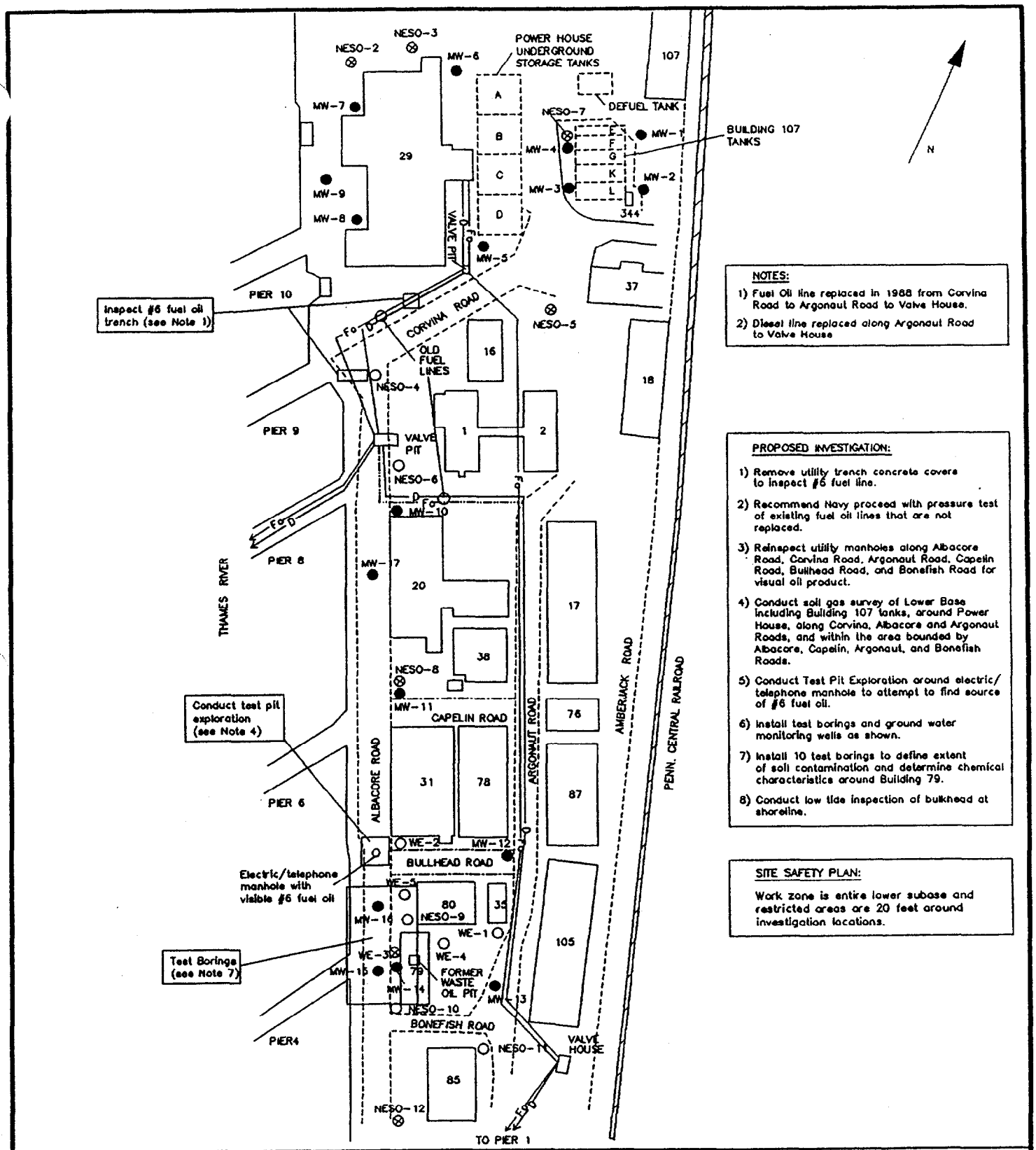
7. Additional Information: According to the IAS report, this general area is subject to flooding and there is potential for hazardous materials to be leached into the river.

8. Potential Hazardous Chemicals Onsite: Hazardous waste inherent to this site may include petroleum products, waste chemicals, solvents, acids, volatile aromatic compounds, PAHs, PCBs, and pesticides.

5.1.11 Lower Subase - Site Description

1. Location and Access: The site is located in the north western portion of the property. Albacore Road provides direct access to the site. The site is bounded on the west by the Thames River and on the east by the Providence and Worcester Railroad. A site plan is shown in Figure 5-11.

2. Existing Information for Site: Detailed _____ Preliminary ___X___ Sketchy _____ None _____



NOTES:

1) Fuel Oil line replaced in 1988 from Corvina Road to Argonaut Road to Valve House.
2) Diesel line replaced along Argonaut Road to Valve House

PROPOSED INVESTIGATION:

1) Remove utility trench concrete covers to inspect #6 fuel line.
2) Recommend Navy proceed with pressure test of existing fuel oil lines that are not replaced.
3) Reinspect utility manholes along Albacore Road, Corvina Road, Argonaut Road, Capelin Road, Bullhead Road, and Bonefish Road for visual oil product.
4) Conduct soil gas survey of Lower Base including Building 107 tanks, around Power House, along Corvina, Albacore and Argonaut Roads, and within the area bounded by Albacore, Capelin, Argonaut, and Bonefish Roads.
5) Conduct Test Pit Exploration around electric/telephone manhole to attempt to find source of #6 fuel oil.
6) Install test borings and ground water monitoring wells as shown.
7) Install 10 test borings to define extent of soil contamination and determine chemical characteristics around Building 79.
8) Conduct low tide inspection of bulkhead at shoreline.

SITE SAFETY PLAN:

Work zone is entire lower subase and restricted areas are 20 feet around investigation locations.

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

LEGEND

PROPOSED	EXISTING
● MW-1 – Monitoring Well	—D— Diesel Line
● TB-1 – Test Boring	—Fo— Fuel Oil Line
	—Fo— Out of Service Fuel Oil Line
	○ NESO-1 – NESO Well
	○ WE-1 – Wehran Well
	⊗ Destroyed Well

FIGURE 5-11
SITE SAFETY PLAN
LOWER SUBASE

ATLANTIC ENVIRONMENTAL SERVICES, INC.

3. The Lower Subase is the original Subase and, hence, its history dates back to 1867. Most of the construction which took place appears to have occurred in the early 1900's (late 1910's and early 1920's) with major expansion between 1935 and 1945. Fuel oil is the major contaminant on the Lower Base and potential sources are summarized below:

   Building 79 Waste Oil Pit - is located adjacent to a major portion of the contamination identified in the Wehran report. This area contained a railroad spur on which diesel train engines were serviced. The service area included a pit into which waste oil and solvents drained during the cleaning and servicing of the diesel engines. The pit is no longer in use and has been filled with concrete. Available building maps show a subsurface drain pipe from the pit extending outside the building foundation toward Albacore Road. The discharge location is undefined.

   The Power Plant Oil Tanks - were located underground on the Lower Base and have been in operation since World War II. The four tanks which were recently replaced had a 170,000 gallon capacity each and were constructed of concrete. Tanks A and B contain #6 grade fuel oil which is pumped to them from the tank farms on the north end of the base. Tank C contains diesel oil, and Tank D contains waste oil from the power plant bilge water oil recovery system. The fuel and waste oil is used in the power plant boilers to generate steam and electricity for support operations on the lower base. Mr. Mansfield reported that when these tanks were replaced, it was apparent that oil leakage occurred. The tanks were replaced about six months ago.

   Fuel Oil Storage Tanks at Building 107 - The five storage tanks are underground and next to a paved parking area. The tanks are concrete and have been in use since prior to World War II. Three of the tanks (E, F, and G) each have a 125,000 gallon capacity and are used to store diesel fuel. Tanks K and L have a 25,000 gallon capacity and are used to store lube oil. The tanks are still in existence.

   Fuel Oil Distribution System - consists of underground #6 and diesel lines as shown on Figure 5-11. The lines are used to transmit barged oil to the power house, to the tanks under the ball field near the main gate, and to fuel ships at the piers.

In 1979, the Navy Environmental Support Office (NESO) conducted an investigation of the Lower Subase to determine the source and extent of oil found in the soils in the riverfront area. A total of twelve monitoring wells were installed across the Lower Subase as part of the investigation. The study found contamination near the powerhouse tanks, around the tanks south of Building 107, and northwest of Building 79. There was an abandoned waste oil pit underneath Building 79 which evidently drained into the nearby soil. The oil found in the vicinity of Building 79 was concluded to be a lubricating oil.

The NESO report recommended the abandonment of the waste oil pit (it was later backfilled with concrete) and the installation of a recovery well system. The system was operated until most of the oil was apparently recovered.

Wehran was conducting a confirmation study for three sites on the Upper Subase during 1985 and 1986, when oil was found by Navy personnel in the concrete utility trenches and manholes on the Lower Subase. Wehran installed five additional monitoring wells in the vicinity of Building 79 to determine the extent of the oil contamination. The Wehran investigation concluded the oil contamination was primarily to the north of Building 79 and consisted of #6 fuel oil.

Atlantic investigated the site on September 30, 1988 and was unable to observe the abandoned waste oil pit because of the building layout. Atlantic revisited the site on November 7, 1988 and observed the interior of numerous manholes and noted oil contamination only in the area north of Building 79.

4. Facilities Onsite: Potable water, electrical and sanitary facilities are available from many sources in the lower base.

5. Buried Utilities: The entire lower base is served power, water, steam, fuel oil, sewer and telephone through buried utilities. The available utility maps will be reviewed for placement of borings/wells and Subase personnel will be contacted to clear and mark utility locations.

6. Topography: The site is generally level and is located adjacent to the pier area.

7. Potential Hazardous Chemicals Onsite: Potential hazardous materials may include waste oil, solvents, #6 fuel oil, and diesel fuel.

5.2 Entry Objectives

The HASP was developed to provide a predetermined level of safety with contingencies during non intrusive testing, drilling, well installation, well development, soil sampling, sediment sampling, and ground water sampling activities at the Subase. The purpose of the field investigation is to determine the extent and source of contamination onsite, assess environmental and public health risks, and evaluate remedial action plans.

5.3 Authorized Site Personnel and Their Responsibilities

The following responsibilities have been assigned to the personnel indicated below:

(Note: One person may be responsible for more than one job function.)

Project Team Leader: Paul Burgess
Site Safety Engineer: John Ripp
Recordkeeper: Curtis Kraemer
Field Team Leader: Curtis Kraemer
Field Team Members:
Charles Pierce
Malcolm Webster
James L. Cutler
Lynn Metcalf
Terry Taylor
W. Curtis Nichols
Michael Nejdl

Authorized Navy Representatives:
William Mansfield (Point of Contact)
James Fitzpatrick
Adrienne Townsell (Engineer in Charge)

State/Federal Agency Representatives:

Contractor(s): Weston Geophysical, Inc.
East Coast Drilling, Inc.
LaFramboise Well Drilling, Inc.
Radiation Safety Associates, Inc.

5.4 Control of Site Access

1. The site safety engineer will be responsible for controlling access to all work areas and contaminated zones on the site.

2. The sites which are the subject of the restoration study have been identified according to restricted zones, decontamination zones, and the support zone(s) ("clean" areas, such as the field office or laboratory). These areas are indicated on the individual site maps and are described as follows:.

a. Restricted Zones:

1) In areas of excavation including surface soil sampling, the work is defined as a circle around the sample point or drill rig with a radius of 20 feet. Only authorized site personnel will be able to enter this zone under the appropriate level of protection during sampling activities.

2) The entire wetland and drainage channels associated with Area A Landfill.

b. Decontamination Zone(s):

1) Personnel decontamination will also be conducted near the site office area. The office will be marked by a sign.

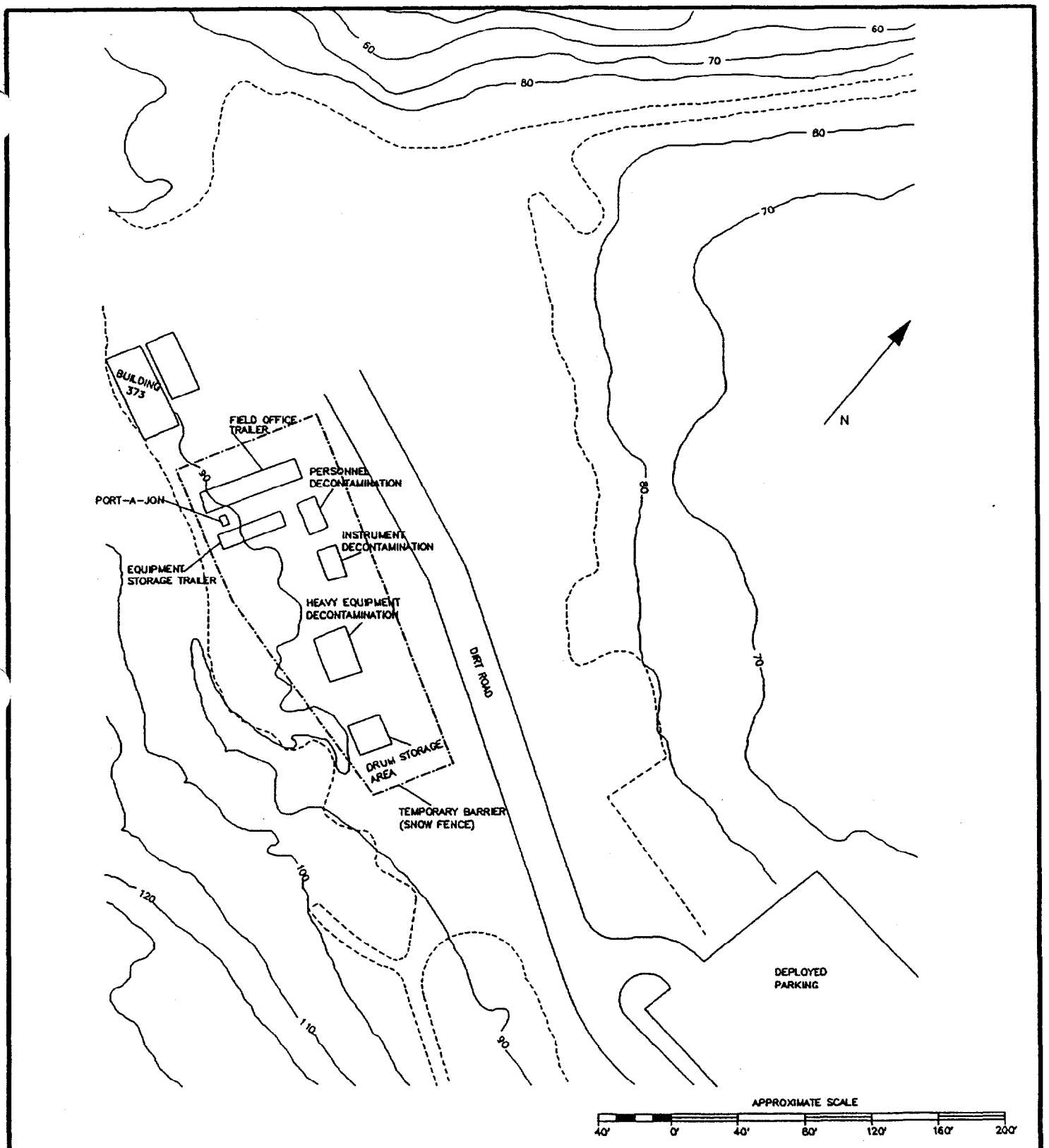
2) All heavy equipment and drilling tools will be decontaminated at a centralized area near the site office trailer. All sediment and water from this operation will be contained and stored in drums prior to disposal.

c. Support Zones (clean areas):

1) The Site office will be located at a field trailer at the contractor lay down area on Area A Landfill, see Figure 5-12 for location of base of operations.

2) Equipment storage location will be situated adjacent to the site office.

3) Portable rest room areas near the site office trailer.



INSTALLATION RESTORATION STUDY NAVAL SUBMARINE BASE NEW LONDON GROTON, CT	LEGEND		FIGURE 5-12 SITE SAFETY PLAN LOCATION OF ATLANTIC'S BASE OF OPERATIONS
	PROPOSED	EXISTING	
		—95— Existing Grade	ATLANTIC ENVIRONMENTAL SERVICES, INC.

Maps of the base of operations and each of the eleven sites delineating the various areas described above will be posted at the following locations:

POC's Office
Atlantic's Site Office
Subase Security Office

If site conditions develop that require changes in the established zones, the Navy POC will be notified immediately. The zones will be revised, and a meeting will be held for site personnel to inform them of the changes, the reasons that caused them to be made, and any new health and safety practices that might be necessary as a result of the altered site conditions. The site maps will be revised to show the new configuration of controlled areas. The new maps will be posted at the locations listed above and attached to the copy of the HASP kept in the site office.

5.5 Evaluation of Potential Hazards at the Associated Sites

The major waste types expected at a Subase site, based on past operations, and the primary hazards of each are identified below.

Waste Sources: FUEL OIL, WASTE OIL AND PETROLEUM PRODUCTS

Potential Locations: All Step I and Step II sites except for the Spent Acid Storage and Disposal Area

Form: Gas ___ Liquid _X_ Sludge _X_ Solid ___

Characteristic: Corrosive ___ Ignitable _X_ Radioactive ___ Volatile _X_ Toxic ___ Reactive ___ Other ___ Unknown ___

Containment: Drum _?_ Pit _?_ (Buried) Pond ___ Lagoon ___ Above ground tank ___ Below ground tank _?_ Soils _X_ Debris ___ Other ___

Waste Sources: MEDICAL WASTES

Potential Locations: Goss Cove Landfill, OBDANE, Area A Landfill, OBDA and DPDO

Form: Gas ___ Liquid _X_ Sludge ___ Solid _X_

Characteristic: Corrosive ___ Ignitable ___ Radioactive ___ Volatile ___ Toxic _X_ Reactive ___ Other ___ Unknown _X_

Containment: Drum _X_ Pit _X_ (Buried) Pond ___ Lagoon ___
Above ground tank ___ Below ground tank ___
Soils _?_ Debris _X_ Other ___

Waste Sources: PROPANE OR OTHER COMPRESSED GAS TANKS

Potential Locations: Area A Landfill, Goss Cove Landfill and the DPDO

Form: Gas _X_ Liquid ___ Sludge ___ Solid ___

Characteristic: Corrosive ___ Ignitable _X_ Radioactive ___
Volatile _X_ Toxic ___ Reactive ___ Other ___
Unknown ___

Containment: Drum ___ Pit ___ (Buried) Pond ___ Lagoon ___
Above ground tank ___ Below ground tank _?_
Soils ___ Debris ___ Other ___

Waste Sources: PAINT PRODUCTS

Potential Locations: All sites

Form: Gas ___ Liquid _X_ Sludge ___ Solid ___

Characteristic: Corrosive ___ Ignitable ___ Radioactive ___
Volatile _X_ Toxic _X_ Reactive ___ Other ___
Unknown ___

Containment: Drum _?_ Pit ___ (Buried) Pond ___ Lagoon ___
Above ground tank ___ Below ground tank ___
Soils _X_ Debris _X_ Other ___

Waste Sources: ACIDS

Potential Locations: Spent Acid Storage and Disposal Area, Area A Landfill, DPDO

Form: Gas ___ Liquid _X_ Sludge ___ Solid _X_

Characteristic: Corrosive _X_ Ignitable ___ Radioactive ___
Volatile ___ Toxic _X_ Reactive ___ Other ___
Unknown ___

Containment: Drum _?_ Pit _?_ (Buried) Pond ___ Lagoon ___
Above ground tank ___ Below ground tank _X_
Soils _X_ Debris ___ Other ___

Waste Sources: WASTE/LUBE OIL

Potential Locations: All sites

Form: Gas ___ Liquid _X_ Sludge _X_ Solid ___

Characteristic: Corrosive ___ Ignitable _X_ Radioactive ___
Volatile _X_ Toxic _X_ Reactive ___ Other ___
Unknown ___

Containment: Drum _?_ Pit _?_ (Buried) Pond ___ Lagoon ___
Above ground tank ___ Below ground tank _?_
Soils _X_ Debris ___ Other ___

Waste Source: PCB's

Potential Locations: Area A Landfill, Goss Cove Landfill, DPDO

Form: Gas ___ Liquid _X_ Sludge ___ Solid _X_

Characteristic: Corrosive ___ Ignitable ___ Radioactive ___
Volatile ___ Toxic _X_ Reactive ___ Other ___
Unknown ___

Containment: Drum _?_ Pit _?_ (Buried) Pond ___ Lagoon _?_
Above ground tank ___ Below ground tank _?_
Soils _X_ Debris ___ Other ___

Waste Sources: PESTICIDES

Potential Locations: Area A wetland and drainage way, OBDA

Form: Gas ___ Liquid _X_ Sludge _X_ Solid _X_

Characteristic: Corrosive ___ Ignitable ___ Radioactive ___
Volatile ___ Toxic _X_ Reactive ___ Other ___
Unknown ___

Containment: Drum _?_ Pit ___ (Buried) Pond ___ Lagoon ___
Above ground tank ___ Below ground tank ___
Soils _X_ Debris ___ Other ___

Waste Sources: SOLVENTS

Potential Locations: All sites except for the Spent Acid Storage and Disposal Site

Form: Gas ___ Liquid _X_ Sludge ___ Solid ___

Characteristic: Corrosive _X_ Ignitable _X_ Radioactive ___
Volatile _X_ Toxic _X_ Reactive _X_ Other ___
Unknown ___

Containment: Drum _?_ Pit _?_ (Buried) Pond ___ Lagoon ___
Above ground tank ___ Below ground tank ___
Soils _X_ Debris ___ Other ___

Waste Sources: POLYNUCLEAR AROMATIC HYDROCARBONS (PAHs)

Potential Locations: Area A landfill, OBDA, DPDO and Goss Cove Landfill

Form: Gas ___ Liquid _X_ Sludge _X_ Solid _X_

Characteristic: Corrosive _X_ Ignitable ___ Radioactive ___
Volatile _X_ Toxic _X_ Reactive ____ Other ___
Unknown ___

Containment: Drum ___ Pit ___ (Buried) Pond ___ Lagoon ___
Above ground tank ___ Below ground tank _X_
Soils _X_ Debris _X_ Other ___

Waste Sources: ORDINANCE

Potential Locations: Area A landfill, DPDO and Goss Cove Landfill

Form: Gas ___ Liquid ___ Sludge ___ Solid _X_

Characteristic: Corrosive ___ Ignitable _X_ Radioactive ___
Volatile ___ Toxic ___ Reactive _X_ Other ___
Unknown _X_

Containment: Drum _?_ Pit ___ (Buried) Pond ___ Lagoon ___
Above ground tank ___ Below ground tank _X_
Soils _?_ Debris _?_ Other ___

Waste Sources: OTTO FUEL

Potential Locations: Torpedo Shops

Form: Gas ___ Liquid _X_ Sludge _X_ Solid ___

Characteristic: Corrosive ___ Ignitable _X_ Radioactive ___
Volatile _X_ Toxic _X_ Reactive ___ Other ___
Unknown ___

Containment: Drum _X_ Pit ___ (Buried) Pond ___ Lagoon ___
Above Ground Tank _X_ Below Ground Tank _X_
Soils _X_ Debris ___ Other ___

NOTE: "?" indicates a feature or characteristic whose existence is determined on a site specific basis during the preliminary phase of the investigation; x indicates a characteristic usually associated with the specific waste type)

The specific chemicals expected to be found on the site are listed below and Materials Safety Data Sheets for these compounds are included in Appendix B.

Substances Involved	Primary Hazards
1. Petroleum product contaminated soils	Skin absorption, vapor inhalation, skin or eye contact
2. Solvents	Vapor inhalation, skin absorption, skin or eye contact
3. Acid	Vapor inhalation, skin or eye contact, reactions with other chemicals
4. Propane or other compressed gas	Explosion, vapor, inhalation, skin or eye contact
5. Medical Wastes	Vapor, inhalation, skin or eye contact
6. Pesticides & PCBs	Skin or eye contact
7. PAH compounds	Skin or eye contact
8. Otto Fuel	Skin Absorption, vapor inhalation, skin or eye contact

The following additional hazards, not related to Subase disposal activities, also are expected to be found on site: Overhead power lines, vehicular traffic around site vicinity, and buried utilities.

5.6 Levels of Protection For Site Workers

Levels of protection specified by the EPA refer largely to requirements for respiratory protection. The lists below stipulate equipment for respiratory, clothing, and other types of protection that will be required for different tasks during the site investigation. The designated levels of protection are based on evaluation of potential hazards and risks associated with work at the Subase site.

Based on organic vapor readings using a HNu photoionization detector or OVA flame ionization detector in the work zone for each site activity, the criteria for maintaining or revising levels of protection taken in respiratory areas are as follows:

Background (ambient)	Level D
5-50 ppm above ambient	Level C
50-500 ppm above ambient	Level B
500-1000 ppm above ambient	Level A

5.6.1 Levels of Protection for Specific Site Activities

			Level of Protection	Backup Protection
1.	SITE:	CBC Drum Area		
	ACTIVITY:	Surface Soil Sampling	D	C
2.	SITE:	Rubble Fill at Bunker A-86		
	ACTIVITY:	Surface soil samples at base of fill	D	C
3.	SITE:	Torpedo Shops		
	ACTIVITY:	Soil Gas Survey (non-intrusive)	D	C
		Soil Borings and Well Installation	C	B
		Well Development	D	C
		Ground Water Sampling	D	C
		Surface Water Sampling	D	C
		Sediment Sampling	D	C
4.	SITE:	Goss Cove Landfill		
	ACTIVITY:	Radiological Survey	D	C
		Geophysical Survey (non-intrusive)	D	C
		Soil Gas Survey (non-instrusive)	D	C
		Borings and Well Installation	C	B
		Well Development	D	C
		Ground Water Sampling	D	C
5.	SITE:	OBDANE		
	ACTIVITY:	Surface Soil Samples	D	C
6.	SITE:	Spent Acid Storage and Disposal Area		
	ACTIVITY:	Inspection (semi-confined space)	C	B
		Borings and Soil Sampling	D	C
7.	SITE:	Former Gasoline Station		
	ACTIVITY:	Geophysical Survey (non-intrusive)	D	C
		Soil Gas Survey (non-intrusive)	D	C
		Soil Borings	C	B

8.	SITE:	Area A Landfill Proper		
	ACTIVITY:	Radiological Survey	D	C
		Geophysical Survey	D	C
		Soil Gas Survey	D	C
		Borings and Well Installations	C	B
		Well Development	D	C
		Ground Water Sampling	D	C
9.	SITE:	Area A Wetland Upstream of Dike		
	ACTIVITY:	Surface Soil/Sediment Sampling	D	C
		Surface Water Sampling	D	C
		Soil Borings	D	C
		Well Installation on Perimeter	D	C
		Well Development	D	C
		Ground Water Sampling	D	C
10.	SITE:	Area A Drainage Way Downstream of Dike		
	ACTIVITY:	Sediment Sampling	D	C
		Surface Water Sampling	D	C
		Soil Borings	D	C
		Well Installations	D	C
		Well Development	D	C
		Ground Water Sampling	D	C
		Biological Sampling	D	C
11.	SITE:	OBDA		
	ACTIVITY:	Surface Soil Sampling	D	C
12.	SITE:	DPDO		
	ACTIVITY:	Radiological Survey	D	C
		Geophysical Survey	D	C
		Soil Gas Survey	D	C
		Surface Soil Sampling	D	C
		Soil Borings and Well Installations	C	B
		Well Development	D	C
		Ground Water Sampling	D	C

13. SITE: Lower Base

ACTIVITY:		
Soil Gas Survey	D	C
Test Pit Excavations	C	B
Soil Borings and Well Installations	C	B
Well Development	D	C
Ground Water Sampling	D	C
Confined Space Inspection	B	A

Specific protective equipment for each level of protection is as follows:

Level C	Level D
half- or full-face respirators (MSA GMC-H or equivalent) depending on site conditions	hard hats with splash shields or goggles
tyvek splash resistant suit	tyvek suit or work overalls
hard hats with splash shields or goggles	steel-toe boots and over-boots
steel-toe boots and over-boots	disposable, latex, inner gloves
disposable, latex inner gloves	chemical-resistant, outer gloves
chemical-resistant outer gloves	

Level B	Level A
pressure-demand, full face SCBA or pressure demand supplied air respirator with escape SCBA	pressure-demand, full face SCBA or pressure demand supplied air respirator with escape SCBA
chemical resistant clothing	fully encapsulating chemical resistant suit
inner and outer chemical resistant gloves	inner and outer chemical resistant gloves
chemical resistant safety boots or shoes	chemical resistant safety boots or shoes
hardhat	hardhat
two way radio	two way radio

The site safety engineer will keep close track of the work schedules listed in the Site Sampling Plan in order to be sure that all workers entering the site have had their safety briefing and the amount of safety equipment kept on site, such as the number of respirators available, is sufficient for all of the workers and observers present at any time.

5.6.2 Radiological Monitoring

An environmental radiation survey will be conducted onsite, prior to field sampling activities, by Radiation Safety Associates, Inc. This survey is an OSHA requirement prior to drilling on a site with unknown conditions. Their scope of services include the following:

- Perform a gamma radiation survey at three sites at the Subase. These areas include Goss Cove Landfill, Area A Landfill and DPDO Area.
- Locate and identify to Atlantic areas where the environmental levels of gamma radiation indicate the presence of radioactive material.
- In areas where gamma radiation levels are elevated, the Navy POC will be contacted and beta and alpha radiation surveys will be performed in order to accurately characterize the situation.
- Submit a written report of the findings of the radiological survey and state the specific ambient and action levels for site workers.

5.6.3 Geophysical Survey

A geophysical survey will be performed at the Subase site, by Weston Geophysical Corporation, prior to field sampling activities. This survey will be implemented in areas associated with buried drums or underground tanks or gas cylinders, specifically; Area A Landfill, Goss Cove Landfill, Former Gasoline Station, and the DPDO Area.

This survey will be used to locate any buried metallic objects prior to instituting the drilling activities so they can be avoided. The geophysical study will include the following:

- Perform an electromagnetic survey of Area A Landfill (5-8 acres), Goss Cove (3 acres), Former Gasoline Station (1 acre), and DPDO Area (5 acres).
- Located and identify areas of concern in respect to buried metal objects.
- Perform a magnetometer, resistivity and ground penetrating radar (GPR) survey to attempt to accurately characterize the situation.

5.6.4 Ambient Monitoring and Protection Limits

During drilling, excavation, and sampling, the air in work areas will be sampled periodically for the presence of contaminants as stipulated by the EPA Interim Standard Operation Guidelines. A HNu portable photoionizer will be utilized to periodically monitor the levels of organic vapors in the ambient air during the field work to ensure that appropriate levels of respiratory protection are employed at all times. HNu readings will be taken continuously during the advancement of drill holes or test pits. Measurements will be monitored from within the test pits or the top of the borings as an indicator of the worst case conditions, however, measurements will be monitored from the respiratory level (waist level and higher) for determining the actual safety conditions and whether there is a need to change to a higher level of safety (or whether the level of safety can be lowered). In addition, Atlantic will use an oxygen deficiency and lower explosive limit (LEL) meter to screen for potential gas or vapor leaks around drilling operations in unknown areas. The following gas specific Draeger tubes will be used as necessary:

- hydrogen sulfide
- natural gas
- benzene
- vinyl chloride
- mercury vapor
- cyanide

Finally, Atlantic will maintain a geiger counter (LUDLUM Model 19 Micro-R Meter) for screening purposes.

5.6.5 Heat Stress Monitoring

Wearing personal protective equipment puts site workers at risk of developing heat stress which may result in health effects ranging from fatigue to serious illness to death. Heat stress is caused by the interplay of a variety of factors, including ambient conditions, workload, clothing, and the physical characteristics of each worker. The major symptoms of heat stress are listed in Table 5-1. When the temperature in the work area is at or above 70 degrees F (21 degrees C), all workers, even those not wearing protective clothing, will be monitored for heat stress during rest periods according to the following procedures:

- Take pulse over a 30 second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one third and keep the rest time the same. If, at the next rest period, the heart rate still exceeds 110 beats per minute, shorten the following work period again by one third. Continue the process as necessary.

- Take body temperature orally using a clinical thermometer kept under the tongue for three minutes. Take temperature at the end of each work cycle before drinking anything. If the temperature exceeds 99.6^{o} F (37.6^{o} C), shorten the next work period by one third without changing the rest period. If the temperature still exceeds 99.6^{o} F at the beginning of the next rest period, shorten the following work cycle by one third. No worker will be permitted to wear a semi-permeable or impermeable garment if their temperature exceeds 100.6^{o} F (38.1^{o} C).

- If possible, it is also a good practice to monitor worker's body water loss. Body water loss is determined by weighing each worker, on a scale good to 0.25 pounds, at the beginning and end of each day. The difference in weights will indicate whether an individual is drinking enough fluids to prevent dehydration. The body weight loss should not exceed 1.5 percent of the total body weight in one work day.

5.6.6 Precautions for Sampling or Contacting Medical Wastes

Due to the ambiguous nature of where historic medical waste were disposed and the potential for encountering it on each of the eleven sites, Atlantic will take special precautions when working. If encountered, the site personnel will handle lab packs, syringes, medicinal vials, and/or soiled fabric by remote handling (pliers or other tool) practices. Level C respiratory protection plus a double

TABLE 5-1

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

SIGNS AND SYMPTOMS OF HEAT STRESS

- Heat rash may result from continuous exposure to heat or humid air.
- Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
  - muscle spasms
  - pain in the hands, feet, and abdomen
- Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:
  - pale, cool, moist skin
  - heavy sweating
  - dizziness
  - nausea
  - fainting
- Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms area
  - red, hot, usually dry skin
  - lack of or reduced perspiration
  - nausea
  - dizziness and confusion
  - strong, rapid pulse
  - coma

---

layer of chemical resistant gloves will be worn while handling these wastes. Such wastes will be stored in plastic bags and documented in field logs and through chain-of-custody procedures. In no case will any site workers be allowed to breath or touch any form or sign of medical wastes. Medical wastes encountered will be placed under the control of the Navy for disposal with other hospital wastes generated at the Subase.

5.6.7 Precautions for Sampling or Contact with Buried Compressed Gas or Ordinance

As in the Goss Cove Landfill, buried metal containers of compressed gas may be encountered. It is also unknown if ordinance may have been inadvertently disposed of in any Subase landfill. This is a possibility while drilling in the other two landfills, i.e. DPDO and Area A.

The non-intrusive geophysical surveys should identify buried tanks, ordinance, drums and metal containers. Boreholes will be located so as to avoid these metal objects. Atlantic will use a metal detector, organic vapor analyzers geiger counters and LEL (lower explosive limit) meters at the drilling operations in these landfills to screen for potential releases of compressed gas. If a release is emanate, the site safety engineer and the activity POC will be notified and emergency procedures will be implemented.

The field operations at Goss Cove landfill will be scheduled so that Atlantic is working there on days when the Nautilus museum is closed to the public. In this way Subase security can close the parking lot at this site while sampling is taking place.

5.6.8 Precautions for Confined Entry Work

The Field Sampling Plan does not call for performing any specific confined entry work, but the nature of site investigations is to find the unexpected. Therefore, if any confined entry work is required, it will be performed in accordance with NAVSEA S6470-AA-SAT-010 (NAVSEA Gas Free Engineering Program) and NIOSH Standards for Working in Confined Spaces (December, 1979). Copies of both standards will be kept in the field trailer at all times. Confined entry work will not be performed without first notifying and receiving approval from the site safety engineer.

5.7 Communication Procedures

Atlantic will utilize mobile telephones at the base of operations and for each field activity in order to have access to emergency support groups and between field team members. Where possible, walkie-talkies will be used in areas such as the Area A wetland to communicate with the site office trailer.

5.8 Decontamination Procedures

Decontamination areas will be established for the following activities:

1) Personnel Decontamination
2) Equipment Decontamination
3) Sampling Equipment Decontamination

5.8.1 Personnel Decontamination Station

A personnel decontamination area will be set up near the site office. This station will have benches where workers can sit, clean and remove protective clothing (e.g., boots and gloves) and other equipment, such as respirators. It will be equipped with basins for water, detergent, and other decontamination fluids. Once personnel have gone through decontamination at this station and taken off their protective gear, they will be able to proceed to a sink where they will wash themselves where ever they may have been exposed to any contaminants.

The following specific decontamination procedure will be used by site workers wearing protective clothing and equipment from level D through level B:

Step 1 - Equipment drop

Step 2 - Boot and glove wash and rinse, and tape removal and drop (wash with non-foaming detergent, rinse with fresh water spray, then dilute acetone, then fresh water spray)

Step 3 - Hard hat and goggle removal (use same wash as in step 2)

Step 4 - Tyvek suit removal

Step 5 - Respirator wash and rinse and drop (use same wash and rinse sequence as in step 2 with a soft-bristle brush and a sponge)

Step 6 - Inner glove removal

Step 7 - Wash potentially exposed skin (use water and soap at indoor sink)

Wash water and used cleaning fluids may be stored in drums onsite as specified in the Field Sampling Plan.

5.8.2 Heavy Equipment Decontamination

The area designated for heavy equipment decontamination will be located near the site office. A shallow retainage structure will be built where the equipment will be parked during each cleaning operation. A steam generator and brushes will be used to clean drill rigs, backhoes, auger flytes, casing materials, and other tools. The drilling equipment will be cleaned after each borehole operation. No heavy equipment will be permitted to leave the Subase unless it has been thoroughly decontaminated.

As stated above drilling equipment will be decontaminated at a central location near the site office trailer. To prevent the spread of potentially contaminated soil at each drilling location at the Subase, the following procedure will apply:

- Prior to any drilling, a 20 x 20 foot heavy duty plastic tarp will be placed on the ground centered over the borehole.
- All drilling cuttings will be retained on the plastic and may be placed in a 55 gallon drum as specified in the Field Sampling Plan.
- At the conclusion of the boring or well installation, the tarp and all soils may be drummed as specified in the Field Sampling Plan.
- All drums with contaminated materials will be transported to the Subase hazardous waste storage facility where they will be properly stored and labelled.
- All drilling tools will be held within plastic sheeting at each borehole site and transported to the heavy equipment decontamination area after the boring is completed.

All soil, sediment and water from the heavy equipment decontamination area may be removed from the cleaning structure and stored in properly labelled drums as specified in the Field Sampling Plan.

5.8.3 Sampling Equipment Decontamination

During the drilling of bore holes, split spoon samplers will be cleaned before each sample is obtained. Stainless steel hand augers will be decontaminated before each sample is collected. The cleaning procedures are presented below:

1. Scrub with a brush in Alconox detergent
2. Rinse in clean tap water
3. Rinse with methanol
4. Rinse with distilled water
5. Allow to air dry

Stainless steel bailers will be used to sample ground water monitoring wells during the later part of the investigation. The bailers will also be cleaned in a similar manner.

5.8.4 Example Decontamination Equipment Checklist

Item	Quantity
Plastic garbage barrels	1
Liners for garbage barrels	2 boxes
Galvanized Steel basins	2
Alconox detergent concentrate	2 qt. dry
Hand pump sprayers	4
Long handle soft bristle brushes	10
Cleanser for respirators	1 box
Steam generator	1
Liquid detergent and paper towels	Plenty
Distilled Water	10 gals.
Methanol	10 gals.
55 gallon DOT approved drums	60

5.9 Location of Buried Utilities

A substantial portion of the Subase sites may be underlain by shallow, buried utilities so that it will be necessary for the field team to exercise a high degree of caution in determining the exact location of each excavation done on the site. The Subase public works department will be contacted so that active lines in the site areas can be identified and marked out. Maps of known utilities at the site will be made during the preliminary investigation from maps of former Naval plant operations and information supplied by former and current site employees.

Site workers will use these data to choose apparently safe locations for borings and test pits. A geophysical survey will also be conducted on many sites to identify buried utilities among other site features. Where geophysics is not planned, Atlantic will also use metal detectors and pipe locators for site screening. Excavation will proceed carefully at shallow depths to avoid rupturing a line that may be present but that was not detected, because it is not metallic or because some type of instrument error occurred.

5.10 Engineering Controls and Work Practices

Engineering controls and work practices specified by both OSHA and EPA are directed primarily toward limiting exposure through application of engineered barriers. These requirements apply to practices on Superfund sites.

5.11 Handling Drums and Containers

Regulations for handling drums and containers are specified by OSHA. Potential hazards associated with handling drums include vapor generation, fire, explosions, and possible physical injury.

Handling of drums/containers at the Subase site may involve the movement of unknown materials. Prior to handling of drums, they should be visually inspected to gain information regarding their content. The investigation team should look for:

- symbols or words which indicates that the contents are hazardous, radioactive, explosive, corrosive, toxic or flammable.
- Signs of deterioration for example: rust, corrosion or leaks.
- Signs that drum is under pressure such as bulging or swelling.
- Drum type

Air quality monitoring should be conducted around drums using a portable organic vapor meter. Encountering buried drums or containers is anticipated, and a ground penetrating device, such as a metal detector should be used to estimate the location and depth of the drums. Some drill cuttings, test pit wastes, and ground water may be drummed for subsequent disposal. These drums will be transported to the onbase hazardous waste storage area for disposal by the Navy. The field team will properly mark any drums, identifying, as a minimum, content and date.

5.12 Illumination

Illumination requirements identified by OSHA are directed to work efforts inside buildings and/or during non-daylight hours. All field activities planned for the Subase site will occur outside during daylight hours.

5.13 Sanitation for Temporary Worksites

Sanitary facilities at the Subase site will be available in the area provided by a local port-a-jon company. Location of this facility will be near the field office at Atlantic's base of operations.

6.0 SIGNATURES OF FIELD TEAM MEMBERS AND OBSERVERS

THIS SITE SAFETY PLAN HAS BEEN RECEIVED AND READ BY:

(Signatures of site investigation team members and observers who have been through site safety briefing and have read this health and safety plan.)

NAME	DATE	FIRM	TELEPHONE

APPENDIX A

RECOMMENDED BLOOD TESTS

APPENDIX A: RECOMMENDED BLOOD TESTS

MEDICAL SURVEILLANCE PROGRAM

Function	Test	Example
Liver:	Blood Tests	Total protein, albumin globulin, total bilirubin (direct bilirubin if total is elevated).
Kidney:	Blood Tests	Blood urea nitrogen (BUN), creatinine, uric acid.
Blood-Forming Function:	Blood Tests	Complete blood count (CBC) with differential and platelet evaluation, including white cell count (WBC), red blood count (RBC), hemoglobin (HGB), hematocrit or packed cell volume (HCT), and desired erythrocyte indices. Reticulocyte count may be appropriate if there is a likelihood of exposure to hemolytic chemicals.

NOTE: From Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities; October 1985; DHHS (NIOSH) Publication No. 85-115.

APPENDIX B

MATERIAL SAFETY DATA SHEETS

INDEX OF MATERIAL SAFETY DATA SHEETS

Sulfuric Acid
Cadmium
Mercury
Beryllium
Antimony
Thallium
Silver Nitrate
Chromium
Selenium
Copper
Zinc
Silver
Arsenic Trioxide
Methylene Chloride
1,1,1-Trichloroethane
Trichloroethylene
Chloroform
Benzene
Toluene
Mineral Spirits Type I, Type II, Type III
Phenol
Ethylene Dichloride
Propane
Di (2-Ethyl hexyl) Phthalate
n-Heptane
Methyl Mercaptan
Automotive Gasoline Lead Free
Fuel Oil No. 1, No. 2, No. 5, No. 6
Diesel Fuel No. 2-D
Dichlorotetrafluoroethane
Napthalene
Aroclor (polychlorinated biphenols - PCBs)
Varsol 1, 18

Material Safety Data Sheet

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No. 9
SULFURIC ACID, CONCENTRATED
Revision C
Issued: October 1980
Revised: February 1986

SECTION 1. MATERIAL IDENTIFICATION

19

MATERIAL NAME: SULFURIC ACID, CONCENTRATED

OTHER DESIGNATIONS: Oil of Vitriol, Hydrogen Sulfate; H_2SO_4; CAS #7664-93-9

MANUFACTURER/SUPPLIER: Available from many suppliers, including:
Allied Corporation, PO Box 2064R, Morristown, NJ 07960; Telephone: 800 631-8050

HMIS
H:3
F: 0
R: 2
PPE: *
* See Sect. 8

R 1
I 3
S 4
K 0

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Hydrogen Sulfate (H_2SO_4)	93-98	8-hr TWA: 1 mg/m^3
Water	Balance*	Human, Mist Inhalation, TCLo: 3 mg/m^3, 24 wk. (Toxic Mouth Effects)
		Rat, Oral, LD_{50}: 2140 mg/kg

* Material is obtained by the reaction of SO_3 and water. Can contain low impurity levels, such as 0.02% max of iron as Fe. Properties vary with H_2SO_4 content.

Current OSHA standard and ACGIH (1985-86) TLV. NIOSH has a 10-hr TWA, 40-hr. work week, of 1 mg/m^3.

SECTION 3. PHYSICAL DATA

	93.19% H_2SO_4	98.33% H_2SO_4	100% H_2SO_4
Boiling Point, 1 atm, deg C	ca 281	ca 338	ca 330 (dc)
Specific Gravity (60/60°F)	1.8354	1.84	1.84
Volatiles, % @ 340°C	ca 100	ca 100	ca 100
Melting Point, deg C	ca -34	ca 3	10.4

Water Solubility ... Complete Miscible
Vapor Pressure, mm Hg @ 100°F ... <1 (93.19% H_2SO_4); Deg. Baume ... 66 (93.19% H_2SO_4) - Density of H_2SO_4 is often reported in degrees Baume Be). Formula is Be=145 [145/sp gr for liquids heavier than water].

Appearance and odor: Clear, colorless, hygroscopic, oily liquid with no odor. Mists greater than 1 mg/m^3 are easily recognizable. Those at 5 mg/m^3 are distinctly objectionable.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
None - Nonflammable	NA	NA	NA	NA

Sulfuric acid is nonflammable; however, it is a strong oxidizing agent and may cause ignition by contact with combustible materials. Small fires may be smothered with suitable dry chemical. Cool exterior of storage tanks of H_2SO_4 with water to avoid rupture if exposed to fire. Do not add water or other liquid to the acid! The acid, especially when diluted with water, can react with metals to liberate flammable hydrogen gas.
Sulfuric acid mists and vapors from a fire area are corrosive (see sect. 5).
Fire fighters must wear self-contained breathing equipment and fully protective clothing.

SECTION 5. REACTIVITY DATA

Sulfuric acid is stable under normal conditions of use and storage. It does not undergo hazardous polymerization. It is a strong mineral acid reacting with bases and metals. The concentrated acid is also a dehydrating agent, picking up moisture readily from the air or other materials. Hydrogen gas may be generated within a H_2SO_4 container. Vent drums cautiously.

This material reacts exothermically with water. (Acid should always be added slowly to water. Water added to acid can cause boiling and uncontrolled splashing of the acid.) Sulfur oxides can result from decomposition and from oxidizing reactions of sulfuric acid.

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SECTION 6. HEALTH HAZARD INFORMATION | TLV

Concentrated sulfuric acid is a strong mineral acid, an oxidizing agent, and a dehydrating agent that is rapidly damaging to all human tissue with which it comes in contact. Ingestion may cause severe injury or death. Eye contact produces severe or permanent injury. Inhalation of mists can damage both the upper respiratory tract and the lungs. Sulfuric acid is not listed as a carcinogen by the NTP, IARC, or OSHA.

FIRST AID: EYE CONTACT: Immediately flush eyes (including under eyelids) with plenty of running water for at least 15 minutes. Speed in diluting and rinsing out acid with water is extremely important if permanent eye damage is to be avoided. Obtain medical help as soon as possible.* SKIN CONTACT: Immediately flush affected areas with water, removing contaminated clothing while under the safety shower. Continue washing with water and get medical attention.*

INHALATION: Remove to fresh air. Restore breathing. Call a physician immediately. INGESTION: Dilute acid immediately with large amounts of milk or water, then give milk of magnesia to neutralize. Never give anything by mouth to an unconscious person. Do not induce vomiting; if it occurs spontaneously, continue to administer fluid. Obtain medical attention as soon as possible.*

Maintain observation of patient for possible delayed onset of pulmonary edema.

* GET MEDICAL HELP = In plant, paramedic, community.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Handle major spills by a predetermined plan. Contact supplier for assistance in this planning, in meeting local regulations, and for disposing of large amounts. Notify safety personnel. Provide optimum ventilation; vapors are extremely irritating. Stop leak if you can do so without risk.

Cleanup personnel need protection against inhalation or contact. Keep upwind. Contain spill. Minor leaks or spills can be diluted with much water and neutralized with soda ash or lime. If water is not available, cover contaminated area with sand, ashes, or gravel and neutralize cautiously with soda ash or lime.

DISPOSAL: Follow Federal, state, and local regulations. Runoff to sewer may create hydrogen gas, which is a fire or explosion hazard. EPA (CWA) RQ 1000 lbs. (40 CFR 117).

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general ventilation to meet current TLV requirements in the workplace. Where mists are up to 50 mg/m^3, a high-efficiency particulate respirator with full facepiece is warranted; a type-C supplier-air respirator with full facepiece operated in pressure-demand mode is used to 100 mg/m^3.

Avoid eye contact by use of chemical safety goggles or face shield where splashing may occur. Acid-resistant protective clothing, such as rubber gloves, aprons, boots, and suits, is recommended to avoid body contact.

Eyewash fountain and safety showers with deluge type of heads should be readily available where this material is handled or stored.

Contact lenses pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

Comprehensive preplacement and annual medical examinations with emphasis on dental erosion, cardiopulmonary system, and mucous membrane irritation and cough are indicated.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Sulfuric acid in carboys or drums should be stored in clean, ventilated storage areas having acid-resistant floors with good drainage. Keep out of direct sunlight, do not store above 89.6°F (32°C). Storage facilities are to be separate from organic materials, metallic powders, chromates, chlorates, nitrates, carbides, oxidizables, etc. Soda ash, sand, or lime should be kept in general storage or work areas for emergency use. Protect containers against physical damage. Glass bottles need extra protection. Sulfuric acid is highly corrosive to most metals, especially below 77% H_2SO_4. Avoid breathing mist or vapors. Avoid contact with skin or eyes. Do not ingest. Do not add water to concentrated acid. Drums may contain hydrogen gas, so open cautiously. Use nonsparking tools free of oil, dirt, and grit and vapor-proof electrical fixtures

DOT Classification: Corrosive Material. ID No.: UN1830 Label: Corrosive

Data Source(s) Code: 1-12, 19, 20, 24, 26, 31, 37-39, 42, 82. CK

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Approvals [illegible], 6/86.

Indust. Hygiene/Safety [illegible] 6/86

Medical Review [illegible] July 86

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MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

No. 23

CADMIUM METAL
Revision B

Date December 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: CADMIUM METAL
DESCRIPTION: Silver-white, malleable elemental metal
OTHER DESIGNATIONS: Cadmium Anodes, Cd, GE Material B10C11, ASTM B440, CAS #007 440 439
MANUFACTURER: Available from many suppliers, including:
ASARCO Inc.
120 Broadway Telephone: (801) 262-2459 (Emergency Phone)
New York, NY

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Cadmium *Current OSHA TLV as developed by ANSI. **ACGIH TLV (1980) for fume, salt or dust. NIOSH has recommended a 10-hr TWA of 0.04 mg/m^3 with a 15 minute ceiling of 0.2 mg/m^3. TLV was set at level to prevent systemic effects of chronic cadmium poisoning. The massive metal is usually safe unless metal fume is formed (heating) or soluble cadmium compounds are formed (acid reaction or corrosion).	>99.8	8-hr TWA fume 0.1 mg/m^3 } * dust 0.2 mg/m^3 } or 0.05 mg/m^3** Human, inhalation TCLo 88 µg/m^3/8.6 yrs (systemic effect) Rat, intramuscular TDLo 14 mg/kg (carcinogenic effects)

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg C (F) --	767 (1415)	Specific gravity (H_2O=1) ---	8.6
Vapor pressure at 394 C, mm Hg-------	1	Melting point, deg C -------	320.9
Solubility in water ----------	Insoluble	Atomic weight ----------	112.41
Viscosity @ 340 C, cp ----------	2.37	Brittle temperature, deg C -	80

Appearance and Odor: Silvery white, bluish, lustrous metal; no odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
Not applicable	570 C* (Cloud) 250 C* (dust layer)	Dust Cloud*	--	--

Extinguishing Media: CO_2 or dry chemical type; sand can be used.
Cd dust will burn with evolution of CdO fumes; it is a weak fire and explosion hazard.
Firefighters must wear self-contained breathing apparatus and full protective clothing.

*Through 74 µm sieve; cloud can be ignited by 4.0J spark.

SECTION V. REACTIVITY DATA

Massive metal is stable at room conditions when dry; when, at red heat it oxidizes in air to CdO. Finely powdered metal can be pyrophoric. Heat treatment, welding, or soldering of cadmium metal and cadmium coatings will produce toxic CdO and Cd metal fumes.
The sulfide, carbonate and hydroxide are insoluble in water while the halides, nitrate and sulfate are relatively soluble. Cd forms a variety of soluble complexes such as cyanide & amines. Soluble in acids. Resistant to alkalies. Tarnishes in moist air.
Ammonium nitrate & powdered Cd may yield an explosive reaction. It is incompatible with strong oxidizing agents, elemental sulfur, selenium, tellurium, and hydrazoic acid. Nitryl fluoride passed over a mildly warm Cd metal can produce incandescence.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV (See Sect. II)

Exposures to cadmium dust/fume can result in pulmonary irritation, dermatitis, or allergic sensitization. Pneumonitis can occur after excessive inhalation at 0.5 to 2.5 mg/m^3. Fatal pulmonary edema†(delayed effects) can result from levels which provide insufficient discomfort for warning; for example, at or above 5 mg/m^3 for 8 hrs or at 40-50 mg/m^3 for 1 hr. Symptoms of overexposure can be a dry, burning throat, headache, muscle aches, cough, chest tightness and pain, nausea, chills and fever. Chronic exposure, low level fume, may lead to emphysema, anemia, kidney damage, anosemia, and yellow rings around the necks of teeth. Cadmium can be toxic by ingestion.

FIRST AID:

Eye Contact: Flush with running water for 15 minutes, including under eyelids.
Skin Contact: Wash contact area well with soap and water.
Inhalation: Remove victim to fresh air. Restore breathing if required; have trained person administer 60-100% oxygen. Contact physician or hospital.
Ingestion*: Contact physician for gastric lavage followed by saline catharsis. (If physician not readily available, give 2-3 glasses water to drink and induce vomiting.)
Obtain medical assistance for treatment, observation, and support as needed.

*Chelating agents used by physicians in cadmium poisoning: Calcium disodium edetate or pencillamine. †Latent period of up to 12 hours.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of spills. Clean-up personnel need protection against inhalation of dust or fumes. Pick up material using vacuum or wet mopping or sweeping to avoid dusting.

DISPOSAL: Recover scrap metal and store in closed container for salvage. When possible, return cadmium materials to supplier for reclamination. Incineration can be a cause of air pollution; proper scrubber needed. Conc. soluble Cd waste can be precipitated with lime and collected by filtration. Effluent is treated further as needed to reduce Cd conc. to compliance levels. Cadmium compound containing waste (EPA number D006 under RCRA) to be disposed in an approved chemical landfill of the California Class I type. Follow Federal, State and Local regulations. Toxic to fish. (Conc. greater than 0.001 mg/L; depends on pH).

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide efficient local exhaust ventilation to meet TLV requirements in the workplace. Approved respirator protection required when heating, grinding, and for operations where dust and/or fume exposure may occur. A self-contained or air supplied respirator can be used up to 2 mg/m^3 with a full face piece above 0.4 mg/m^3. (Above 2 mg/m^3 a positive pressure mode or auxillary air supply is needed, respectively.)

Wear rubber gloves, chemical goggles and/or face shield and protective coveralls. Special work clothing and laundering recommended. Change work clothing daily; shower after work.

Provide periodic medical examinations for those regularly exposed, including chest x-ray, vital capacity, and urinalysis. Preclude from exposure those individuals with lung, liver, kidney, and blood ailments until approved by physician.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in a dry, low fire-risk area; avoid storage conditions where corrosion can occur. Keep powdered metal in closed containers, protected from physical damage. Use good housekeeping practices to prevent accumulation of dust; use good cleaning techniques, such as vacuuming to keep airborne particulate at a minimum. Use nonsparking tools where cadmium particulate is found.

Use good hygienic practice in handling cadmium and its compounds. No eating or smoking in work areas.

Toxic effects of Cd are influenced by the presence or absence of other elements, such as Zn & Se. As an elemental material, cadmium is not degradable; but it can be isolated as insoluble salts in secure landfills.

DATA SOURCE(S) CODE: 1-12,19,20,24-27,31,37-40

APPROVALS: MIS CRD J. M. Nielsen
Industrial Hygiene and Safety 12-9-80
MEDICAL REVIEW: 16 Dec. 1980

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Material Safety Data Sheet

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GENIUM PUBLISHING CORP.

No. 26

MERCURY
(Revision C)
Issued: September 1981
Revised: August 1988

SECTION 1. MATERIAL IDENTIFICATION 26

Material Name: MERCURY

Description (Origin/Uses): Used in barometers, thermometers, hydrometers, and pyrometers; in mercury arc lamps producing ultraviolet rays; in switches and fluorescent lamps; as a catalyst in oxidations of organic compounds; in alloys; in explosives; and for extracting gold and silver from ore.

Other Designations: Colloidal Mercury; Metallic Mercury; Quicksilver; Hg; Hydrargyrum;
CAS No. 7439-97-6

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

Comments: Inorganic and organic mercury compounds are highly toxic, as is pure mercury.

Genium

HMIS
H 3 R 1
F 0 I 4
R 0 S 1
PPG* K 0
*See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Mercury, CAS No. 7439-97-6	Ca 100	**OSHA PEL** Ceiling: 1 mg per 10 m³ **ACGIH TLV (Skin*), 1987-88** TLV-TWA: 0.05 mg/m³ as Hg (Mercury Vapor) **Toxicity Data**** Rabbit, Inhalation, LC_{Lo}: 29 mg/m³ (30 Hrs)
*Mercury can be absorbed through intact skin, which contributes to overall exposure. **See NIOSH, *RTECS* (OV4550000), for additional data with references to reproductive, mutagenic, and tumorigenic effects.		

SECTION 3. PHYSICAL DATA

Boiling Point: 673°F (357°C)
Specific Gravity (H_2O = 1): 13.546 at 68°F (20°C)
Vapor Pressure: 0.0018 Torr at 77°F (25°C)
Water Solubility (%): Insoluble
Molecular Weight: 201 Grams/Mole
Melting Point: -37.93°F (-38.85°C)

Appearance and Odor: A silver, heavy liquid; odorless. **Danger:** Mercury vapor has no warning properties.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
*	*		*	*

Extinguishing Media: *Mercury does not burn. Use extinguishing agents that will put out the surrounding fire.

Unusual Fire or Explosion Hazards: When exposed to the high temperatures that occur during a fire, mercury can vaporize to form extremely toxic fumes.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Mercury is stable in closed containers at room temperature under normal storage and handling conditions. It cannot undergo hazardous polymerization.

Chemical Incompatibilities: Hazardous reactions involving mercury and acetylene, ammonia, boron phosphodiiodide, chlorine, chlorine dioxide, methyl azide, sodium carbide, nitric acid, oleum, and sulfuric acid are reported (Genium ref. 84).

Conditions to Avoid: Do not expose mercury to incompatible chemicals.

Hazardous Products of Decomposition: Extremely toxic mercury metal fumes are likely to be produced during fires.

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SECTION 6. HEALTH HAZARD INFORMATION

Mercury is not listed as a carcinogen by the NTP, IARC, or OSHA.

Summary of Risks: Mercury is very toxic due to its liquid and fat solubility, lack of charge, and membrane permeability. It is a slowly cumulative poison that concentrates in the brain, kidneys, and liver. It is very hazardous when spilled or heated. Mercury and its vapor are rapidly absorbed by the membranes lining the respiratory tract, the gastrointestinal (GI) tract, and the skin. Mercury is a teratogen (causes physical defects in embryos). **Medical Conditions Aggravated by Long-Term Exposure:** Preexisting problems of the target organs can be worsened. Provide preplacement and periodic medical exams emphasizing the target organs. **Target Organs:** Skin, eyes, respiratory system, central nervous system (CNS), kidneys. **Primary Entry:** Skin absorption/contact, inhalation. **Acute Effects:** Erosion of the respiratory/GI tracts, nausea, vomiting, bloody diarrhea, shock, headache, metallic taste. Inhalation of high concentrations for short periods can cause pneumonitis, chest pain, dyspnea, coughing, stomatitis, gingivitis, and salivation. **Chronic Effects:** Tremors, emotional problems, loss of concentration, depression, drowsiness, fatigue, insomnia, loss of memory, kidney problems, eye lesions, vision disturbances, sore mouth and throat, problems with the sense of taste or smell, nosebleeds, nasal inflammation, loss of weight or appetite, poor hand-eye coordination, awkwardness, and unsteadiness, as well as dermatitis. **FIRST AID: Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. **Skin.** Immediately wash the affected area with soap and water because of the increased exposure from skin absorption. **Inhalation.** Remove exposed person to fresh air; restore and/or support his or her breathing as needed. Have medical personnel administer oxygen to treat the chemical pneumonitis that may develop. **Ingestion.** Never give anything by mouth to someone who is unconscious or convulsing. Note to physician: If indicated by degree of ingestion, saline cathartics and charcoal should be used. Chelation therapy with d-penicillamine may also be indicated.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. Treatment of chronic mercury poisoning requires expert medical care. At the first signs, immediately remove the exposed person from further exposure and have him or her examined and treated by a physician trained in occupational mercury poisoning.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, restrict access to the spill area to necessary personnel, and provide adequate ventilation. Clean up spills promptly. Specialized equipment and/or techniques may be required to safely deal with large mercury spills; if large quantities of mercury are used in the workplace, detailed, prior spill-management planning is recommended. Collect spilled mercury by using a suction pump and an aspirator bottle with a long capillary tube. For finely divided mercury in inaccessible cracks, corners, etc., treatment with calcium polysulfide and excess sulfur is recommended to convert the mercury globules into mercury sulfide. Vacuum cleaners may be used if they are equipped with specially designed mercury-absorbent exhaust filters. Collect the mercury into tightly sealed containers for later disposal or reclamation. Cleanup personnel must use the recommended personal protective equipment (see sect. 8).

Waste Disposal: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Do not pour mercury down a drain. Mercury is very harmful to the environment. Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations
Air Contaminant (29 CFR 19010.1000 Subpart Z)

EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste No. U151
CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg)*

*Per the Clean Water Act, § 407 (a); Clean Air Act, § 112; and Resource Conservation and Recovery Act, § 3001.

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of mercury may occur, wear a full face shield or splash guard. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., to prevent any contact with mercury and the skin.

Ventilation: Install and operate general and local ventilation systems powerful enough to continuously maintain airborne levels of mercury below the OSHA PEL standard cited in section 2.

Safety Stations: Make emergency eyewash stations, washing facilities, and safety/quick-drench showers available in work areas.

Contaminated Equipment: Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean mercury from shoes and equipment. Separate work and street clothes; store work clothes in special lockers and always shower before changing to street clothes.

Comments: Practice good personal hygiene; always wash thoroughly after using this material. Keep it off of your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store mercury in a cool, dry, well-ventilated area in tightly closed unbreakable polyethylene containers. Protect these containers from physical damage.

Special Handling/Storage: Construct storage areas to have smooth, hard, nonporous floors with no cracks or spaces so that spilled mercury globules do not form in inaccessible areas.

Comments: Mercury evaporates slowly, but if it is spilled it can form many tiny globules that evaporate much faster than a single pool of it will. In an unventilated area, significant concentration of mercury vapor can develop from this enhanced evaporation effect. This poisonous vapor is particularly hazardous if breathed over a long period of time, so spills or releases of mercury require very meticulous cleaning procedures.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Mercury, Metal	**DOT Label:** None	**IMO Class:** 8
DOT Hazard Class: ORM-B	**DOT ID No.** NA2809	**IMO Label:** Corrosive

References: 1, 2, 8, 26, 38, 84-94, 100.

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Prepared by PJ Igoe, BS

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MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

No. 59

BERYLLIUM
METAL/POWDER

Date April 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: BERYLLIUM METAL/POWDER
OTHER DESIGNATIONS: Glucinium, Glucinum, Be, CAS #007 440 417
MANUFACTURER: Material is available from several suppliers, including:

CERAC, Inc.
P.O. Box 1178
Milwaukee, WI 53201
Phone: (414) 289-9800

Brush Wellman
Metal & Oxide Div.
Elmore, OH 43416
Phone: (419) 862-2745

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Beryllium	> 97	8-hr TWA 2 μg/m³*(as Be)
Beryllium Oxide	< 3	Ceiling Level 5 μg/m³
		Peak 25 μg/m³/30 min
*Current (1979) OSHA and ACGIH TLV. In 1975 OSHA proposed an 8-hr TWA of 1 μg/m³ with a ceiling of 5 μg/m³ (15 min. sample); OSHA believes that beryllium and its compounds should be treated as a carcinogenic threat to man. (The proposed OSHA standard is still under review, but is expected to issue in 1980.)		Human, inhalation TCLo 300 mg/m³, pulmonary effects
		Rabbit, intravenous TDLo 20 mg/kg, neoplastic effects

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg C	2970	Specific gravity at 20 C	1.848
Vapor pressure at 1910 C, mm Hg	7.6	Melting point, deg C	1278±5
Water solubility, hot water	Slight	Atomic weight	9.01
cold water	Insol.		

Appearance & Odor: A grayish-white metal (hexagonal crystal structure) also as powdered metal; no odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
N/A	Powder ca. 1200 F	Dust explosion hazard		

Extinguishing Media: Do not use water or CO_2. Smother fire with approved dry powder extinguisher.* Beryllium can be a moderate fire hazard if exposed to flame. The hazard increases as particle size decreases. A cloud of Be dust in air can be explosive (areas where dusting may occur require Class II, Group E electrical services, 29 CFR 1910.309). Combustion products of this material are highly toxic.
Firefighters should use full protective clothing, eye protection, and self-contained breathing apparatus. After exposure to a beryllium fire, they should clean equipment and clothing thoroughly and bathe carefully. *Sand, graphite, powder, and sodium chloride have also been recommended.

SECTION V. REACTIVITY DATA

Beryllium is stable at room temperature and resists oxidation at ordinary temperatures.* When heated in air or in mixed CO_2 and nitrogen, it can be ignited.
It is acid and alkali soluble; it reacts with strong bases to evolve hydrogen.
Mixtures of the powdered metal with CCl_4 or trichloroethylene will flash on heavy impact.
Warm beryllium will react incandescently with phosphorus, fluorine or chlorine.
Molten lithium metal (180 C) severely attacks beryllium metal.

*Will form oxide on solid surfaces when moist.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 2 μg/m^3 (See Sect. II)

Be is highly toxic by inhalation of fume or dust. Prolonged or repeated skin contact can cause skin irritation or dermatitis. Eye contact can produce conjunctivitis.

Implantation under the skin (via a chip or sliver or by particles entering a wound) can produce hard lesions with central non-healing areas which must be surgically removed.

Acute inhalation can produce pneumonitis with non-productive cough, chest pain, shortness of breath, weakness, and pulmonary edema. Chronic exposures can produce berylliosis (progressive lung damage) and systemic beryllium disease, including pneumonitis (as above), joint pain, skin lesions, chills & fever, & damage to liver, spleen & heart.

Present studies have indicated that Be is so poorly absorbed through the gut that ingestion is not an important hazard. (Hamilton, Industrial Toxicology, 3rd Edition). Animal studies have shown beryllium to produce lung and bone tumors; it is a suspected carcinogen for man.

FIRST AID:

Eye Contact: Flush eyes thoroughly with running water for 15 minutes, including under the eyelids. Get medical attention.

Skin Contact: Wash affected area thoroughly with soap and water after removing contaminated clothing. If skin is broken, get medical attention.

Inhalation: Remove to fresh air. Restore breathing and support with oxygen as needed. Keep warm and at rest. Get medical attention.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

If powdered metal is spilled, notify safety personnel. Exclude all from area except clean-up personnel with protective equipment against contact or inhalation hazards. Provide ventilation and remove sources of heat or ignition. Pick up powder spills by methods such as vacuuming or wet mopping; prevent dusting conditions. Collect particulate scrap in sealed container for recovery or disposal.

DISPOSAL: Scrap or waste material disposal is best accomplished by arranging to return to the supplier in a mutually acceptable form. Beryllium waste unsuitable for recycle must be handled in accordance with Federal, State, and Local regulations. Burying in an approved landfill, or burning in an approved incinerator with a scrubber, followed by burying the residues in an approved landfill, have been used in the past.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Isolate workplaces where beryllium dust and fume are generated. Provide adequate general and local exhaust ventilation (with filtration to purify recycled air and to protect the external environment) to meet TLV requirements. Provide approved respirators for emergency and nonroutine use above the TLV: High efficiency filter masks are suitable as high as 50 μg/m^3; use air-supplied or self-contained respirators above 50 μg/m^3. A full-facepiece respirator is needed above 10 μg/m^3.

Workers may require body-covering protective clothing, gloves and safety goggles. When exposed above the TLV, a change of clean protective clothing and a shower at the end of the day is required. (Wash protective clothing with suitable protection for the launderer.) Avoid carrying beryllium particulate outside the workplace on hair or clothing.

Eyewash stations and safety showers should be available.

Monitor the workplace to properly determine and control exposure to beryllium.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Use only with adequate ventilation where Be can become airborne. When Be or its alloys is heated (as in welding or sintering processes) hazardous levels of fume can be generated. Store in clean, dry place away from incompatible materials (see Sect V) in low fire-hazard area. Protect containers from physical damage. Label clearly.

Use good housekeeping practices to prevent accumulation of Be-containing deposits. Give preplacement and annual medical exams to those who may be exposed above the TLV. Preclude from exposure those with pulmonary disease, chronic skin, liver, heart, or kidney conditions, abnormal chest X-ray or blood count, or vital capacity depression greater than 10% Provide worker training.

DOT Classification of powder - POISON B.

DATA SOURCE(S) CODE: 1-12, 18-20, 24-26

APPROVALS: MIS, CRD J. M. Nielsen

Industrial Hygiene and Safety 4-21-80

MEDICAL REVIEW: 5/5/80

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MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

No. 70

ANTIMONY METAL/POWDER

Date September 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: ANTIMONY METAL/POWDER
OTHER DESIGNATIONS: Stibium, Sb, ASTM B237, GE Material B10F2, CAS #007 440 360
MANUFACTURER: Available from several suppliers.

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Antimony	> 99	8-hr TWA 0.5 mg/m^3* (as Sb)
*Current OSHA Standard and ACGIH (1980) TLV. NIOSH has proposed a 10-hr TWA of 0.5 mg/m^3 with an Action level at 0.25 mg/m^3. TLV was establish at a level to prevent irritation and systemic effects.		Rat, intraperitoneal LDLo 100 mg/kg Rat, oral LD_{50} 100 mg/kg

SECTION III. PHYSICAL DATA

Boiling point, @ 1 atm, deg C ---- 1750
Vapor pressure @ 886 deg C, mm Hg - 1
Solubility in water ------- Insoluble
Specific gravity, @ 25 C --------- 6.68
Melting point, deg C ---------- 630.5
Mohs hardness ---------- 3-3.5
Molecular weight ---------- 121.76

Appearance: A brittle, flaky, crystalline solid with a lustrous blue-white color; an amorphous gray allotrope is also known. The powder form is dark gray, lustrous.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
--	420 C* (cloud) 330 C* (dust layer)	Dust cloud explosion*	0.42 oz/ft^3	--

Extinguishing Media: (Obtain detailed fire-fighting information from supplier.)
Antimony bulk metal is combustible in air at high temperature. When ignited it burns with a brilliant flame, giving off dense white fumes (Sb_2O_3).
When powdered antimony is exposed to heat or ignition sources it is a moderate fire and explosion hazard. Particle size and dispersion in air determine reactivity.
Firefighters should use self-contained breathing equipment and eye protection.
*91% of dust goes thru a 74 micron sieve. Sb dust cloud can be ignited by a 1.92 J spark.

SECTION V. REACTIVITY DATA

Antimony metal (bulk) is stable in dry air at room temperature. It slowly tarnishes in moist air. It is not very reactive with cold, dilute acids, but reacts readily with aqua regia and hot, concentrated sulfuric acid. Nascent hydrogen can react with Sb or its alloys with Mg or Zn to form stibine (SbH_3), a colorless, highly toxic gas with a disagreeable odor (TLV 0.1 ppm). Sb can react vigorously or violently with oxidizing agents, such as nitrate salts, halogens, nitric acid, perchloric acids, ClF_3, $KMnO_4$, etc.
Powdered antimony reacts more vigorously than the bulk material and forms dangerous mixtures with oxidizing agents. Reactivity is further increased on heating.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 0.5 mg/m^3

Antimony is an irritant of the mucous membranes, eyes, and skin.
Exposures to dust/powder can cause eye inflammation, nasal irritation, chronic dermatitis ranging from mild rashes to blemishes resembling chicken pox, and muscle pain and weakness. Chronic inhalation of subtoxic doses of dust or fume above the TLV may result in chemical pneumonia, intraalveolar lipid deposits, liver and cardiac involvement, and possible kidney disease. Acute ingestion may cause violent vomiting, diarrhea, slow pulse and low blood pressure, shallow breathing, and death.

FIRST AID:

Eye Contact: Flush with running water for 15 minutes, including under the eyelids.
Skin Contact: Wash area with soap and water. Treat burns as usual.
Inhalation: Remove to fresh air.
Ingestion*: Contact physician! Gastric lavage followed by saline catharsis.

In all cases of excessive exposure get prompt medical help for further treatment, support, and observation.

*Chelation therapy with Dimercaprol (BAL) under a physician's care will increase Sb elimination rate in urine.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of powder spills. Small spills can be removed by vacuuming or wet sweeping in order to keep airborne dust at a minimum. Clean up personnel should use protective equipment.

DISPOSAL: Scrap metal can be returned to supplier. Unsalvageable waste may be buried in an approved secure landfill. Follow Federal, State, and Local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements in the workplace where Sb powder is used or where Sb-containing metal is heated.
Respirators should be available for nonroutine or emergency use above the TLV: High efficiency dust respirator below 5 mg/m^3 and self-contained or air-supplied respirators with full facepiece above 5 mg/m^3.
Avoid eye contact by use of chemical safety goggles where dusty conditions occur. Wear protective clothing appropriate for the work situation to minimize skin contact. Clothing to be changed daily and laundered. Showering after work with a complete change to street clothing is desirable. (Separate lockers for street clothes).
Eyewash stations and washing facilities should be readily accessible.
Provide preplacement and periodic medical examinations for those regularly exposed to antimony, with emphasis directed to skin and mucous membranes and the pulmonary, cardiac, and reproductive systems. Provide suitable training to those working with antimony. Monitor the workplace. Keep records.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in a dry, well-ventilated, low-fire risk area. Avoid heat and direct sunlight.
Use good housekeeping practices to prevent accumulation of dust and follow sound cleaning techniques that will keep airborne particulate at a minimum.
Avoid breathing dust or fume. Minimize skin contact by using barrier creams, rubber gloves and aprons, and good personal hygiene. Keep Sb dust off clothing. Wash hands and face before eating, drinking or smoking after handling this material.

DATA SOURCE(S) CODE: 2-12,24,26,27,31,37,41

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APPROVALS: MIS CRD J. M. Nielsen
Industrial Hygiene and Safety 10-9-80
MEDICAL REVIEW: 10/22/80

Material Safety Data Sheet

From Genium's Reference Collection
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GENIUM PUBLISHING CORP.

No. 30

THALLIUM METAL
(Revision A)
Issued: December 1980
Revised: April 1988

SECTION 1. MATERIAL IDENTIFICATION

25

Material Name: THALLIUM METAL

Description (Origin/Uses): Used in semiconductor research; also alloyed with mercury for the manufacture of switches and closures that operate at subzero temperatures.

Other Designations: Tl; NIOSH *RTECS* No. XG3425000; CAS No. 7440-28-0

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

Comments: The hazards of working with thallium metal are associated with cutting, grinding, welding, etc., that produce dust, fumes, powders, and gases.

Not Found

HMIS	
H 1	
F 1	R 1
R 1	I 3
PPG*	S 1
*See sect. 8	K -

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Thallium Metal, CAS No. 7440-28-0	Ca 100	IDLH* Level: 20 mg/m³ (Soluble Compounds) **OSHA PEL (Skin**)** 8-Hr TWA:*** 0.1 mg/m³ **ACGIH TLV, 1987-88** TLV-TWA:*** 0.1 mg/m³ **Toxicity Data****** Man, Oral, TD_{Lo}: 5.714 mg/kg

*Immediately dangerous to life and health (soluble).
**This material or its salts can be absorbed through intact skin, which contributes to overall exposure.
***Exposure limit defined for soluble thallium compounds as Tl.
****See NIOSH, *RTECS*, for additional data.

SECTION 3. PHYSICAL DATA

Boiling Point: 2655°F (1457°C)
Melting Point: 579°F (304°C)
Specific Gravity (H_2O = 1): 11.85

Water Solubility (%): Insoluble
Molecular Weight: 204 Grams/Mole

Appearance and Odor: A bluish white, very soft, easily fusible heavy metal; odorless.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
*	*		*	*

Extinguishing Media: *Use dry chemical, "alcohol" foam, carbon dioxide, or water spray to put out thallium fires. Contact your supplier for further recommendations.

Unusual Fire or Explosion Hazards: Thallium metal dust particles suspended in the air can explode. If a thallium dust cloud forms, immediately eliminate all possible sources of ignition such as sparks, open flame, etc., and spray the area with a water mist or fog. Working with this material can produce heat and sparks, which can ignite flammable materials and vapors in the workplace.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Thallium metal is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization. In air, a poisonous coating of thallium oxide (Tl_2O) can develop on the exposed surface of thallium metal.

Chemical Incompatibilities: This material reacts violently with fluorine.

Conditions to Avoid: Prevent contact with fluorine. Avoid exposure to sources of ignition such as open flame, sparks, and lighted tobacco products.

Hazardous Products of Decomposition: During fires thallium can form thallium oxide.

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SECTION 6. HEALTH HAZARD INFORMATION

Thallium metal is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: Thallium is a cumulative poison. It or its salts can be absorbed through intact skin; if they are ingested they are rapidly absorbed by the gastrointestinal (GI) tract. Thallium acts as a mitotic (affecting cell division) agent and a general cellular poison. Acute poisoning chiefly affects the central nervous system (CNS) and the GI tract. The ingestion of soluble thallium salts causes more serious effects than the ingestion of the pure metal. **Medical Conditions Aggravated by Long-Term Exposure:** Disorders of the CNS, GI tract, kidneys, liver, and eyes may be worsened by exposure to thallium. Administer preplacement and periodic medical exams emphasizing these organs' functions. **Target Organs:** Eyes, CNS, lungs, liver, kidneys, GI tract. **Primary Entry:** Skin absorption or contact, inhalation. **Acute Effects:** Nausea, vomiting, diarrhea, tingling or pain in the extremities, weakness, coma, convulsions, and death. **Chronic Effects:** Weakness, pain in the extremities (polyneuritis); loss of hair (alopecia, the most visible sign); and disorders of the cardiac, renal, and endocrine systems. **FIRST AID: Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. **Skin.** Immediately wash the affected area with soap and water because of the increased hazard from absorption. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. **Ingestion.** *Treat as an emergency.* Never give anything by mouth to someone who is unconscious or convulsing. If the exposed person is responsive, give him or her several glasses of milk or water to drink and then induce vomiting.
GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. The treatment recommended in Genium reference 100 (p. 529) includes the following: Maintain fluid and electrolytic balance; administer potassium chloride to replace thallium intracellularly; and use hemoperfusion and hemodialysis as warranted by the specifics of the incident. Various chelating therapies have been recommended.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate all nonessential personnel, and provide adequate ventilation. Cleanup personnel need protection against contact with and inhalation of dust (see sect. 8). Prevent skin contact. Scoop up spilled thallium into suitable containers for disposal. Carefully sweep or vacuum up small spills or residues without creating dust.
Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Consider recycling. Follow Federal, state, and local regulations.
OSHA Designations
Air Contaminant (29 CFR 1910.1000 Subpart Z, for soluble thallium compounds as Tl)
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste: Listed without Number
CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Follow the eye- and face-protection guidelines in 29 CFR 1910.133. **Respirator:** Wear a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. For emergency or nonroutine use (e.g., cleaning reactor vessels or storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves; boots; aprons; and clean, impervious, body-covering clothing to prevent any possibility of skin contact. Barrier creams may be useful to limit the effects of skin contact.
Ventilation: Install and operate general and local ventilation systems powerful enough to maintain airborne levels of thallium below the OSHA PEL standard cited in section 2.
Safety Stations: Make eyewash stations, washing facilities, and safety showers available in use and handling areas.
Contaminated Equipment: Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Particles can adhere to contact lenses and cause corneal damage. Do *not* wear contact lenses in any work area.
Comments: Practice good personal hygiene; always wash thoroughly after using this material. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store thallium metal in a cool, dry, well-ventilated area in closed containers away from oxidizing agents, fluorine, and sources of ignition.

Special Handling/Storage: Practice good housekeeping techniques that minimize accumulation of dust; cleaning procedures should not create dusty conditions.

Transportation Data (49 CFR 172.101-2):

DOT Shipping Name: Thallium Salt, Solid, NOS	**DOT Label:** Poison	**IMO Label:** Poison or St. Andrew's Cross (X)*
DOT ID Nos. UN1707; NA1707	**DOT CLass:** Poison B	**IMO Class:** 6.1

*Harmful-Stow away from Foodstuffs (IMO Label, Materials of Class 6.1 Packaging Group III).

References: 1, 2, 12, 73, 84-94, 100, 103.

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Material Safety Data Sheet

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GENIUM PUBLISHING CORP.

No. 81

SILVER NITRATE
(Revision A)
Issued: December 1980
Revised: August 1988

SECTION 1. MATERIAL IDENTIFICATION

26

Material Name: SILVER NITRATE

Description (Origin/Uses): Used in photography, silver plating, inks, paints, hair dyes, and pharmaceuticals; in etching ivory, coloring porcelain, and the manufacturing of mirrors; also as a universally applied reagent in analytical chemistry.

Other Designations: Lunar Caustic; $AgNO_3$; CAS No. 7761-88-8

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

HMIS		NFPA Nonfire		NFPA Fire
H	2		R	1
F	0		I	4
R	2		S	3
PPG*			K	0
*See sect. 8				

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Silver Nitrate, CAS No. 7761-88-8	Ca 100	**OSHA PEL** 8-Hr TWA: 0.01 mg/m³ (as Silver) **ACGIH TLVs, 1987-88** TLV-TWA: 0.1 mg/m³ (Metal Dust and Fume) TLV-TWA: 0.01 mg/m³ (Soluble Compounds, as Ag)
*See NIOSH, *RTECS* (VW4725000), for additional data with references to reproductive, irritative, and mutagenic effects.		**Toxicity Data*** Man, Unknown, LD_{Lo}: 29 mg/kg Mouse, Oral, LD_{50}: 50 mg/kg

SECTION 3. PHYSICAL DATA

Boiling Point: Decomposes at 824°F (440°C) into metallic silver, nitrogen, oxygen, and nitrogen oxides.
Melting Point: 414°F (212°C)
Specific Gravity (H_2O = 1): 4.35
Water Solubility (%): Complete
Molecular Weight: 170 Grams/Mole
Vapor Pressure: Negligible

Appearance and Odor: Colorless, transparent large crystals or white small crystals; odorless.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
*	*		*	*

Extinguishing Media: *Silver nitrate does not burn. Use water only on small fires; do not use dry chemical or CO_2. For large fires, flood the area with water. For extensive fires in cargo areas, make every effort to extinguish flames from remote, safe locations using unmanned hose holders or monitor nozzles. If this is impossible, evacuate the area and let the fire burn. Contain the runoff from fire control; uncontrolled runoff to sewers may create fire or explosion hazards. Remove containers of silver nitrate from the area if it is safe to do so; cool fire-exposed containers with water at a safe distance until well after the fire is extinguished.
Unusual Fire or Explosion Hazards: Silver nitrate *alone* does not present any unusual fire or explosion hazard when exposed to heat or flame; however, it is a strong oxidizer that greatly increases the flammability of any combustible material it touches.
Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Silver nitrate is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.
Chemical Incompatibilities: Under suitable conditions, silver nitrate reacts dangerously (explosion; ignition, propellant type of burning; formation of explosive products) with acetylene, ammonium hydroxide, aziridine, calcium carbide, ethanol, ethanol and nitric acid, ethyleneimine, 1-bromo-2-propyne, charcoal, chlorine trifluoride, ethylene oxide, ethylene hydroperoxide, hydrogen peroxide, magnesium oxalic acid, tartaric acid, peroxymonosulfuric acid, phosphine, phosphonium iodide, phosphorus, phosphorus isocyanate, sulfur, plastics, arsenic, or cuprous acetylide. See Genium reference 84 (p. 491M-185).
Conditions to Avoid: Do not expose silver nitrate to incompatible chemicals.
Hazardous Products of Decomposition: Toxic fumes such as silver oxides and toxic gases such as nitrogen oxides can be produced during certain fire conditions.

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SECTION 6. HEALTH HAZARD INFORMATION

Silver nitrate is not listed as a carcinogen by the NTP, IARC, NIOSH, ACGIH, or OSHA.
Summary of Risks: Silver nitrate, along with its dust and solution, is very irritating and corrosive to the skin; eyes; mucous membranes; and, if ingested, to the gastrointestinal tract. It may be absorbed into the body following ingestion or inhalation. Ingestion can cause severe gastroenteritis and gastric bleeding, and chronic, possibly fatal, gastroenteritis or shock. Inhalation or ingestion can lead to generalized argyria, a slate gray pigmentation or color change that may be uniformly distributed over the face, forehead, neck, hands, and forearms; the fingernails may be a chocolate brown color. Skin contact, especially if the skin is wet, can cause skin burns or localized pigmentation problems. Initial pigmentation occurs in the eyes, nasal septum, and throat before generalized argyria occurs. Seizures have been reported following ingestion.
Medical Conditions Aggravated by Long-Term Exposure: None reported. **Target Organs:** Eyes, skin, nasal septum, throat, fingernails. **Primary Entry:** Inhalation, skin contact. **Acute Effects:** Inhalation may cause shortness of breath, coughing, and sore throat. **Chronic Effects:** Generalized argyria and methemoglobinemia may result from long-term exposure to silver nitrate.
FIRST AID
Eyes: Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. Permanent eye injuries can result from eye contact with silver nitrate dust or solution; any eye exposure must be treated as an emergency.
Skin: Immediately wash the affected area with soap and water. Treat skin burns. **Inhalation:** Remove the exposed person to fresh air. **Ingestion:** Never give anything by mouth to someone who is unconscious or convulsing. Give the exposed person 4 to 8 ounces of milk or water to drink. Do not induce vomiting.
GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. Specific medical protocols have been developed to treat methemoglobinemia.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: If dust is generated, wear appropriate respiratory protection (see sect. 8). Ventilate the affected area; carefully scoop or vacuum waste, using an appropriate filter, into a suitable container for reclamation or disposal. Remove sources of heat or ignition. Do not get water inside containers of silver nitrate. Genium ref. 85 (guide 45) recommends the following: for small, dry spills, use a clean shovel to put the material into a clean, dry container. Cover containers and move them out of the spill area. For small spills, flush the area with flooding amounts of water. For large spills, dike the area far beyond the spill for later disposal.
Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.
OSHA Designations
Air Contaminant (29 CFR 1910.1000 Subpart Z)
EPA Designations (40 CFR 302.4)
CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg), per the Clean Water Act (CWA), Section 311 (b) (4)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of silver nitrate solution may occur, wear a full face shield or splash guard. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Use a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). **Other:** Wear impervious gloves, boots, aprons, and gauntlets, etc., as required by the specific work environment to prevent excessive skin contact or contamination.
Ventilation: Install and operate general and local exhaust-ventilation systems powerful enough to maintain airborne levels of silver nitrate dust below the OSHA PEL standard cited in section 2. **Safety Stations:** Make eyewash stations, washing facilities, and safety showers available in use and handling areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Particles can adhere to contact lenses and cause corneal damage. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from shoes and equipment.
Comments: Practice good personal hygiene; always wash thoroughly after using this material. Keep it off of your clothes and equipment. Avoid transferring silver nitrate dust from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store silver nitrate in a cool, dry, well-ventilated, low-fire-risk area away from incompatible chemicals (see sect. 5).

Special Handling/Storage: Protect containers from physical damage, use this material with adequate ventilation, and do not create dusty conditions.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Silver Nitrate	**DOT Label:** Oxidizer	**IMO Label:** Oxidizer
DOT ID No. UN1493	**DOT Hazard Class:** Oxidizer	**IMO Class:** 5.1

References: 1, 2, 4, 5, 9, 12, 27, 43, 55, 58, 73, 82-94, 103, 112, 113, 114.

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NO. 53

MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

CHROMIUM METAL/POWDER

Date March 1981

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: CHROMIUM METAL/POWDER
OTHER DESIGNATIONS: Chrome, Cr, ASTM A481, CAS #007 440 473, GE Materials B10D1, B50T2005
MANUFACTURER: Available from many suppliers.

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Chromium	>99	8-hr TWA 1.0 mg/m^3*
		Rat, Intravenous TDLo 2 mg/kg/6W-I Neoplastic effects
*Current OSHA standard for chromium metal and insoluble salt. ACGIH (1980) TLV Intended Changes List, 0.5 mg/m^3		Rat, Implant TDLo 1 mg/kg/6W-I Neoplastic effects
TLV set at a level to prevent pulmonary disease.		
Status: Publication of a proposed regulation in summer of 1981 is anticipated. (BNA Reporter 12/11/80 pg 756)		

SECTION III. PHYSICAL DATA

Boiling point, deg C	2200	Specific gravity @ 20 C	7.19
Vapor pressure, 1 mm Hg, deg C	1616	Melting point, deg C	1890
Vapor density (Air=1)	1.79	Atomic weight	52
Soluble in H_2O, g/100g	Insoluble		

Appearance and Odor: Steel-gray, no odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
	580 C* (cloud) 400 C* (dust layer)	Dust cloud explosion*	0.230 oz/ft^3	

Extinguishing Media: (Obtain detailed fire-fighting information from supplier.)
Powdered form is combustible. Use water spray or fog, dry chemical, CO_2, sand.
When powdered chromium is exposed to heat or ignition sources it is a moderate fire and explosive hazard. Index of explosibility (<.1 weak, >10 severe) 0.1. Particle size and dispersion in air determine reactivity.
Firefighters should wear self-contained breathing apparatus.
*100% of dust goes thru a 74 micron sieve. Can be ignited by a 140 millijoule spark.

SECTION V. REACTIVITY DATA

This metal is stable when properly stored and handled.
Reacts readily with dilute acids (not nitric) to form chromous salts. Soluble in acids (not nitric) and strong alkalis. Not oxidized by air, even in presense of noticeable moisture. Powder is incompatible with strong oxidizing agents, including high O_2 conc.
Evaporation of Hg from Cr amalgam leaves pyrophoric chromium. Finely divided Cr attains incandescence with nitrogen oxide, potassium chlorate, sulfur dioxide.
Fused ammonium nitrate below 200 C reacts explosively; Cr dust (when heated) suspended in CO_2 is ignitable and explosive.
Molten lithium at 18 C attacks Cr severely. At high temperature, oxidation of metal may produce toxic chromium oxide fumes (See MSDS #5).

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SECTION VI. HEALTH HAZARD INFORMATION

TLV (See Sect. II)

Chromium metal is relatively nontoxic. Inhalation hazard of powders is dependent upon particle size. Chromium metal and insoluble salts are said to be involved in histological fibrosis of the lungs. (Ref. 31). When metal is heated to a high temperature, fumes produced may be damaging to the lungs when inhaled (possible pneumoconiosis?). Dusts or powder can cause eye and skin irritation.

FIRST AID:

Eye Contact: Flush with running water for 15 minutes, including under eyelids.

Inhalation: Remove victim to fresh air. Restore and/or support breathing as required.

Ingestion: Give water to drink. Induce vomiting.

Seek prompt medical help for further treatment, support, and observation.

Skin: Brush off chromium dust. Wash well with soap and water.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of large spills. Remove sources of heat or ignition.

Provide adequate ventilation. Keep airborne dust at a minimum. Clean up personnel to wear protective clothing and approved respirator. Remove spills quickly and place in appropriate containers for disposal or reuse.

DISPOSAL: Reclaim salvageable metal. Place waste in approved secure landfill.* Or incinerate with approved air pollution controls. Follow Federal, State, and Local regulations.

*California Class I.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements in the workplace.

Respiratory protection (MESA/OSHA approved) equipment necessary for certain work situations. Respiratory protection in the form of a self-contained breathing apparatus with a full facepiece to be used when the particle concentration's upper limit is 50 mg/m^3. Avoid eye contact by use of chemical safety goggles where dusty conditions occur. Wear protective clothing appropriate for the work situation to minimize skin contact. Clothing to be changed daily and laundered. Showering after work with a complete change to street clothing is desirable.

Eyewash stations should be readily accessible in areas of use of powdered chromium.

Provide preplacement and periodic medical examinations for those regularly exposed to chromium dust or fume with emphasis on respiratory systems.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS (for chromium powder)

Store material in cool, dry, well-ventilated area. Away from heat or ignition sources.

Use good housecleaning practices to prevent accumulation of dust and follow cleaning techniques (vacuuming and wet sweeping) that will keep airborne particulate at a minimum. Use nonsparking tools and ground electrical equipment and machinery.

Avoid inhalation of dust. Minimize skin contact by using rubber gloves and aprons. Wash thoroughly after handling. Store separate from acids and oxidizing agents. Keep containers closed and protect from physical damage.

DATA SOURCE(S) CODE: 2-7,9-12,25,26,31,37-44

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APPROVALS: MIS J. M. Nielsen
CRD

Industrial Hygiene and Safety JW 3-16-81

MEDICAL REVIEW: 23 March 1981

Material Safety Data Sheet

From Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 136
SELENIUM
Issued: April 1988

SECTION 1. MATERIAL IDENTIFICATION

25

Material Name: SELENIUM

Description (Origin/Uses): Used to manufacture other selenium compounds; also used in photography and xerography and as a catalyst and pigment.

Other Designations: Elemental Selenium; Selenium Base; Selenium Dust; Selenium Metal; Selenium Metal Powder; Se; NIOSH *RTECS* No. VS7700000; CAS No. 7782-49-2

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

Comments: See Genium Industrial MSDS 152 (Selenium Dioxide).

HMIS	
H 3	
F 0	R 1
R 1	I 4
PPG*	S 2
*See sect. 8	K 0

Not Found

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Selenium, CAS No. 7782-49-2	ca 100	IDLH* Level: 100 mg/m³ **OSHA PEL**** 8-Hr TWA: 0.2 mg/m³ **ACGIH TLV,** 1987-88** TLV-TWA: 0.2 mg/m³ **Toxicity Data***** Rat, Oral, LD_{50}: 6700 mg/kg Rat, Inhalation, LD_{Lo}: 33 mg/kg (8 Hrs)

*Immediately dangerous to life and health
**This exposure limit is defined for selenium compounds as Se.
***See NIOSH, *RTECS*, for additional data with references to reproductive, mutagenic, and tumorigenic effects.

SECTION 3. PHYSICAL DATA

Boiling Point: ca 1263°F (684°C)
Water Solubility: Insoluble
Melting Point: ca 644°F (340°C)

Specific Gravity (H_2O = 1): Both amorphous and crystalline forms have specific gravities between 4 and 5.
Molecular Weight: 79 Grams/Mole

Appearance and Odor: A dark red to bluish black amorphous solid or dark red, grey, or black crystals appearing in two distinct forms, or allotropes, because of differences in crystalline structures; odorless.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
*	*		*	*

Extinguishing Media: *Selenium does not burn. Use agents such as dry chemical, "alcohol" foam, or carbon dioxide that will extinguish the surrounding fire.

Unusual Fire or Explosion Hazards: None.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Selenium is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.

Chemical Incompatibilities: This material reacts dangerously with carbides, fluorine, oxygen, potassium, and many more materials (see Genium ref. 84).

Conditions to Avoid: Avoid direct contact with incompatible chemicals to prevent dangerous and violent reactions. Avoid the unintended contact of water with selenium in storage areas or reactor vessels.

Hazardous Products of Decomposition: When heated to decomposition, selenium readily emits toxic oxides of selenium (SeO_2). Selenium itself is a highly toxic and dangerous material.

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SECTION 6. HEALTH HAZARD INFORMATION

Selenium is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: Direct exposure to selenium or inhalation of its dust causes severe irritation of the skin, eyes, and the upper respiratory tract (URT). **Caution:** Some symptoms of exposure to selenium (e.g., chemical pneumonia) may be delayed for several hours. **Medical Conditions Aggravated by Long-Term Exposure:** None reported. **Target Organs:** URT, skin, eyes. **Primary Entry:** Inhalation, skin contact. **Acute Effects:** Skin and eye burns, contact dermatitis, intense irritation of the URT, and headache. Cases with flulike symptoms resembling metal-fume fever within 24 hours of exposure have been reported.
Chronic Effects: Odor of garlic on breath; fatigue; irritability; URT irritation; pallor; gastrointestinal distress; metallic taste; and an allergic eye reaction with red, sometimes puffy, eyelids.
FIRST AID: Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water. **Skin.** Immediately wash the affected area with plenty of running water. Any worker who develops a rash or contact dermatitis must get medical attention and prevent any further contact with selenium metal or its compounds (e.g., selenium dioxide; see Genium Industrial MSDS 152). **Inhalation.** Remove exposed person to fresh air; restore and/or support his or her breathing as needed. Prompt administration of oxygen gas (O_2) by trained medical personnel may aid recovery. **Ingestion.** Give exposed person several glasses of water to dilute material. Do not induce vomiting. Never give anything by mouth to someone who is unconscious or convulsing.

Treat each exposure to selenium as an emergency! GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. If chelation therapy to remove the metallic selenium is indicated, calcium disodium edetate ($CaNa_2$-EDTA) is the chelating agent of choice; do *not* use dimercaprol. Burns may require treatment with 10% sodium thiosulfate cream.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate all nonessential personnel, provide adequate ventilation, and do not add any water to the spill or leak area. Cleanup personnel need protection against contact with and inhalation of dust (see sect. 8). Scoop up spilled selenium into suitable containers for disposal. Carefully sweep or vacuum up small spills or residues without creating dust.
Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations for disposal. Follow Federal, state, and local regulations.
OSHA Designations
Air Contaminant (29 CFR 1910.1000 Subpart Z)
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste: Listed without a Number
CERCLA Hazardous Substance, Reportable Quantity: 1 lb (0.454 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Follow the eye- and face-protection guidelines in 29 CFR 1910.133. **Respirator:** Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. For emergency or nonroutine use (e.g., cleaning reactor vessels or storage tanks) wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves; boots; aprons; and clean, impervious, body-covering clothing to prevent any possibility of skin contact.
Ventilation: Install and operate general and local maximum explosion-proof ventilation systems powerful enough to maintain airborne levels of selenium below the OSHA PEL standard cited in section 2. **Safety Stations:** Make eyewash stations, washing facilities, and safety showers available in areas of use and handling. Make the 10% sodium thiosulfate solution or cream and the $CaNa_2$-EDTA chelating agent formula (sect. 6) readily available to a trained safety specialist. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Particles can adhere to contact lenses and cause corneal damage. Do *not* wear contact lenses in any work area.
Comments: Practice good personal hygiene; always wash thoroughly after using this material. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store selenium in a cool, dry, well-ventilated area in tightly closed containers away from oxidizing agents, organic materials, water, metals, and incompatible chemicals (see sect. 5). **Special Handling/Storage:** Prevent moisture or water contamination in any storage facility. Consider installing an automatic monitoring system to detect selenium contamination; storage under an inert gas (e.g., a nitrogen blanket) may be warranted depending on the work environment. **Engineering Controls:** Use selenium in closed engineering systems because of its significant health and physical hazards (see sects. 4, 5, and 6). All engineering systems (production, transportation, etc.) should be of maximum explosion-proof design (i.e., they must be nonsparking, electrically grounded and bonded, etc.). **Comments:** Perform all work with selenium with a sustained, conscientious effort to prevent accidental contact with water. Do not create a dusty working environment. Develop a sustained, conscientious program of working guidelines prior to any accidental exposure.
Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Selenium Metal Powder	**DOT Label:** Poison	**IMO Label:** St. Andrew's Cross (X)*
DOT Class: Poison B	**DOT ID No.** UN2658	**IMO Class:** 6.1

*Harmful-Stow away from Foodstuffs (IMO Label, Materials of Class 6.1 Packaging Group III)
References: 1, 2, 12, 73, 84-94, 100, 103.

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Prepared by PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
Medical Review: MJ Hardies, MD

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MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
...45 CATALYN ST., SCHENECTADY, NY 12303 USA (518) 377-8854

MSDS # 162
COPPER (SCRAP - GENERIC)

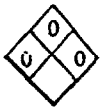
Issued: December 1985
Revised:

...om Genium's MSDS Collection, to be used as a reference.

SECTION 1. MATERIAL IDENTIFICATION

18

MATERIAL NAME: COPPER (SCRAP-GENERIC)
OTHER DESIGNATIONS: Copper (Cu) Metal, Casting, or Powder Scrap
DESCRIPTION: Copper or Copper Alloy.
MANUFACTURER: Available from several suppliers.



R 1
I 3
S 1
K 0

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
BASE METAL: Copper (Cu) CAS #7440 50 8	100% maximum	*PEL (OSHA): 0.1 mg/m^3 **TLV (ACGIH): 0.2 mg/m^3 (as copper fume) *PEL (ACGIH): 1.0 mg/m^3 **TLV (ACGIH): 1.0 mg/m^3 (as copper dust or mist) Rat, oral TDLo: 152 mg/kg Human, oral TDLo: 120 mg/kg

* OSHA Permissible Exposure Limit (PEL)
** American Conference of Govermental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's) current as of revision date.

SECTION 3. PHYSICAL DATA

...iling Point @ 1 atm .....~2500°C
...apor Pressure @ 20°C (mm Hg)... N/A
% Volatile by Volume ..... N/A
Melting Point ..... Approx. 1100C
Solubility in Water ..... Insoluble
Evaporation Rate (BuAc=1) ... N/A

APPEARANCE & ODOR: Solid, various shapes, odorless, red/brown-colored metal or powder.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
None	None	None	NA	NA

EXTINGUISHING MEDIA: Will not burn. Use water to cool.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Fine metal particles produced when ground, sawed, etc., can burn. High concentration of fines (fine particles) in the air may present an explosion hazard. Good housekeeping and adequate ventilation is recommended. Use air-supplied or self-contained breathing apparatus if fires are in enclosed areas.

SECTION 5. REACTIVITY DATA

This material is stable under most conditions. No hazardous polymerization or explosion conditions exist for the bulk metal.

INCOMPATIBILITIES: Strong acids

COMPOSITION PRODUCTS: Metallic oxides (copper fumes)

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SECTION 6. HEALTH HAZARD INFORMATION

TLV See Section 2

Copper scrap is poorly absorbed through the skin or alimentary tract, and while in the solid state it is not considered a hazard. Operations such as welding, dust generation, or fume generation could allow exposure to copper dusts and fumes. Therefore, it is important to maintain exposure levels below the regulated levels as noted in Section 2. Determine actual exposures by industrial hygiene monitoring.

Short-term exposure to copper dusts or fumes may cause irritation of the upper respiratory tract and "metal fume fever," a transient condition with symptoms of fever and chills. Chronic or long-term exposure may result in lung X-ray changes not associated with harmful effects.

FIRST AID:

EYE CONTACT: Protect eyes from particles or fumes. Wash exposed eyes with copious amounts of water for at least 15 minutes.

SKIN CONTACT: Protect skin from molten metal and radiant heat when melting scrap. Skin contamination from powder may be cleaned with soap and water. Machine turnings may present a laceration hazard.

INHALATION: Move to fresh air, restore or support breathing as required.

INGESTION: NA

Copper has not been identified as a carciongen by NTP, IARC or OSHA.

SECTION 7. SPILL, LEAK AND DISPOSAL PROCEDURES

Copper scrap is normally recycled or sold as scrap or landfilled if recycling cannot be justified. Clean up dust/powder spills promptly by vacuum and wet cleaning methods. Treat as an inert solid. Dispose of in accordance with OSHA, EPA, state, or local regulations.

SECTION 8. SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION: Use NIOSH/MSHA-approved dust/fume respirator or air-supplied respirator if concentrations of copper in air exceed the regulated standards. Use air-supplied or self-contained breathing apparatus (SCBA) in confined spaces.

VENTILATION: Use only with adequate ventilation where respirable dusts/mists/fumes are possible. Use local exhaust ventilation when cutting, grinding, welding, or remelting.

EYE PROTECTION AND PROTECTIVE CLOTHING: Protect skin from cuts and from hot procedures and processes. Eye and face protection required when grinding, welding, cutting or remelting. Maintain good hygiene and safe work processes. Scrap from machining may be contaminated with cutting oils. When handling oil-contaminated copper, wear rubber gloves to prevent skin contact.

Contact lenses pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Always maintain exposures below the PEL/TLV. Use industrial hygiene air monitoring to ensure that your use of this material does not create a hazard. Always use exhaust ventilation when feasible.

DATA SOURCE(S) CODE (See Glossary) 1-12, 14, 19, 20, 30, 31, 40, 59. OW

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APPROVALS J O Durrico 3/86.

INDUST. HYGIENE/SAFETY [signature] 3-86

MEDICAL REVIEW: [signature] Mar 86

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GENIUM PUBLISHING CORP.

No. 176

ZINC METAL/POWDER

Issued: March 1986

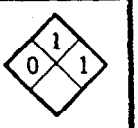
SECTION 1. MATERIAL IDENTIFICATION 19

MATERIAL NAME: ZINC METAL/POWDER

OTHER DESIGNATIONS: Spelter; CAS #7440-66-6; ASTM B-69; Zn

DESCRIPTION: Shining white, malleable, blue-gray metal; bars, sheets, wire, foil, flake, and powder.

HMIS
H: 1
F: 1
R: 1
PPE: *
* See Sect. 8



R 0
I 2
S 1
K -

MANUFACTURERS: Available from several suppliers, including: Meadowbrook Corp., 30 Rockefeller Plaza, New York City, NY 10112; Telephone:)(212) 582-0420

COMMENTS: Commonly used for galvanizing iron and other metals, electroplating, battery cells, and as an alloying component of brass or bronze. Zinc oxide is used as a pigment in cosmetics and ointments.

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
ZINC; CAS #7440-66-6	>98	OSHA PEL* as Zinc Oxide: 5 mg/m^3
* Current ACGIH (1985-86) TWA is 5 mg/m^3 as ZnO fume, while STEL for ZnO is 10 mg/m^3. Metallic zinc particulates can be considered a nuisance dust.		Human, Inhalation TCLo: 1 hr.

SECTION 3. PHYSICAL DATA

Boiling Point ... 1664.6°F (907°C)
Melting Point ... 788°F (420°C)
Vapor Pressure ... 736°C mm Hg 100
Percent Volatile by Volume ... Not Found
Water Solubility ... Insoluble

Molecular Weight ... 65.38
Vapor Density (Air = 1) ... Not Found
Evaporation Rate ... Not Found
Specific Gravity (H_2O = 1) ... 7.14

Appearance and odor: Bright gray-white metallic solid, foil or particulate. No odor.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
Not Found	Powder/650 millijoules	Dust Cloud Exp. Level		

NFPA CLASSIFICATION: 1.
EXTINGUISHING MEDIA: Special mixtures of dry chemical or clean, dry sand. Dust will form explosive mixtures with air. Bulk dust in a damp state may generate heat through chemical reaction and hydrogen gas. UNUSUAL FIRE/EXPLOSION HAZARDS: Zn may generate toxic fumes when heated, causing metal fume fever (see sect. 6). Fire fighters should use self-contained breathing apparatus when fighting fires involving zinc or zinc powder. SPECIAL FIRE-FIGHTING PROCEDURES: Zinc and zinc powder will burn in chlorine gas. Care should be taken to ensure that fires involving bulk quantities of zinc powder that are extinguished with water do not generate heat or possible hydrogen gas with subsequent reignition through the reaction of zinc powder and water. Concentrations of zinc oxide powder should remain open and not be sealed to allow safe drying.

SECTION 5. REACTIVITY DATA

Zinc metal/powder is stable. Hazardous polymerization cannot occur.
CHEMICAL INCOMPATIBILITIES: Contact with acids or alkaline hydroxides will yield hydrogen gas. Zinc may react with halogenated hydrocarbon solvents to form salts and hydrogen gas. The combination of zinc and carbon disulfide will result in an incandescent reaction.
CONDITIONS TO AVOID: Bulk zinc dust should be kept in dry, well-ventilated storage to prevent reaction with water and generation of hydrogen gas. Zn powder reacts explosively with manganese chloride. Zn is resistant to fluorine, chlorine, and bromine, but it reacts strongly with these halogens in the presence of water vapor.
HAZARDOUS DECOMPOSITION PRODUCTS: Zinc and zinc powder will react with water to generate hydrogen gas.
COMMENTS: When combined with oxygen, zinc or zinc powder will generate a fume that can result in metal fume fever (see sect. 6).

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SECTION 6. HEALTH HAZARD INFORMATION | TLV

This product is not considered a carcinogen by the NTP, OSHA, or IARC.

SUMMARY OF RISKS: Zinc metal in most forms is not toxic and is not readily absorbed through the skin, GI tract, or lungs. Zn is considered essential to life. Although most inorganic Zn compounds are potential causes of gastroenteric irritation, a high-level dose is relatively nontoxic when ingested. Inhalation of zinc fumes normally generated by zinc and extreme heat may cause metal fume fever, which is accompanied by dryness and irritation of the throat, coughing and dyspnea, a feeling of weakness, muscle pain, and general malaise. Removal from exposure will normally alleviate symptoms, with no residual or chronic effects.

TARGET ORGANS: Lungs, skin. PRIMARY ENTRY: inhalation, dermal contact.

ACUTE EFFECTS: Inhalation of high levels of zinc fumes may cause metal fume fever.

CHRONIC EFFECTS: Prolonged skin contact may cause a drying dermatitis. Zinc and zinc powder have little history of causing chronic effects.

FIRST AID: EYE CONACT: Flush well with running water to remove particulates; get medical attention if irritation persists.* SKIN CONTACT: For cuts, dermal abrasion, irritation, or thermal burns, get medical attention.* INHALATION: Remove person to fresh air; get medical attention if symptoms persist.* INGESTION: Get medical help if large amount is ingested.

* GET MEDICAL ASSISTANCE = In plant, paramedic, community.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Notify safety personnel of large powder spills. Clean up, minimizing dust generation, heat, sources of ignition, and moisture. Approved, grounded vacuum cleaners may be used for final cleanup. Place picked-up powder in closed, pressure-vented, dry metal containers.

DISPOSAL: Deposit unsalvageable waste in an approved landfill per Federal, state, and local regulations. Zinc powder should not be shipped if it is wet.

COMMENTS: Consider EPA Code D 001 or D 003 for Zn powder disposal.

SECTION 8. SPECIAL PROTECTION INFORMATION

GOGGLES: Wear safety goggles to prevent eye contact with particulates.

GLOVES: Wear tightly woven, nonstatic-generating, protective clothing. Special protective clothing is needed for work with hot or molten Zn.

RESPIRATOR: Use NIOSH-approved respirator when dust/fume exceeds the TLV.

VENTILATION: Provide local (explosion-proof) exhaust ventilation to meet TLV requirements. An approved dust-collection system is needed to gather airborne particulates.

OTHER: Preplacement and periodic examination of personnel is suggested. Eyewash stations should be accessible outside the use area. Use of contact lenses in areas of Zn particulate generation should be prohibited because they pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Solid zinc metal does not need special storage segregation; however, zinc powder should be stored dry in a storage area free from ignition sources, chlorine, bromine, or fluorine gas and/or acids.

SPECIAL HANDLING/STORAGE: Follow approved cleaning techniques for zinc powder. Good handling is necessary to control powder dispersal and prevent generation of airborne particulates.

ENGINEERING CONTROLS: Facilities for handling large amounts of zinc powder require special design; approved procedures; use of grounded, electrical, nonsparking tools; and emergency planning for fire and spills.

COMMENTS: See NFPA 491M

NOT designated as a hazardous substance by EPA (40 CFR 116)

DOT Classification: Zn Powder - Flammable Solid

UN1436

Data Source(s) Code: 2-12, 14, 26, 31, 37, 41, 59, 61, 62, 82, 84. OW

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Approvals	[illegible] 6/86
Indust. Hygiene/Safety	[illegible] 6/86
Medical Review	[illegible] July 86

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Material Safety Data Sheet

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GENIUM PUBLISHING CORP.

No. 181

SILVER

Issued: April 1986

SECTION 1. MATERIAL IDENTIFICATION

20

MATERIAL NAME: SILVER
DESCRIPTION: Elemental metal.
OTHER DESIGNATIONS: Ag, Argentum, CAS #7440-22-4.

MANUFACTURER/SUPPLIER: Available from many suppliers.

COMMENTS: Photography products account for 30% of industrial consumption. Additional uses include electrical conductors, coins, silverware, and jewelry.

HMIS
H:1
F:0
R:0
PPE*
*See sect. 8

Not Found

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Silver, Ag	99+	TWA 0.1 mg/m^3* TWA 0.01 mg/m^3** ---------- Rat, Implant, TD: 2570 mg/kg

* Current (1985-86) ACGIH TLV for silver dust and fume.

** Current (1985-86) ACGIH TLV for soluble silver compounds and OSHA exposure limit.

SECTION 3. PHYSICAL DATA

Boiling Point ... 3833.6°F (2112°C)
Vapor Pressure ... Not Found
Water Solubility ... Insoluble
Vapor Density (Air = 1) ... Not Found
Evaporation Rate ... Not Found

Specific Gravity (H_2O = 1) ... 10.5
Melting Point ... 1763.4°F (961.9°C)
Percent Volatile by Volume ... Not Found
Molecular Weight ... 107.87

Appearance and odor: Ductile and malleable lustrous white metal.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
Not Found	Not Found	Not Found	Not Applicable	Not Applicable

NFPA Classification: Noncombustible.

EXTINGUISHING MEDIA: Use proper extinguisher for surrounding fire.

UNUSUAL FIRE/EXPLOSION HAZARDS: None.

SPECIAL FIRE-FIGHTING PROCEDURES: None.

SECTION 5. REACTIVITY DATA

Silver is stable. Hazardous polymerization cannot occur.

CHEMICAL INCOMPATIBILITIES: Acetylene and silver form an insoluble, explosive acetylide. If silver is treated with nitric acid in the presence of ethyl alcohol, silver fulminate may be formed, which can be detonated.
Ethylenimine forms explosive compounds with silver. Finely divided silver and hydrogen peroxide solutions may explode.
This material is incompatible with oxalic and tartaric acid. Ammonia plus silver may form explosive compounds.
Bromoazide explodes on contact with silver foil.

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SECTION 6. HEALTH HAZARD INFORMATION | TLV

Silver is not considered a carcinogen by the NTP, IARC, or OSHA.

SUMMARY OF RISKS: Silver has no known physiological function in man and will accumulate in most tissues. Chronic accumulation (threshold in excess of 1 gram) in the body can result in argyria, a permanent condition associated with widespread bluish pigmentation of the skin and conjunctiva. TARGET ORGANS: Generally, where contact occurs. PRIMARY ENTRY: Inhalation, long-term handling (causes particles to become embedded in skin), or absorption through sweat glands. ACUTE EFFECTS are associated with soluble silver compounds that may be caustic, causing local irritations or destruction of tissue, depending upon strength of solution. CHRONIC EFFECTS: Argyria may be a local or general effect, depending upon previous exposure. FIRST AID: EYE CONTACT: Flush with water for 15 minutes. Get medical attention.* SKIN CONTACT: Wash skin with soap and water. Argyria from long-term exposure is permanent and cannot be washed away. INHALATION: Remove victim to fresh air. INGESTION: Dilute with water. Get medical attention.*

* GET MEDICAL ASSISTANCE = In plant, paramedic, community. Get medical help for further treatment, observation, and support after first aid, if indicated.

COMMENTS: The original 0.01 mg/m^3 TLV was established to prevent a lifetime body accumulation exceeding 1 gram, where argyria would become evident. Evaluation of 25 years of data has shown 0.01 mg/m^3 to be too conservative; therefore, the ACGIH raised the TLV to 0.1 mg/m^3.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Notify safety personnel; prevent entry into sewers or surface waters. Wear respirator where a dusting hazard is anticipated.

WASTE DISPOSAL: Reclaim or sell waste to a commercial reclaimer.

SECTION 8. SPECIAL PROTECTION INFORMATION

GOGGLES are not required unless metal is in the molten state.

GLOVES: Repeated handling may discolor the skin because of skin rubbing against the metal. Cotton gloves will prevent this cosmetic effect.

RESPIRATOR is required where metal dust or fumes are generated with inadequate exhaust ventilation. Air samples should be collected to quantify the exposure levels.

VENTILATION is required where air exposures exceed the TLV-TWA'S.

OTHER: Reclamation of silver from photographic or X-ray film may involve cyanide compounds. Proper precautions must be taken when working with cyanide compounds. See Genium MSDS #13, Potassium Cyanide, for further information.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Silver is usually stored in locked cabinets or safes to prevent theft.

ENGINEERING CONTROLS: Exhaust ventilation where TLV-TWA is exceeded.

EPA Hazardous Substance Designation: 40 CFR 260

Data Source(s) Code: 2, 4, 6, 14, 59, 82, 84, NFC 1983. DW

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Approvals	JO. Acardo, 11/86
Indust. Hygiene/Safety	10-86
Medical Review	10/86

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Material Safety Data Sheet

From Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 194

ARSENIC TRIOXIDE

Issued: June 1986

SECTION 1. MATERIAL IDENTIFICATION

21

MATERIAL NAME: ARSENIC TRIOXIDE

OTHER DESIGNATIONS: Arsenic Oxide, Arsenic Sesquioxide, Arsenous Oxide, Arsenous Acid Anhydride, White Arsenic, As_2O_3, CAS #1327-53-3.

MANUFACTURER/SUPPLIER: Available from several suppliers, including:
Atomergic Chemetals Corp., 100 Fairchild Ave., Plainview, NY 11803;
Telephone: (516) 349-8800
Sharpe Chemicals Co., 1116 S. Varney St., Burbank, CA 91502;
Telephone: (818) 841-7605

HMIS	Not Found
H 3	
F 0	R 1
R 0	I 4
PPE*	S 2
*See Sect. 8	K 0

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Arsenic Pentoxide, CAS #1327-53-3	>99	ACGIH TLV* 8-hr TWA: 0.2 mg/m^3 OSHA PEL** 8-hr TWA: 0.01 mg/m^3 OSHA Action Level*** 8-hr TWA: 0.005 mg/m^3 Man, Oral, LD_{50}: 1.43 mg/kg Rat, Oral, LD_{50}: 15.1 mg/kg Woman, Oral, TDLo: 600 mg/kg (Reproductive Effect)

* Current (1985-86) ACGIH TLV for arsenic and soluble compounds, as As.

** Current OSHA PEL for inorganic arsenic compounds, as As.

*** Concentration that triggers certain provisions of the OSHA Arsenic Standard (29 CFR 1910.1018).

SECTION 3. PHYSICAL DATA

Melting Point ... 275°F (135°C) (Sublimes)*
Specific Gravity ... 3.865*
Vapor Pressure @ 20°C ... Essentially Zero
Solubility in Water, @ 2°C ... 1.2 g/100cc
@ 100°C ... 11.46 g/100cc
Molecular Weight ... 197.84
Appearance and odor: White amorphous lumps or powder.

* Values are for arsenolite. Amorphous arsenic trioxide melts at 599°F (315°C).

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	LOWER	UPPER
Not Found	Not Found	Not Found	Not Found	Not Found

EXTINGUISHING MEDIA: Arsenic trioxide is noncombustible. Use extinguishing agents (dry chemical, CO_2, water spray, or foam) that are suitable for extinguishing the surrounding fire.
UNUSUAL FIRE/EXPLOSION HAZARDS: Highly toxic fumes and gases may be evolved from this material in a fire situation.

SPECIAL FIRE-FIGHTING PROCEDURES: Fire fighters need self-contained positive-pressure breathing apparatus and full protective gear. Minimize the runoff of fire-control water to prevent pollution.

SECTION 5. REACTIVITY DATA

Arsenic trioxide is stable at room temperature. It does not polymerize.

INCOMPATIBILITIES: Aresenic trioxide may react violently on contact with chlorine trifluoride, fluorine, hydrogen fluoride, oxygen difluoride, sodium chlorate, and other strong oxidizers. Arsine gas (arsenic hydride) can be generated when arsenic compounds come in contact with nascent (freshly formed) hydrogen. This can occur by contact of acid, alkalies, or water with arsenic compounds in the presence of an active metal (zinc, aluminum, magnesium, manganese, sodium, iron, etc.). Arsine is an extremely poisonous (lethal) gas with a garlic odor.
HAZARDOUS DECOMPOSITION PRODUCTS: Arsenic trioxide sublimes when heated. Poisonous arsine gas may also form on decomposition.

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SECTION 6. HEALTH HAZARD INFORMATION

CARCINOGENIC ASSESSMENT: Exposure to arsenic compounds is associated with skin, lung, and possibly liver cancer. The NTP, IARC, and OSHA have identified arsenic compounds as human carcinogens. ROUTES OF ENTRY: Arsenic trioxide can enter the body if it is inhaled or swallowed. EFFECTS OF OVEREXPOSURE: Skin contact can cause dermatitis characterized by erythema (abnormal redness of skin caused by capillary congestion) with burning, itching, swelling, and skin eruptions. Chronic skin effects include cracking, thickening, pigmentation, and drying of the skin. Eye contact can cause conjunctivitis and redness, swelling, and pain. Acute inhalation exposure can cause severe nose and respiratory tract irritation and pulmonary edema. Prolonged or repeated exposure can cause necrosis and perforation of the nasal septem. Other effects of chronic arsenic poisoning by inhalation or ingestion may include gastrointestinal disturbances (nausea, vomiting); nervous system effects involving the extremities (numbness, tingling, burning pain, weakness, incoordination); blood disorders (anemia); liver and kidney injury; and skin and lung cancer. Acute ingestion of arsenic trioxide causes burning of the mouth and throat, vomiting, watery or bloody diarrhea, convulsions, paralysis, coma, and death. A dose of 120 mg of arsenic trioxide can be fatal. FIRST AID: EYE CONTACT: Flush eyes, including under eyelids, with a gentle flow of running water for at least 15 minutes. Get medical help.* SKIN CONTACT: Thoroughly wash affected area with mild soap and water. Prevent further exposure. If irritation or other symptoms persist, get medical help.* INHALATION: Remove victim from exposure. Keep him warm and at rest. If breathing has stopped, administer oxygen under low pressure. Get medical help promptly.* INGESTION: Immediately give victim a large quantity (2-4 glasses) of water to drink; induce vomiting. Keep him warm and at rest. Get medical help immediately!* (Note: Never give anything by mouth or induce vomiting if victim is unconscious or convulsing.) * GET MEDICAL ASSISTANCE = In plant, paramedic, community. Get medical help for further treatment, observation, and support after firest aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

CLEANUP PROCEDURES: Notify safety/environmental personnel of large arsenic trioxide spills. Ventilate spill area. Cleanup personnel should wear protective clothing (gloves, coveralls, goggles, etc.) and use protective respiratory equipment. Carefully vacuum up spilled material (vacuum must have high-efficiency filters to prevent redispersion of dust). Do not sweep or brush it up. Place the waste into a suitable container for reclamation or disposal. Minimize dust generation and prevent skin/eye contact throughout the cleanup process. Wash spill area to remove all residues from environmental surfaces. Use swipe tests to verify cleanliness.

DISPOSAL: This material requires disposal as a hazardous (toxic) waste. Contact supplier or a licensed chemical waste disposal contractor for treatment, packaging, and disposal instructions. Follow Federal, state, and local regulations.

Reportable Spill Quantity: 5000 lbs (2270 kg) (40 CFR 117.3)

EPA Hazardous Waste Number: P012 (40 CFR 261.33)

SECTION 8. SPECIAL PROTECTION INFORMATION

Use local exhaust ventilation when handling this material. Ventilation rates should be sufficient to maintain airborne levels below the PEL. NIOSH-approved respirators should be worn when airborne concentrations exceed the PEL and during nonroutine and emergency operations. Half-mask air-purifying respirators with high-efficiency filters are acceptable for concentrations not greater than 0.1 mg/m^3 (0.5 mg/m^3 with full facepiece). For concentrations above 0.5 mg/m^3, powered air-purifying respirators, positive-pressure-supplied air respirators, or self-contained breathing apparatus are required, depending on the concentration of the material. Respirator usage must be in accordance with appropriate provisions of the OSHA Inorganic Arsenic Standard (29 CFR 1910.1018). Dust-/splash-proof safety goggles should be worn when handling this material. Protective clothing and equipment such as coveralls, gloves, hats, and shoes should be worn when airborne levels exceed the PEL or where the possibility of skin and eye contact exist. Provide clean body-covering work clothing weekly to workers who are exposed to above the PEL (daily if exposed to above 0.1 mg/m^3) and arrange for special handling and laundering of contaminated clothing. OTHER CONTROLS: Changing rooms with separate storage facilities for street and work clothing and showers are required for employees who are exposed to above the PEL. Prevent dust from being transported to the lunchroom through the ventilation system or on contaminated clothing. Consult the OSHA Inorganic Arsenic Standard (29 CFR 1910.1018) for detailed requirements. Eyewash stations, washing facilities, and safety showers should be readily accessible. Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store arsenic trioxide in a cool, dry location in tightly closed containers away from incompatibles (see sect. 5). Protect containers from physical damage. Keep this material away from food products and feed. Maintain good housekeeping practices to prevent accumulation of arsenic trioxide dust. Use procedures that minimize dust generation such as vacuuming (with appropriate filter) or wet cleanup. Brushing or sweeping should be used only where vacuuming or other relevant methods are ineffective. All handling should be done in a careful manner and with appropriate controls (enclosure, ventilation) to prevent dust generation and dispersion. Practice good personal hygiene. Wash face and hands thoroughly before eating, drinking, and smoking. Showering after the workshift is required for employees exposed to above the PEL. Do not eat, drink, use tobacco, chew gum, or apply cosmetics in the work area. Remove contaminated clothing promptly. Launder it before it is worn again. Do not shake clothing to remove dust; use a vacuum cleaner. Avoid inhalation and skin/eye contact. DO NOT INGEST THIS MATERIAL!

DOT Class: Poison B DOT ID No. UN1561 DOT Label: Poison

Data Source(s) Code: 2, 4, 9, 12, 14, 30, 44, 49, 55, 58, 61, 62, 84. CV

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3

Approvals G.O. Carmo, 1/87.

Indust. Hygiene/Safety 11-86

Medical Review

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MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
45 CATALYN ST., SCHENECTADY, NY 12303 USA (518) 377-8854

MSDS # 310
METHYLENE CHLORIDE
Revision E

Issued:
Revised: September, 1985

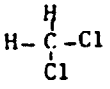
From Genium's MSDS Collection, to be used as a reference.

SECTION 1. MATERIAL IDENTIFICATION

17

MATERIAL NAME: METHYLENE CHLORIDE (Revision E)
OTHER DESIGNATIONS: Dichloromethane, FREON 30, Methane Dichloride, CH_2Cl_2; CAS#75-09-2.
MANUFACTURER/SUPPLIER: Available from many suppliers, including;
Dow Chemical USA
2020 Dow Center
Midland, MI 48640
(517) 636-1000

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
METHYLENE CHLORIDE 	ca 100	8 hr TWA: 100 ppm or 350 mg/m^3*
		Human, Inhalation: TCLo: 500 ppm/8 hr. (Blood effects)
		TCLo: 500 ppm/ 1 year-I (CNS effects)
		Rat, Oral: LD50: 2000 mg/kg

* ACGIH TLV/TWA (1985-86). OSHA PEL is 500 ppm with a ceiling of 1000 and a permissible peak exposure of 2000 ppm for 5 minutes per any two-hour period.

NIOSH recommends a 10 hr. TWA or 75 ppm with a ceiling concentration of 500 ppm (15 minute TWA). NIOSH also warns that toxic hazards associated with exposure to methylene chloride are increased by the presence of alcohol and/or carbon monoxide and by heavy labor and smoking.

SECTION 3. PHYSICAL DATA

Boiling point, 1 atm	104°F (40°C)	Specific gravity, 25/25C	1.32
Vapor pressure @ 20°C, mmHg	340	Volatiles, %	ca 100
Vapor density (Air=1)	2.9	Evaporation rate (CCl_4=1)	1.47
Solubility in water, wt. % @ 20°C	~1.6	Freezing point	-140.8°F (-96°C)
		Molecular weight	84.94

APPEARANCE & ODOR: Colorless liquid with a penetrating ether-like, sweetish odor. The unfatigued recognition threshold for 100% of test panel is 214 ppm.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
None (T.C.C.)	1031°F (555°C)	Vol % at 100°C in O_2	12	66.4

EXTINGUISHING MEDIA: Use extinguishing media that are appropriate for the surrounding fire. Use water spray to cool fire-exposed tanks/containers. When heated, methylene chloride forms weakly combustible mixtures in air. It will form flammable and explosive mixtures in an oxygen-enriched atmosphere. Methylene chloride has a high vapor pressure; when spilled, its vapor concentration in air may increase rapidly. Containers of methylene chloride may rupture violently during a fire.

Firefighters should wear self-contained breathing apparatus with face piece and full protective clothing. Vapors of methylene chloride can flow to low-lying areas.

SECTION 5. REACTIVITY DATA

This material is stable at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization. Methylene chloride is incompatible with alkali metals including sodium-potassium alloy, finely powdered aluminum and magnesium, n-Methyl-n-nitroso-urea, and potassium hydroxide, and potassium tert-butoxide. Contact with these materials may cause violent reaction or explosion. Prolonged exposure to water may cause noticeable hydrolysis to highly corrosive hydrochloric acid when temperature is above 60°C. Avoid contact with oxidizing agents and caustics. In organic-enriched atmospheres or when heated (>100°C) vapors may be readily ignited. Exposure to high temperatures (from open flames, hot surfaces, welding arcs, etc.) can produce corrosive and toxic thermal oxididative decomposition products such as hydrogen chloride and small quantities of phosgene.

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SECTION 6. HEALTH HAZARD INFORMATION

TLV 100 ppm (see Section 2)

Methylene Chloride enters the body mainly by inhalation and skin absorption. Vapors of methylene chloride are narcotic and may cause toxic encephalopathy. Excessive inhalation of vapor (300-700 ppm for 3-5 hrs.) causes slight loss of coordination and equilibrium. Symptoms of overexposure can also include dizziness, nausea, tingling of extremities, stupor, lethargy, convulsions and diminished vision. Severe exposures may cause unconsciousness and death. Symptoms of overexposure to methylene chloride are usually delayed in onset. The liquid is irritating to the eyes and may cause burns if not promptly removed. Prolonged or repeated contact with the skin may cause redness, irritation, dermatitis, frostbite or burns. It may be absorbed through the skin in toxic amounts. Ingestion of methylene chloride causes irritation of the gastrointestinal tract and symptoms resembling those from inhalation of vapor. Long-term exposure to mild or moderate doses of methylene chloride may cause delayed onset (24-48 hrs.) of dizziness, headache, mental confusion, slurred speech, double vision and sleeplessness. Medical recovery may be slow. NOTE: Methylene chloride is stored in body fat and metabolizes to carbon monoxide, which increases and sustains carboxyhemoglobin levels in the blood, reducing its oxygen-carrying capacity. It may damage the liver, kidneys, or blood. Alert medical attendants to its secondary hazard.

FIRST AID: EYE CONTACT: Promptly flush eyes, including under eyelids, with running water for at least 15 minutes. Get medical attention if irritation persists (in-plant, paramedic, or community). SKIN CONTACT: Flush exposed area with water while removing contaminated clothing. Get medical attention if irritation persists. INHALATION: Remove to fresh air. Restore and/or support breathing (O_2 therapy) as required. Keep warm and at rest. Get medical help. Advise physician not to use adrenalin. INGESTION: Get prompt medical help! Do not induce vomiting. If vomiting occurs spontaneously, position victim's head below trunk to resist aspiration hazard. Advise physician not to use adrenalin.

SECTION 7. SPILL, LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of large spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Evacuate all personnel from the area except for those involved in clean-up. Remove leaking container to safe place if feasible. Absorb small spills with an absorbent material such as paper towel or vermiculite. Evaporate off solvent in an exhaust hood and place absorbent in a closed container for disposal. Dike large spills and collect for recovery or disposal. Pick up residue with absorbent (as with small spills) or flush to ground (not to sewer) to evaporate. Clean-up personnel should wear respiratory equipment and protective clothing to prevent inhalation of vapor and contact with skin/eyes. DISPOSAL: Reclaim waste solvent by filtration and distillation procedures. Place in closed containers for disposal by a licensed contractor, or burn in an approved incinerator.
Methylene chloride is designated as a hazardous waste by the EPA. The EPA (RCRA) H.W. No. is 080 (40CFR261).

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation (explosion-proof) to meet TLV requirements. Floor level ventilation and sump ventilation may also be necessary. For emergency or non-routine exposures, wear an appropriate NIOSH-approved respirator. All electrical service in use or storage areas should have an explosion-proof design. When handling liquid, wear neoprene, PVA, or vitron gloves and safety glasses. In case of leak or spill or unusual handling where repeated or prolonged contact may occur, use protective clothing, apron, boots, and splash goggles or face shield as necessary. Remove contaminated clothing promptly and do not reuse until it has been properly laundered. Eye wash stations and safety showers should be readily available in use and handling areas. Contact lenses pose a special hazard; soft lenses absorb; all lenses concentrate irritants. NOTE: CO and CH_2Cl_2 content of workplace air are additive and both must be monitored where methylene chloride exposures occur. Preplacement and annual physical exams should emphasize the nervous and respiratory systems liver, kidneys, skin, eyes and carboxyhemoglobin levels. Those with a history of cardiovascular disease or who are heavy drinkers or smokers should avoid exposure to this material.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from combustibles and sources of heat and ignition. Open containers slowly and with caution. Protect containers from physical damage. Keep containers and storage tanks free of water and moist air. Be careful when handling this compound. Use only with adequate ventilation. Don't breathe vapors. Avoid contact with eyes, skin and clothing. When methylene chloride vapors are drawn into the combustion chamber of a space heater, severe corrosion damage to the heater can occur, even at levels well below the TLV. LARC Review (1979) listed animal carcinogenic determination as indefinite. A substantial risk notice to EPA (TSCA, 8e) reports a high incidence of lung and liver tumors in mice in long-term inhalation studies at 2000-4000 ppm (1984, preliminary).

DOT CLASSIFICATION: ORM-A DOT I.D. No. UN1593 LABEL: None (or St. Andrew's Cross)
IMO CLASS: 6.1
DATA SOURCE(S) CODE (See Glossary) 1-12, 14, 16, 23, 25, 31, 34, 37, 38, 47, 48.R.

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APPROVALS: JO Accurso, 11/85
INDUST. HYGIENE/SAFETY: JW 11-85
MEDICAL REVIEW: Dec 85

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MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

NO 311
INHIBITED
1,1,1-TRICHLOROETHANE
REVISION D
DATE August 1983

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: INHIBITED 1,1,1-TRICHLOROETHANE
OTHER DESIGNATIONS: Methyl Chloroform, MC, CCl_3CH_3, GE Material D5B79, CAS# 000 071 556, α-Trichloroethane
TRADENAMES & MANUFACTURER: BLACO-THANE (Baron-Blakeslee), CHLOROTHENE NU & VG (Dow), INHIBISOL (Penetone Corp.), TRI-ETHANE (PPG Ind. Inc), TRITHENE (SRS, Inc.)

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
1,1,1-Trichloroethane	>95	8-hr TWA 350 ppm**
Inhibitor, typical*	< 5	Unknown
*Inhibitors used are proprietary. Commercial materials contain up to about 5% inhibitor and are designed for cold cleaning or vapor degreasing use or both.		Human, Inhalation LCLo 27 gm/m³/10 min
**Current OSHA PEL and ACGIH (1983) TLV. ACGIH STEL 450 ppm.		TCLo 920 ppm/70 min (CNS effects)
NIOSH (1976) proposed a 10-hr TWA of 200 ppm with a 350 ppm ceiling (15 minute sample) and has recommended caution in use		Human, Oral TDLo 670 mg/kg (GI effects)

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F ----- ca 165*
Vapor pressure, 20 C, mm Hg ----- 100
Vapor density (Air=1) ---------- 4.55
Water solubility, g/100ml H_2O @20C - 0.09
Specific gravity, 25/25C --- 1.3-1.336*
Volatiles, % ---------- ca 100
Melting point, deg C ------- -32
Evaporation rate (CCl_4=1) -- 1
Molecular weight ---------- 133.41

Appearance & Odor: Colorless liquid with a mild, sweetish, pleasant, ether-like odor which may be just perceptible (unfatigued) at about 100 ppm in air.
*Properties depend on the inhibitor and inhibitor level.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits in Air	Lower	Upper
None	537 C (998 F)	(High energy ignition source at 25C), Vol. %	8.0%	10.5

This material is nearly nonflammable. High energy, such as electric arc, is needed for ignition, and the flame tends to go out when the ignition source is removed. Material involved in a fire can emit toxic and irritating fumes. Water fog, carbon dioxide, dry chemical, or foam may be used to fight fires.
Use self-contained or air-supplied breathing apparatus for protection against suffocating vapors and toxic and corrosive decomposition products.

SECTION V. REACTIVITY DATA

This material can be hydrolyzed by water to form hydrochloric acid and acetic acid. It will react with strong caustic, such as caustic soda or caustic potash to form flammable or explosive material. Attacks natural rubber.
It requires inhibitor content to prevent corrosion of metals; and when inhibitor is depleted, it can decompose rapidly by reaction with finely divided white metals, such as aluminum, magnesium, zinc, etc. Do not use these metals for storage containers or in pressurized spraying equipment where MC is involved.
It will decompose at high temperature upon contact with hot metal, or under ultra-violet radiation to produce toxic and corrosive gases (hydrogen chloride, dichloroacetylene, chlorine and some phosgene).

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 350 ppm or 1900 mg/m3

Brief exposure at 900-1000 ppm causes mild eye irritation and loss of coordination due to the early effects of MC on the CNS. Excessive exposure gives headache, drowsiness, impaired judgement, unconsciousness. Defats skin on contact, can produce irritation and dermatitis; can be absorbed through the skin. Eye contact gives pain and irritation. Considered low in toxicity among the chlorinated hydrocarbons.

FIRST AID:

Eye contact: Flush eyes well with plenty of running water for 15 min, including under eyelids.

Skin contact: Remove solvent-wet clothing promptly. Wash contact area with warm water and soap. Get medical attention for irritation.

Inhalation: Remove to fresh air. Restore and/or support breathing as needed. Get medical assistance. (Note: Advise physician not to use adrenalin.)

Ingestion: Contact physician.Aspiration a hazard! Possible spontaneous vomiting. (If medical help not readily available and amount swallowed was appreciable, give milk or water to drink and induce vomiting. Repeat. Estimated lethal dose for 150 lb man is 0.5 to 1 pint.)

PHYSICIAN: Avoid using sympathomimetic amines in treatment.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

For small spills in ventilated area, mop, wipe or soak up with absorbent material avoiding inhalation and contact. Evaporate outdoors or in an exhaust hood.

For large spills, inform safety personnel and evacuate area. Use protective equipment during clean-up (see Sect. VIII). Ventilate area. Contain liquid, pick up and place in closed metal containers. Do not allow to enter drains and water ways.

DISPOSAL: Dispose of via a licensed waste solvent disposal company, or reclaim by filtration and distillation procedures. Follow Federal, State and Local regulations.

Aquatic toxicity TLm 96: 100-10 ppm.

EPA hazardous waste number under RCRA is U226 (40CFR261).

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements. Air-supplied or self-contained respirator should be available for non-routine or emergency use. A chemical cartridge-type respirator can be used for a limited time below 1000 ppm. A full facepiece is needed above 500 ppm.

Chemical goggles or a face shield should be worn if splashing is possible. Gloves and apron (of neoprene, polyethylene or polyvinyl alcohol) should be worn when needed to avoid skin contact. Remove solvent-wet clothing promptly. A safety shower and eyewash station should be available to use area if splashing is probable.

Preplacement and periodic medical examinations should consider cardiovascular, liver, CNS functions, and skin.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, well-ventilated area. Keep water-free. Monitor inhibitor level for vapor degreasing use. Use caution in cleaning operations involving white metal fines (see Sect. V). Trichloroethylene contamination may cause decomposition when aluminum is degreased.

Provide medical monitoring of those regularly exposed to MC in the workplace. Preclude those with CNS, liver, or heart disease from exposure. Personnel using this solvent should avoid drinking alcoholic beverages shortly before,during,or soon after exposure.

NIOSH(1976 Crit. Doc.) expressed concern because of possible birth defects from high level pregnant rat exposures. Since 1976, directed studies have been negative. At occupational physicians' seminar on "Reproductive Hazards in the Workplace," Washington,DC (4/25/83), no physician was aware of data to substantiate the NIOSH concern.

DOT Classification: ORM-A I.D. No. UN2831

DATA SOURCE(S) CODE: 1-12,14,20,23,25,26,30,31,34,37,38,45-49,53

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APPROVALS: MIS/CRD J. M. Nielsen

INDUST. HYGIENE/SAFETY JW 7.21.83

MEDICAL REVIEW: 1 August 1983

Material Safety Data Sheet

From Genium's Reference Collection
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GENIUM PUBLISHING CORP.

No. 312
TRICHLOROETHYLENE
(Revision E)

Issued: July 1979
Revised: August 1987

SECTION 1. MATERIAL IDENTIFICATION

23

MATERIAL NAME: TRICHLOROETHYLENE

DESCRIPTION (Origin/Uses): Prepared from *sym*-tetrachloroethane by way of eliminating HCl by boiling with lime. Used to manufacture organic chemicals, pharmaceuticals; in degreasing and dry cleaning; and as a solvent for fats, waxes, rubbers, oils, paints, varnishes, ethers, and cellulose esters.

OTHER DESIGNATIONS: Ethylene Trichloride; TCE; Trichloroethene; 1,1,2-Trichloroethylene; C_2HCl_3; NIOSH *RTECS* #KX4550000; CAS #0079-01-6

MANUFACTURER/SUPPLIER: Available from several suppliers, including:
Dow Chemical USA, 2020 Dow Center, Midland, MI 48640;
Telephone: (517) 636-1000; (800) 258-CHEM

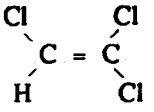
COMMENTS: Trichloroethylene is a toxic solvent and a suspected occupational carcinogen.

HMIS
H 2
F 1
R 1
PPE*
* See sect. 8

R 1
I 3
S 1
K 0

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Trichloroethylene, CAS #0079-01-6; NIOSH *RTECS* #KX4550000	100	ACGIH Values 1987-88 TLV-TWA*: 50 ppm, 270 mg/m^3 TLV-STEL**: 200 ppm, 1080 mg/m^3 OSHA PEL 1986*** 8-Hr TWA: 100 ppm Ceiling: 200 ppm NIOSH REL 1986 10-Hr TWA: 25 ppm TOXICITY DATA Human, Oral, LD_{Lo}: 7 g/kg Human, Inhalation, TC_{Lo}: 6900 mg/m^3 (10 Min) Human, Inhalation, TC_{Lo}: 160 ppm/83 Min Human, Inhalation, TD_{Lo}: 812 mg/kg



* The TLV-TWA is set to control subjective complaints such as headache, fatigue, and irritability.

** The TLV-STEL is set to prevent incoordination and other beginning anesthetic effects from TCE. These levels should provide a wide margin of safety in preventing liver injury.

*** The OSHA PEL is 300 ppm for 5 minutes in any 2 hours.

SECTION 3. PHYSICAL DATA

Boiling Point ... 188.6°F (87°C)
Vapor Pressure ... 58 Torr at 68°F (20°C)
Water Solubility ... Insoluble
Vapor Density (Air = 1) ... 4.53

Evaporation Rate ... Not Listed
Specific Gravity ... 1.4649 at 68°F (20°C)
Melting Point ... -120.64°F (-84.8°C)
Molecular Weight ... 131.40 Grams/Mole

Appearance and odor: Colorless, nonflammable mobile liquid; sweetish odor like chloroform.

COMMENTS: TCE is highly soluble in lipids. A high vapor pressure at room temperature provides the potential for TCE vapors to contaminate use areas.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
Not Listed	770°F (410°C)	% by Volume	8%	10.5%

EXTINGUISHING MEDIA: TCE has no flash point in a conventional closed tester at room temperature, but it is moderately flammable at higher temperatures. Use dry chemical, carbon dioxide, alcohol foam, or other extinguishing agents suitable for the surrounding fire.

OSHA Flammability Class (29 CFR 1910.106): Not Regulated

UNUSUAL FIRE/EXPLOSION HAZARDS: During fire conditions TCE emits highly toxic and irritating fumes, including hydrochloric acid and phosgene. SPECIAL FIRE-FIGHTING PROCEDURES: Wear a self-contained breathing apparatus with a full facepiece operated in a pressure-demand or another positive-pressure mode. At TCE vapor levels of 300-1000 ppm, fire fighters who lack the proper respiratory equipment may experience incoordination and impaired judgment.

DOT Flammability Class (49 CFR 173.115): Not Regulated

SECTION 5. REACTIVITY DATA

Trichloroethylene is stable. Hazardous polymerization can occur under certain circumstances (see Conditions to Avoid and Comments, below).

CHEMICAL INCOMPATIBILITIES include magnesium or aluminum powder, NaOH, KOH, or other strong alkaline materials. Reactions with alkaline materials may lead to the formation of dangerous explosive mixtures of chloroacetylenes.

CONDITIONS TO AVOID: When TCE is heated (as in the case with vapor degreasers) or exposed to sunlight, it requires extra stabilization against oxidation, degradation, and polymerization. It is slowly decomposed by light when moist.

PRODUCTS OF HAZARDOUS DECOMPOSITION include hydrochloric acid and phosgene under certain conditions at elevated temperatures.

COMMENTS: TCE is stable under normal handling and storage conditions, and hazardous polymerization is not expected to occur. However, failure of the stabilizer at elevated temperatures or other extreme conditions may allow polymerization to take place..

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SECTION 6. HEALTH HAZARD INFORMATION

Trichloroethylene is listed as a carcinogen by the NTP, IARC, and OSHA. NIOSH recommends that trichloroethylene be treated as an occupational carcinogen. IARC carcinogenic results are animal suspect, animal positive, and human indefinite. SUMMARY OF RISKS: Moderate exposures to TCE cause symptoms similar to those of alcohol inebriation. Higher concentrations cause narcotic effects. Ventricular fibrillation has been cited as the cause of death following heavy exposures. TCE-induced hepato cellular carcinomas have been detected in mice during tests conducted by the National Cancer Institute (*Chem & Eng News* 54 [April 5, 1976]:4). Organ systems affected by overexposure to TCE are the central nervous system (euphoria, analgesia, anesthesia), degeneration of the liver and kidneys, the lungs (tachypnea), heart (arrhythmia) and skin (irritation, vesication, and paralysis of fingers when immersed in liquid TCE). Contact with the liquid defats the skin, causing topical dermatitis. Certain people appear to experience synergistic effects from TCE exposure concomitant with exposure to caffeine, alcohol, and other drugs. When combined with alcohol intake, toxic effects are increased and may cause a red, blotchy facial and upper body rash commonly called "degreaser's flush." Other reported symptoms of TCE exposure include abnormal fatigue, headache, irritability, gastric disturbances, and intolerance to alcohol. Toxic effects from testing of TCE on humans include hallucination, distorted perception, somnolence (general depressed activity), and jaundice. TARGET ORGANS: Respiratory system, central nervous system, heart, liver, kidneys, and skin. PRIMARY ENTRY: Ingestion, inhalation, skin contact. ACUTE EFFECTS: Headache, vertigo, visual disturbance, tremors, nausea, vomiting, dermatitis, dizziness, drowsiness, and irritation to the eyes, nose, and throat. CHRONIC EFFECTS: None Reported. MEDICAL CONDITIONS AGGRAVATED BY LONG-TERM EXPOSURE: Diseases of the liver, kidneys, lungs, and central nervous system. FIRST AID: EYE CONTACT: Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. Get medical help.* SKIN CONTACT: Wash thoroughly with soap and water. Remove and launder contaminated clothing before wearing it again; clean material from shoes and equipment. Get medical help.* INHALATION: Remove victim to fresh air; restore and/or support his breathing as needed. Do not give adrenalin to the victim. Get medical help.* INGESTION: Call a poison control center. Never give anything by mouth to someone who is unconscious or convulsing. A professional decision regarding whether or not to induce vomiting is required. Do not give adrenalin to the victim. Get medical help.*

*GET MEDICAL ASSISTANCE = IN PLANT, PARAMEDIC, COMMUNITY. Get prompt medical assistance for further treatment, observation, and support after first aid.

COMMENTS: Workers' responses to TCE vary significantly because of many factors, including age, health status, nutrition, and intake of alcohol, caffeine, and medicines. Do not use these substances before, during, or after exposure to TCE. If a worker displays any of the symptoms of exposure to TCE, thoroughly investigate all the possible contributing factors to determine, if possible, how much the work environment levels of TCE are responsible.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Inform safety personnel of any trichloroethylene spill or leak and evacuate the area for large spills. Cleanup personnel must use respiratory and liquid contact protection. Adequate ventilation must be provided. Confine the spilled TCE to as small an area as possible. Do not allow it to run off to sewers or open waterways. Pick up spilled TCE with a vacuum cleaner or an absorbent such as vermiculite.

DISPOSAL: Consider reclamation, recycling, or destruction rather than disposal in a landfill.

Trichloroethylene is designated as a hazardous substance by the EPA (40 CFR 116.4).

Trichloroethylene is reported in the 1983 EPA TSCA Inventory.

EPA Hazardous Waste Number (40 CFR 261.33): U228

EPA Reportable Quantity (40 CFR 117.3): 1000 lbs (454 kgs)

Aquatic Toxicity Rating, TLm 96: Not Listed

SECTION 8. SPECIAL PROTECTION INFORMATION

GOGGLES: Always wear protective eyeglasses or chemical safety goggles. Follow the eye and face protection guidelines of 29 CFR 1910.133. GLOVES: Wear impervious gloves. RESPIRATOR: Use a NIOSH-approved respirator per the *NIOSH Guide to Chemical Hazards* (Genium ref. 88) for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. Any detectable concentration of TCE requires an SCBA, full facepiece, and pressure-demand/positive-pressure modes. WARNING: Air-purifying respirators will not protect workers from oxygen-deficient atmospheres. OTHER EQUIPMENT: Wear rubber boots, aprons, and other suitable body protection appropriate to the existing work environment. VENTILATION: Install and operate general and local exhaust ventilation systems of sufficient power to maintain airborne concentrations of TCE below the OSHA PEL standards cited in section 2. SAFETY STATIONS: Make eyewash stations, washing facilities, and safety showers available in areas of use and handling. Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. OTHER SPECIAL MODIFICATIONS IN THE WORKPLACE: Because of the unresolved controversy about the carcinogenic status of TCE, all existing personal protective equipment and engineering technology should be used to prevent any possibility of worker contact with this material.

COMMENTS: Practice good personal hygiene. Keep material off of your clothes and equipment. Avoid transfer of material from hands to mouth while eating, drinking, or smoking. Adhere to the sanitation requirements of 29 CFR 1910.141 and 29 CFR 1910.142.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Prevent TCE from coming into contact with strong caustics such as NaOH; KOH; chemically active metal like Ba, Li, Na, Mg, Ti; and powdered aluminum or magnesium in acidic solutions. SPECIAL HANDLING/STORAGE: Store this material in a cool, dry, well-ventilated area. Avoid elevated temperatures because products of toxic and corrosive decomposition from TCE may form. Monitor the level of any stabilizer component that may be added to the TCE. (Consult the technical data from the supplier to determine the specifics of any added stabilizer.) If applicable, follow the supplier's recommendation concerning proper rotation of stock, shelf-life requirements, and levels of stabilizers.

ENGINEERING CONTROLS IN THE WORKPLACE: Avoid collecting aluminum fines (very small particles) or chips in a TCE vapor degreaser. Monitor TCE stabilizer levels regularly. Only trained personnel should operate vapor degreasers.

TRANSPORTATION DATA (per 49 CFR 172.101-2):

DOT Hazard Class: ORM-A	DOT ID No. UN1710	IMO Class: 6.1
IMO Label: St. Andrew's Cross (X)*	DOT Shipping Name: Trichloroethylene	DOT Label: None

* Harmful - Stow away from foodstuffs (IMO Label, Materials of Class 6.1 Packaging Group III).

References: 1-9, 12, 14, 21, 73, 87-94. PI

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Approvals JO Accurocco

Indust. Hygiene/Safety 11-19-87

Medical Review M. D. Harbison

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Material Safety Data Sheet

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GENIUM PUBLISHING CORP.

No. 315

CHLOROFORM
(Revision D)
Issued: August 1979
Revised: April 1988

SECTION 1. MATERIAL IDENTIFICATION

25

Material Name: *CHLOROFORM*

Description (Origin/Uses): Used as a solvent for fats, oils, rubber, alkaloids, waxes, and resins; as a cleansing agent.

Other Designations: Trichloromethane; $CHCl_3$; NIOSH *RTECS* No. FS9100000; CAS No. 0067-66-3

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

HMIS
H 2
F 0
R 0
PPG*
*See sect. 8

R 1
I 3
S 2
K 0

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Chloroform, CAS No. 0067-66-3	Ca 100	**OSHA PEL** Ceiling: 50 ppm, 240 mg/m³ **ACGIH TLV, 1987-88** TLV-TWA: 10 ppm, 50 mg/m³ **NIOSH REL** Ceiling: 2 ppm, 9.78 mg/m³ **Toxicity Data*** Human, Oral, LD_{Lo}: 140 mg/kg Rat, Oral, LD_{50}: 908 mg/kg

*See NIOSH, *RTECS*, for additional toxicity data with references to mutagenic, reproductive, tumorigenic, and irritative effects.

SECTION 3. PHYSICAL DATA

Boiling Point: 142°F (61°C)
Melting Point: -82.3°F (-63.5°C)
Vapor Pressure: 158.4 Torrs at 68°F (20°C)
Vapor Density (Air = 1): 4.13

Water Solubility (%): 0.822 ml of $CHCl_3$ per 100 ml of H_2O at 68°F (20°C)
% Volatile by Volume: 100
Molecular Weight: 119 Grams/Mole
Specific Gravity (H_2O = 1): 1.484 at 68°F (20°C)

Appearance and Odor: A heavy, colorless, clear, volatile liquid; characteristic, pleasant, ethereal, sweet odor (recognition threshold: 0.3 mg/m³); sweet taste.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
*	*		*	*

Extinguishing Media: *Chloroform does not burn. Use an agent that will put out the surrounding fire.

Unusual Fire or Explosion Hazards: None reported.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Chloroform is stable if kept in closed containers and protected from air and sunlight. It does not undergo hazardous polymerization; however, even when stabilized with ethanol, this material develops acidity from prolonged exposure to air and light.

Chemical Incompatibilities: This material is incompatible with strong alkalies.

Conditions to Avoid: Avoid prolonged exposure to air and light and to strong alkalies.

Hazardous Products of Decomposition: Toxic and corrosive gases like hydrochloric acid (HCl), chlorine (Cl_2), carbon monoxide (CO), and oxides of chlorine (ClO_x) can be produced during fires.

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SECTION 6. HEALTH HAZARD INFORMATION

Chloroform is listed as a suspected human carcinogen by ACGIH.

Summary of Risks: Exposure to this material affects the central nervous system (anesthesia); heart (arrhythmia, ventricular tachycardia, bradycardia); liver (necrosis, hepatoma); kidney (necrosis); and it is an embryonic toxin. Fatalities are associated with cardiovascular depression and ventricular fibrillation.
Medical Conditions Aggravated by Long-Term Exposure: Ailments of the heart, liver, and kidneys may be worsened by exposure to chloroform. **Target Organs:** Liver, kidneys, heart, skin, eyes. **Primary Entry:** Skin contact, inhalation.
Acute Effects: Dizziness, mental dullness, nausea, headache, fatigue, and anesthesia. **Chronic Effects:** Possible cancer.
FIRST AID
Eyes: Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes.
Skin: Immediately wash the affected area with soap and water. **Inhalation:** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed.
Ingestion: Never give anything by mouth to someone who is unconscious or convulsing. If the exposed person is responsive, give him or her several glasses of milk or water to drink and induce vomiting. Repeat if large quantities were ingested.
Comments: Workers who are regularly exposed to chloroform require preplacement and periodic medical exams emphasizing kidney, liver, skin, and central nervous system functions. Carefully evaluate each exposure that produces a noticeable effect to determine the extent to which factors like alcohol or drugs have affected it.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel of a chloroform spill or leak. Provide ventilation. Cleanup personnel need protection against contact with and inhalation of vapor (see sect. 8). Chloroform vapor is heavier than air and will collect in low-lying areas. Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways.
Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.
OSHA Designations
Air Contaminant (29 CFR 1910.1000 Subpart Z)
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste, No. U044
CERCLA Hazardous Substance, Reportable Quantity: 5000 lbs (2270 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield as a supplementary protective measure. Follow the eye- and face-protection guidelines in 29 CFR 1910.133. **Respirator:** Wear a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. For emergency or nonroutine use (e.g., cleaning reactor vessels or storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** To prevent contact with skin, wear impervious gloves, boots, aprons, gauntlets, etc., as required by the specific work environment. **Ventilation:** Install and operate general and local ventilation systems that are powerful enough to maintain airborne levels of chloroform below the OSHA PEL standard cited in section 2.
Safety Stations: Make eyewash stations, washing facilities, and safety showers available in use and handling areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material. Keep it off of your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Avoid inhalation of vapor!

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store chloroform in closed containers away from light and alkalies.

Special Handling/Storage: Protect containers from physical damage. Do not transfer chloroform through plastic or rubber hoses or pipes.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Chloroform	**DOT Label:** None	**IMO Label:** Poison
DOT Class: ORM-A	**DOT ID No.** UN1888	**IMO Class:** 6.1

References: 1, 2, 12, 73, 84-94, 100, 103.

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Prepared by PJ Igoe, BS
Industrial Hygiene Review: DJ Wilson, CIH
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GENIUM PUBLISHING CORP.

No. 316

BENZENE
(Revision D)
Issued: November 1978
Revised: April 1988

SECTION 1. MATERIAL IDENTIFICATION

25

Material Name: BENZENE

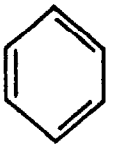
Description (Origin/Uses): Used in the manufacture of medicinal chemicals, dyes, linoleum, airplane dopes, varnishes, and lacquers; and as a solvent for waxes, resins, and oils.

Other Designations: Benzol; Phene; Phenylhydride; C_6H_6; NIOSH *RTECS* No. CY1400000; CAS No. 0071-43-2

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

HMIS			
H	2		
F	3	R	1
R	0	I	4
PPG*		S	2
*See sect. 8		K	4

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Benzene, CAS No. 0071-43-2  *See NIOSH, *RTECS*, for additional data with references to irritative, mutagenic, tumorigenic, and reproductive effects.	Ca 100	**OSHA PEL** 8-Hr TWA: 1 ppm 15-Min Ceiling: 5 ppm Action Level: 0.5 ppm **ACGIH TLV, 1987-88** TLV-TWA: 10 ppm, 30 mg/m³ **Toxicity Data*** Human, Inhalation, LC_{Lo}: 2000 ppm/5 Min Human, Oral, TD_{Lo}: 130 mg/kg Human, Inhalation, TC_{Lo}: 210 ppm

SECTION 3. PHYSICAL DATA

Boiling Point: 176°F (80°C)
Melting Point: 42°F (5.5°C)
Vapor Pressure: 75 Torrs at 68°F (20°C)
Vapor Density (Air = 1): >1

Water Solubility (%): Slight
% Volatile by Volume: 100
Molecular Weight: 78 Grams/Mole
Specific Gravity (H_2O = 1): 0.87865 at 68°F (20°C)

Appearance and Odor: A colorless liquid; characteristic aromatic odor.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
12°F (-11.1°C) CC	928°F (498°C)	% by Volume	1.3%	7.1%

Extinguishing Media: Use dry chemical, foam, or carbon dioxide to put out benzene fires. Water may be ineffective as an extinguishing agent because it can scatter and spread the fire. Use water to cool fire-exposed containers, flush spills away from exposures, disperse benzene vapor, and protect personnel attempting to stop an unignited benzene leak.
Unusual Fire or Explosion Hazards: Benzene vapor is heavier than air and can collect in low-lying areas such as sumps or wells. Eliminate all sources of ignition there to prevent a dangerous flashback to the original liquid benzene. **Danger:** Explosive and flammable benzene vapor-air mixtures can easily form at room temperature; always use this material in a way that minimizes dispersion of its vapor into general work areas.
Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Benzene is stable in closed containers during routine operations. It does not undergo hazardous polymerization.

Chemical Incompatibilities: Hazardous chemical reactions involving benzene and the following materials are reported in Genium reference 84: bromine pentafluoride, chlorine, chlorine trifluoride, chromic anhydride, nitryl perchlorate, oxygen, ozone, perchlorates, perchloryl fluoride and aluminum chloride, permanganates and sulfuric acid, potassium peroxide, silver perchlorate, and sodium peroxide.

Conditions to Avoid: Avoid all exposure to sources of ignition and to incompatible chemicals.

Hazardous Products of Decomposition: Toxic gases like carbon monoxide (CO) may be produced during benzene fires.

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SECTION 6. HEALTH HAZARD INFORMATION

Benzene is listed as a suspected human carcinogen by the ACGIH.

Summary of Risks: Prolonged skin contact with benzene or excessive inhalation of its vapor may cause headache, weakness, loss of appetite, and lassitude. Continued exposure can cause collapse, bronchitis, and pneumonia. The most important health hazards are cancer (leukemia), bone marrow effects, and injuries to the blood-forming tissue from chronic low-level exposure.

Medical Conditions Aggravated by Long-Term Exposure: Ailments of the heart, lungs, liver, kidneys, blood, and central nervous system (CNS) may be worsened by exposure. Administer preplacement and periodic medical exams emphasizing these organs' functions and reassign workers who test positive. **Target Organs:** Blood, CNS, bone marrow, eyes, and upper respiratory tract (URT). **Primary Entry:** Skin contact, inhalation. **Acute Effects:** Dizziness, mental dullness, nausea, headache, fatigue, and giddiness. **Chronic Effects:** Possible cancer (leukemia).

FIRST AID

Eyes: Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes.

Skin: Immediately wash the affected area with soap and water.

Inhalation: Remove the exposed person to fresh air; restore and/or support his or her breathing as needed.

Ingestion: Never give anything by mouth to someone who is unconscious or convulsing. Do not induce vomiting because of the possibility of aspiration.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, provide ventilation, and eliminate all sources of ignition immediately. Cleanup personnel need protection against contact with and inhalation of vapor (see sect. 8). Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways.

Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations for disposal. Follow Federal, state, and local regulations.

OSHA Designations

Air Contaminant (29 CFR 1910.1000 Subpart Z)

EPA Designations (40 CFR 302.4)

RCRA Hazardous Waste, No. U019

CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield. Follow the eye- and face-protection guidelines in 29 CFR 1910.133. **Respirator:** Wear a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. For emergency or nonroutine use (e.g., cleaning reactor vessels or storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., to prevent any possibility of skin contact with this suspected human carcinogen. **Ventilation:** Install and operate general and local ventilation systems powerful enough to maintain airborne levels of benzene below the OSHA PEL standard cited in section 2.

Safety Stations: Make eyewash stations, washing facilities, and safety showers available in use and handling areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material. Keep it off of your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do *not* eat, drink, or smoke in any work area. Do not inhale benzene vapor!

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store benzene in a cool, dry, well-ventilated area away from sources of ignition and incompatible chemicals.

Special Handling/Storage: Protect containers from physical damage. Electrically ground and bond all metal containers used in shipping or transferring operations. Follow all parts of 29 CFR 1910.1028.

Engineering Controls: All engineering systems (production, transportation, etc.) must be of maximum explosion-proof design (non-sparking, electrically grounded and bonded, etc.)

Comments: If possible, substitute less toxic solvents for benzene; use this material with extreme caution and only if it is absolutely essential.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Benzene	**DOT Label:** Flammable Liquid	**IMO Label:** Flammable Liquid
DOT Class: Flammable Liquid	**DOT ID No.** UN1114	**IMO Class:** 3.2

References: 1, 2, 12, 73, 84-94, 100, 103.

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GENIUM PUBLISHING CORP.

No. 317
TOLUENE
(Revision D)

Issued: August 1979
Revised: April 1986

SECTION 1. MATERIAL IDENTIFICATION 20

MATERIAL NAME: TOLUENE

OTHER DESIGNATIONS: Methyl Benzene, Methyl Benzol, Phenylmethane, Toluol, C_7H_8, CAS #0108-88-3

MANUFACTURER/SUPPLIER: Available from many suppliers, including:
Allied Corp., PO Box 2064R, Morristown, NJ 07960; Telephone: (201) 455-4400
Ashland Chemical Co., Industrial Chemicals & Solvents Div., PO Box 2219, Columbus, OH; Telephone: (614) 889-3844

HMIS
H: 2
F: 3
R: 0
PPE*
*See sect. 8

R 1
I 3
S 2
K 4

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Toluene	ca 100	8-hr TLV: 100 ppm, or 375 mg/m^3* (Skin)** Man, Inhalation, TCLo: 100 ppm: Psychotropic*** Rat, Oral, LD_{50}: 5000 mg/kg Rat, Inhalation, LCLo: 4000 ppm/4 hrs. Rabbit, Skin, LD_{50}: 14 gm/kg Human, Eye: 300 ppm

* Current (1985-86) ACGIH TLV. The OSHA PEL is 200 ppm with an acceptable ceiling concentration of 300 ppm and an acceptable maximum peak of 500 ppm/10 minutes.

** Skin designation indicates that toluene can be absorbed through intact skin and contribute to overall exposure.

*** Affects the mind.

SECTION 3. PHYSICAL DATA

Boiling Point ... 231°F (111°C)
Vapor Pressure @ 20°C, mm Hg ... 22
Water Solubility @ 20°C, wt. % ... 0.05
Vapor Density (Air = 1) ... 3.14
Evaporation Rate (BuAc = 1) ... 2.24
Specific Gravity (H_2O = 1) ... 0.866
Melting Point ... -139°F (-95°C)
Percent Volatile by Volume ... ca 100
Molecular Weight ... 92.15

Appearance and odor: Clear, colorless liquid with a characteristic aromatic odor. The odor is detectable to most individuals in the range of 10 to 15 ppm. Because olfactory fatigue occurs rapidly upon exposure to toluene, odor is not a good warning property.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
40°F (4°C) CC	896°F (480°C)	% by Volume	1.27	7.1

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical, alcohol foam. Do not use a solid stream of water because the stream will scatter and spread the fire. Use water spray to cool tanks/containers that are exposed to fire and to disperse vapors.

UNUSUAL FIRE/EXPLOSION HAZARDS: This OSHA class IB flammable liquid is a dangerous fire hazard. It is a moderate fire hazard when exposed to oxidizers, heat, sparks, or open flame. Vapors are heavier than air and may travel a considerable distance to an ignition source and flash back.

SPECIAL FIRE-FIGHTING PROCEDURES: Fire fighters should wear self-contained breathing apparatus with full facepiece operated in a positive-pressure mode when fighting fires involving toluene.

SECTION 5. REACTIVITY DATA

CHEMICAL INCOMPATIBILITIES: Toluene is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization. This material is incompatible with strong oxidizing agents, dinitrogen tetraoxide, silver perchlorate, tetranitromethane, and uranium hexafluoride. Contact with these materials may cause fire or explosion. Nitric acid and toluene, especially in the presence of sulfuric acid, will produce nitrated compounds that are dangerously explosive.

CONDITIONS TO AVOID: Avoid exposure to sparks, open flame, hot surfaces, and all sources of heat and ignition. Toluene will attack some forms of plastics, rubber, and coatings. Thermal decomposition or burning produces carbon dioxide and/or carbon monoxide.

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SECTION 6. HEALTH HAZARD INFORMATION | TLV

Toluene is not considered a carcinogen by the NTP, IARC, or OSHA. SUMMARY OF RISKS: Vapors of toluene may cause irritation of the eyes, nose, upper respiratory tract, and skin. Exposure to 200 ppm for 8 hours causes mild fatigue, weakness, confusion, lacrimation (tearing) and paresthesia (a sensation of prickling, tingling, or creeping on the skin that has no objective cause). Exposure to higher concentrations may cause headache, nausea, dizziness, dilated pupils, and euphoria, and, in severe cases, may cause unconsciousness and death. The liquid is irritating to the eyes and skin. Contact with the eyes may cause transient corneal damage, conjunctival irritation, and burns if not promptly removed. Repeated and/or prolonged contact with the skin may cause drying and cracking. It may be absorbed through the skin in toxic amounts. Ingestion causes irritation of the gastrointestinal tract and may cause effects resembling those from inhalation of the vapor. Chronic overexposure to toluene may cause reversible kidney and liver injury. FIRST AID: EYE CONTACT: Immediately flush eyes, including under eyelids, with running water for at least 15 minutes. Get medical attention if irritation persists.* SKIN CONTACT: Immediately flush skin (for at least 15 minutes) while removing contaminated shoes and clothing. Wash exposed area with soap and water. Get medical attention if irritation persists or if a large area has been exposed.* INHALATION: Remove victim to fresh air. Restore and/or support breathing as required. Keep victim warm and quiet. Get medical help.* INGESTION: Give victim 1 to 2 glasses of water or milk. Contact a poison control center. Do not induce vomiting unless directed to do so. Transport victim to a medical facility. Never give anything by mouth to a person who is unconscious or convulsing. * GET MEDICAL ASSISTANCE = In plant, paramedic, community. Get medical help for further treatment, observation, and support after first aid, if indicated.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Notify safety personnel of large spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Limit access to spill area to necessary personnel only. Remove leaking containers to safe place if feasible. Cleanup personnel need protection against contact with liquid and inhalation of vapor (see sect. 8).
WASTE DISPOSAL: Absorb small spills with paper towel or vermiculite. Contain large spills and collect if feasible, or absorb with vermiculite or sand. Place waste solvent or absorbent into closed containers for disposal using nonsparking tools. Liquid can be flushed with water to an open holding area for handling. Do not flush to sewer, watershed, or waterway.
COMMENTS: Place in suitable container for disposal by a licensed contractor or burn in an approved incinerator. Consider reclaiming by distillation. Contaminated absorbent can be buried in a sanitary landfill. Follow all Federal, state, and local regulations. TLm 96: 100-10 ppm. Toluene is designated as a hazardous waste by the EPA. The EPA (RCRA) HW No. is U220 (40 CFR 261). The reportable quantity (RQ) is 1000 lbs/454 kg (40 CFR 117).

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements. Ventilation fans and other electrical service must be nonsparking and have an explosion-proof design. Exhaust hoods should have a face velocity of at least 100 lfm (linear feet per minute) and be designed to capture heavy vapor. For emergency or nonroutine exposures where the TLV may be exceeded, use an organic chemical cartridge respirator if concentration is less than 200 ppm and an approved canister gas mask or self-contained breathing apparatus with full facepiece if concentration is greater than 200 ppm.
Safety glasses or splash goggles should be worn in all work areas. Neoprene gloves, apron, face shield, boots, and other appropriate protective clothing and equipment should be available and worn as necessary to prevent skin and eye contact. Remove contaminated clothing immediately and do not wear it until it has been properly laundered.

Eyewash stations and safety showers should be readily available in use and handling areas.

Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Store in a cool, dry, well-ventilated area away from oxidizing agents, heat, sparks, or open flame. Storage areas must meet OSHA requirements for class IB flammable liquids. Use metal safety cans for handling small amounts. Protect containers from physical damage. Use only with adequate ventilation. Avoid contact with eyes, skin, or clothing. Do not inhale or ingest. Use caution when handling this compound because it can be absorbed through intact skin in toxic amounts. SPECIAL HANDLING/STORAGE: Ground and bond metal containers and equipment to prevent static sparks when making transfers. Do not smoke in use or storage areas. Use nonsparking tools. ENGINEERING CONTROLS: Preplacement and periodic medical exams emphasizing the liver, kidneys, nervous system, lungs, heart, and blood should be provided. Workers exposed to concentrations greater than the action level (50 ppm) should be examined at least once a year. Use of alcohol can aggravate the toxic effects of toluene.
COMMENTS: Emptied containers contain product residues. Handle accordingly!
Toluene is designated as a hazardous substance by the EPA (40 CFR 116). DOT Classification: Flammable liquid. UN1294.
Data Source(s) Code: 1-9, 12, 16, 20, 21, 24, 26, 34, 81, 82. CR

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Approvals J.O. Accrocco, 11/86.
Indust. Hygiene/Safety DJW 10-86
Medical Review [signature] Oct 86

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MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

NO. 334
MINERAL SPIRITS
TYPE I
Revision B
DATE July 1984

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: MINERAL SPIRITS, TYPE I
DESCRIPTION: Refined distillate of petroleum. Hydrocarbon mixture (see Sect II) with a controlled distillation range and a flash point >100 F.
OTHER DESIGNATIONS: Stoddard Solvent; Petroleum Distillate, Naphtha or Spirits, (combustible); White Spirits; ASTM D235, Type I; GE Material D5B8; CAS #008 052 413; C_9H_2O.
MANUFACTURER: Available from many suppliers.

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Mineral Spirits, Type I		8-hr TWA 100 ppm* (or 525 mg/m^3)
Typical composition:		
Paraffinic hydrocarbons	30-50	
Naphthenic hydrocarbons (Cycloparaffins)	30-40	
Aromatic and olefinic hydrocarbons	10-20	Eye, Human 470 ppm/15M (Irritation Effect)

*ACGIH (1983) TLV; STEL is 200 ppm. NIOSH has recommended a 10-hr TWA of 60 ppm or 350 mg/m^3. The "action level" is also recommended to be 350 mg/m^3. Current OSHA PEL for Stoddard Solvent is 500 ppm.

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F	300-407	Specific gravity 60/60 F	ca 0.79
Vapor pressure @ 25 C, mm Hg	ca 5	Volatiles, %	ca 100
Vapor density (Air=1) (average)	ca 4.8	Evaporation rate (BuAc=1)	ca 0.08
Solubility in water, 20C	Insoluble		

Appearance & Odor: Clear, colorless liquid with a kerosine-like odor that is usually perceptible to humans at about 1 ppm in air.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
100 F min. (TCC)	450-500 F	% by volume	0.8	~6

Extinguishing media: Foam, dry chemical, carbon dioxide, and water spray or fog. Use of a direct stream of water on burning liquid can scatter flames.
This liquid is near its lower flammability limit at room temperature (saturated air at 25 C contains about 0.5 volume % of Stoddard Solvent). In a fire situation or when heated or misted, it becomes a hazardous, highly flammable material.
Use self-contained breathing apparatus for respiratory protection in fighting fires in enclosures.

SECTION V. REACTIVITY DATA

This material is stable in closed containers under its normal handling and storage conditions. It does not polymerize.
As a combustible hydrocarbon liquid (OSHA Class II), it can react violently with strong oxidizing agents such as chlorine, oxygen, or such strong oxidizing acids as nitric and sulfuric.
Thermal-oxidative degradation can produce carbon monoxide and partially oxidized hydrocarbons.

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NO. 334

SECTION VI. HEALTH HAZARD INFORMATION

TLV 100 ppm (See Sect II)

This material is a central nervous system depressant and a mucous membrane irritant. Symptoms of overexposure include dizziness, headache, intoxication with euphoria leading to unconsciousness. Nose and throat irritation may occur from inhalation. Prolonged or repeated skin contact will cause defatting, irritation and dermatitis. Eye contact with liquid can cause conjunctivitis. Eye irritation can also occur after 15 minutes exposure to vapors at 470 ppm. A fatal ingestion dosage for humans is estimated at 3-4 ounces. Aspiration into the lungs after ingestion can cause edema; and one ounce aspirated may be fatal.

FIRST AID:

Eye Contact: Flush thoroughly with running water for 15 min., including under eyelids.

Skin Contact: Promptly remove solvent wet clothing and wash contact area with soap and water. Get medical help if irritation persists or if large body area contacted.

Inhalation: Remove to fresh air. Restore and/or support breathing as needed. (If breathing is difficult, give oxygen therapy.) Get medical help.

Ingestion: Contact physician! Aspiration a hazard! Give 3 oz of USP white mineral oil or edible vegetable oil to drink. Do not induce vomiting unless medical help is not available, the victim is alert, and >1-2 oz has been ingested.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of large spills. Eliminate sources of heat or ignition. Provide adequate ventilation. Clean-up personnel need protection against skin contact and inhalation of vapors. Contain spill. Recover liquid when possible. Absorb small spills and residues with vermiculite, dry sand, or similar material. Pick up and place in suitable containers. Avoid discharging Mineral Spirits directly into a sewer or surface waters!

DISPOSAL: Absorbed material can be buried in an approved landfill, incinerated, or removed via a licensed solvent disposal company. Follow Federal, State and Local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general ventilation and, especially when heated or misted, local exhaust ventilation (explosion-proof) to meet TLV requirements. A chemical cartridge respirator with organic vapor cartridge and a full facepiece can be used below 1000 ppm. Self-contained breathing apparatus with a full facepiece has been recommended for use up to 5000 ppm.

Approved protective gloves should be used to prevent prolonged or repeated skin contact.

Chemical safety goggles and/or face shield should be used where splashing is possible. An eyewash station and washing facilities should be accessible.

Remove contaminated clothing (fire and health hazard); thoroughly dry or launder before reuse.

Preplacement and periodic medical exams should emphasize skin, liver, kidney, central nervous system, and respiratory diseases for those regularly exposed. Individuals with such problems may be at an increased risk from exposure.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in a cool, clean, well-ventilated, fire resistant storage area away from oxidizing agents and sources of heat and ignition. Use a solvent storage room or cabinet that meets requirements for an OSHA Class II Combustible liquid. Store in closed metal drums or safety cans with identifying labels. Prevent physical damage to containers.

Bond and ground containers for transfers of liquid to prevent static sparks. Use non-sparking tools and follow electrical codes in areas of use and storage. No smoking in areas of use or storage.

Use with good ventilation. Avoid inhalation of mist or vapors. Prevent eye contact and repeated or prolonged skin contact.

DOT Classification: PETROLEUM NAPHTHA I.D. No. UN1255 Label: (None)
PETROLEUM DISTILLATE I.D. No. UN1268 Label: (None)

DATA SOURCE(S) CODE: 2-7,9,11,12,14,16,27,31,38,47

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APPROVALS: MIS/CRD	J. G. Nielsen
INDUST. HYGIENE SAFETY	7-23-84
MEDICAL REVIEW:	1 August 1984

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GENIUM PUBLISHING CORP.

NO. 334A

MINERAL SPIRITS
TYPE II
~~Revision B~~

DATE July 1984

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: MINERAL SPIRITS, TYPE II
DESCRIPTION: Refined distillates of petroleum. It is the higher boiling half of Type I distillate (MSDS #334) with a controlled distillation range and flash point, >140 F.
OTHER DESIGNATIONS: Stoddard Solvent (high flash point); Petroleum Distillate, Spirits or Naphtha (combustible); White Spirits; GE Material D5B8D; CAS #008 052 413; ASTM D235, Type II.
MANUFACTURER: Available from many suppliers.

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Mineral Spirits, Type II		8-hr TWA 100 ppm* (or 525 mg/m^3).
Typical Composition:		
Paraffinic hydrocarbons	40-60	
Naphthenic hydrocarbons (Cycloparaffins)	30-40	
Aromatic hydrocarbons	5-15	Eye, Human 470 ppm/15M (Irritation Effect)

*ACGIH (1983) TLV; STEL is 200 ppm for Stoddard Solvent.
Current OSHA PEL for Stoddard Solvent is 500 ppm.
NIOSH has recommended a 10-hr TWA of 60 ppm or 350 mg/m^3.
The "action level" is also recommended to be 350 mg/m^3.

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F	350-412	Specific gravity 60/60F	ca 0.8
Vapor pressure @ 25 C, mm Hg	ca 4	Volatiles, %	ca 100
Vapor density (Air=1) (average)	ca 5	Evaporation rate (BuAc=1)	0.08
Solubility in water	Insoluble		

Appearance & Odor: Clear, colorless liquid with a characteristic petroleum odor that is usually perceptible to humans at about 1 ppm in air. Olfactory fatigue can occur in 6 minutes at low conc.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air % by volume	Lower	Upper
140 F minimum (TCC)	450-500 F		0.9	6

Extinguishing media: Foam, dry chemical, carbon dioxide, and water spray or fog. Use of a direct stream of water on burning liquid can scatter flames. In a fire situation or when it is heated or misted, it becomes a hazardous, highly flammable material.
Use self-contained breathing apparatus for respiratory protection in fighting fires in enclosures.

SECTION V. REACTIVITY DATA

This material is stable in closed containers under its normal handling and storage conditions. It does not polymerize.
As a combustible hydrocarbon liquid (OSHA Class IIIA), it can react violently with strong oxidizing agents such as chlorine, oxygen, or such strong oxidizing acids as nitric and sulfuric.
Thermal-oxidative degradation can produce carbon monoxide and partially oxidized hydrocarbons.

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NO. 334A

SECTION VI. HEALTH HAZARD INFORMATION

TLV 100 ppm (See Sect II)

This material is a central nervous system depressant and a mucous membrane irritant. Symptoms of overexposure include dizziness, headache, intoxication with euphoria leading to unconsciousness. Nose and throat irritation may occur from inhalation. Prolonged or repeated skin contact will cause defatting, irritation and dermatitis. Eye contact with liquid can cause conjunctivitis. Eye irritation can also occur after 15 minutes exposure to vapors at 470 ppm. A fatal ingestion dosage for humans is estimated at 3-4 ounces. Aspiration into the lungs after ingestion can cause edema; and one ounce aspirated may be fatal.

FIRST AID:

Eye Contact: Flush thoroughly with running water for 15 min., including under eyelids.

Skin Contact: Promptly remove solvent wet clothing and wash contact area with soap and water. Get medical help if irritation persists or if large body area contacted.

Inhalation: Remove to fresh air. Restore and/or support breathing as needed. (If breathing is difficult, give oxygen therapy.) Get medical help.

Ingestion: Contact physician! Aspiration a hazard! Give 3 oz of USP white mineral oil or edible vegetable oil to drink. Do not induce vomiting unless medical help is not available, the victim is alert, >1-2 oz has been ingested.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of large spills. Eliminate sources of heat or ignition. Provide adequate ventilation. Clean-up personnel need protection against skin contact and inhalation of vapors. Contain spill. Recover liquid when possible. Absorb small spills and residues with vermiculite, dry sand, or similar material. Pick up and place in suitable containers. Avoid discharing Mineral Spirits directly into a sewer or surface waters!

DISPOSAL: Absorbed material can be buried in an approved landfill, incinerated, or removed via a licensed solvent disposal company. Follow Federal, State and Local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general ventilation and, especially when heated or misted, local exhaust ventilation (explosion-proof) to meet TLV requirements. A chemical cartridge respirator with organic vapor cartridge and a full facepiece can be used below 1000 ppm. Self-contained breathing apparatus with a full facepiece has been recommended for use up to 5000 ppm.

Approved protective gloves should be used to prevent prolonged or repeated skin contact.

Chemical safety goggles and/or face shield should be used where splashing is possible. An eyewash station and washing facilities should be accessible.

Remove contaminated clothing (fire and health hazard); thoroughly dry or launder before reuse.

Preplacement and periodic medical exams should emphasize skin, liver, kidney, central nervous system, and respiratory diseases for those regularly exposed. Individuals with such problems may be at an increased risk from exposure.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in a cool, clean, well-ventilated, fire resistant storage area away from oxidizing agents and sources of heat and ignition. Use a solvent storage room or cabinet that meets requirements for an OSHA Class IIIA Combustible liquid. Store in closed metal drums or safety cans with identifying labels. Prevent physical damage to containers.

If heated or mist is present, bond and ground containers for transfers of liquid to prevent static sparks, use nonsparking tools, follow electrical codes, no smoking.

Use with good ventilation. Avoid inhalation of mist or vapors. Prevent eye contact and repeated or prolonged skin contact.

DOT Classification: PETROLEUM NAPHTHA I.D. No. UN1255 Label: (None)
PETROLEUM DISTILLATE I.D. No. UN1268 Label: (None)

DATA SOURCE(S) CODE: 2-7,11-14,16,27,31,47,49

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APPROVALS: MIS/CRD

INDUST. HYGIENE/SAFETY 7-23-84

MEDICAL REVIEW: 1 August 1984

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GENIUM PUBLISHING CORP.

No. 334B

STODDARD SOLVENT
Type III
Revision A
Date November 1977

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: STODDARD SOLVENT, Type III
OTHER DESIGNATIONS: Odorless Mineral Spirits, Odorless Petroleum Spirits, Odorless Solvent, ASTM D484 Type III, GE Material D5B8C
DESCRIPTION: Highly aliphatic hydrocarbon mixture with a controlled distillation range and flash point and low odor.
MANUFACTURER: Available from many suppliers.

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Stoddard Solvent, Type III Typical Composition: A highly aliphatic hydrocarbon mixture, often isoparaffins with some naphthenes. *This is the current OSHA TLV level for Stoddard Solvent and Petroleum Distillates. ACGIH has indicated that future TLV levels should depend on the actual composition of the hydrocarbon mixture. (Suppliers' estimates are usually 100-300 ppm for TLV for this solvent.)		TLV 500 ppm * (or 2950 mg/m^3)

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F ---- 300-412
Vapor pressure @ 25 C, mm Hg -- ca 5
Vapor density (Air = 1) -------- ca 4.8 av
Solubility in water ---------- Insoluble

Specific gravity (H_2O = 1) ------- ca 0.76
Volatiles, % ---------- ca 100
Evaporation rate (BuAc = 1) ------ ca 0.08

Appearance & odor: Clear, colorless liquid with a slight odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
(TCC) 100 F minimum	450-500 F	% by volume	0.9	6

Extinguishing media: Foam, dry chemical, carbon dioxide, and water spray or fog.
Combustion in a limited amount of air can generate toxic carbon monoxide. Use self-contained breathing apparatus for respiratory protection in fighting fires in enclosures.
Note that this liquid is near its lower flammability limit (saturated air at 25 C contains about 0.5 volume % of Stoddard Solvent). In a fire situation or when it is heated, it becomes a highly flammable material.

SECTION V. REACTIVITY DATA

This material is considered to be stable under its normal handling and storage conditions.
As a combustible hydrocarbon, it can react violently with strong oxidizing agents such as chlorine, oxygen, or such strong oxidizing acis as nitric and sulfuric. Store away from these and other strong oxidizing agents.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 500 ppm/100 ppm (see Sect. II)

Stoddard Solvent, like all petroleum distillates, is a central nervous system depressant. Symptoms of overexposure include dizziness, headache, intoxication with euphoria leading to unconsciousness. Nose and throat irritation may occur from inhalation. Prolonged or repeated skin contact will cause defatting and dermatitis. Eye contact with the liquid causes conjunctivitis. Eye irritation can occur after 15 minutes at 470 ppm. A fatal ingestion dosage for humans is 3-4 ounces if no aspiration into the lungs occurs; aspiration of one ounce or less can be fatal.

FIRST AID:

Inhalation: Remove to fresh air. Give artificial respiration if required. Get medical assistance.

Eye contact: Wash eyes immediately with large amounts of water.

Skin contact: Wash contact area promptly with soap and water. Remove solvent wet clothing immediately.

Ingestion: Do not induce vomiting. Contact a physician immediately!

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

For massive spills, evacuate the area. Eliminate ingnition sources. Recover as much of the free liquid as possible for disposal, and use an absorbent to pick up the residue. Avoid discharging Stoddard Solvent directly into a sewer or surface waters.

Dispose of the absorbed material or the free waste liquid by incineration or via a licensed solvent disposal company.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Work place areas require exhaust ventilation to maintain vapor levels below the TLV. In emergencies respiratory protection can be provided for a limited time by an approved organic vapor cartridge below 3500 mg/m^3; above this level a full facepiece canister-type, air-supplied-type, or self-contained-type respirator is required.

Rubber of polyvinyl gloves should be used to prevent prolonged or repeated skin contact.

Safety goggles or face shields should be used where splashing of solvent into the eyes is possible. An eye wash fountain should also be available in areas where splashing is probable.

Ventilation equipment should be explosion-proof, and any tools used in the area should be of the non-sparking type.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

This combustible liquid should be stored in a cool, clean, well-ventilated, fire resistant storage room or in a solvent storage carbinet that meets OSHA requirements. Store in closed metal drums or safety cans with identifying labels that indicate the flammability of the material.

Electrically interconnect and ground containers for transfers of liquid to avoid fires from static sparks.

Areas of use and storage for this material should have good ventilation and all sources of open flame and high heat should be excluded. Prohibit smoking in these areas.

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Industrial Hygienist and
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MSDS # 355
PHENOL (Revision B)

Issued: September, 1986
Revised: September, 1985

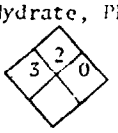
From Genium's MSDS Collection, to be used as a reference.

SECTION 1. MATERIAL IDENTIFICATION

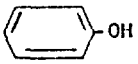
MATERIAL NAME: PHENOL

OTHER DESIGNATIONS: Carbolic Acid, Hydrobenzene, Oxybenzene, Phenic acid, Phenyl Hydrate, Phenyl hydroxide, Phenylic acid, Phenyl alcohol, CAS #000 108 952, C_6H_5OH

MANUFACTURER/SUPPLIER: Available from many suppliers, including;
Dow Chemical USA
2020 Dow Center
Midland MI 48640 (517) 636-1000



SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
PHENOL 	ca 100	8 hr TWA: 5 ppm, 19 mg/m^3 (Skin) STEL: 10 ppm, 38 mg/m^3*
		Human, Oral LDLo: 140 mg/kg
		Rat, oral LDLo: 414 mg/kg
		Rat, skin LD50: 669 mg/kg

* Current OSHA PEL and ACGIH TLV/STEL (1984-85) (Skin) notation indicates a potential contribution to overall exposure via absorption through the skin.

NIOSH recommends a 10 hr. TWA of 20 mg/m^3 with a ceiling of 60 mg/m^3 for any 15 minute period.

SECTION 3. PHYSICAL DATA

Boiling Point @ 1 atm ..... 359.4°F (181.9°C)
Vapor pressure @ 25°C 0.35
Vapor density (Air=1) 3.24
Solubility in water (% by wt.) ... 8.4 @ 20°C
(Sol. in all proportion @ temp. >66°C)

APPEARANCE & ODOR: White crystalline solid with a characteristic sharp medicinal sweet, tangy odor which is detectable above 0.05 ppm. Phenol turns pink or red if it contains impurities or if it is exposed to heat or light.

Specific Gravity (H_2O=1):
Solid: 1.017 @ 25/4°C
Liquid: 1.0576 @ 41/4°C
Melting point ..... 109.4°F (43°C)
Volatiles, % by vol @ 20°C .. ca 100
Evaporation rate (BuAc=1) ... <0.03
Viscosity, CPS, @ 80°C 1.51
Molecular weight 94.12

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
175°F (79°C) C.C.	1319°F (715°C)	% by volume	1.5	8.6

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical, or alcohol type foam. Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool fire-exposed tanks/containers. Phenol presents a moderate fire hazard when exposed to heat, flame, or oxidizers. When heated, it remits toxic fumes and vapors which will form explosive mixtures with air. Solid phenol burns with difficulty, giving off a heavy smoke.

Firefighters should wear self-contained breathing apparatus and full protective clothing when fighting fires involving phenol. NOTE: Water containing phenol can cause severe chemical burns.

SECTION 5. REACTIVITY DATA

This material is stable at room temperature under normal handling and storage conditions. It does not undergo hazardous polymerization. Phenol is incompatible with strong oxidizing agents and halogens. Reaction with calcium hypochlorite is exothermic and produces toxic fumes which may ignite. Hot phenol is corrosive to many metals, including aluminum, lead, magnesium, and zinc. Reaction with these materials causes phenol to become discolored. Do not heat phenol above 122°F (90°C).

Thermal decomposition or burning produces oxides of carbon and water.

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SECTION 6. HEALTH HAZARD INFORMATION

TLV 5 ppm or 19 mg/m^3 (Skin)

Phenol is a general protoplasmic poison which is corrosive to body tissue. Poisoning can occur via skin absorption, vapor inhalation, or ingestion. Vapors of phenol are irritating to the eyes, nose, and throat. The liquid is rapidly absorbed through the skin. Contact with the skin causes a white wrinkled discoloration followed by a severe burn or systemic poisoning if not properly removed. Intense burning and pain from skin contact may be delayed. Absorption of phenol through skin may cause sudden collapse, or death. Symptoms develop rapidly. When ingested, phenol causes burning of the gastrointestinal tract, and blotches on the lips and in the mouth. Headache, nausea, dizziness, dyspnea, shock, convulsions, and death may follow exposures by any route. Chronic exposure to low concentrations of phenol may cause digestive disturbances, nervous disorders, skin eruptions, and death due to liver and kidney damage. The TLV is set to prevent systemic poisoning.

FIRST AID: EYE CONTACT: Immediately flush eyes, including under eyelids, with copious amounts of running water for at least 30 minutes. Get medical attention! (Inplant, community, paramedic). SKIN CONTACT: Immediately flush skin for at least 30 minutes while removing contaminated clothing and shoes. Get medical attention! INHALATION: Remove victim to fresh air. Restore and/or support breathing as necessary. Keep person warm and quiet. Transport to a medical facility. INGESTION: Give victim large quantities of milk or water as quickly as possible. Induce vomiting by touching back of throat with finger. Do not give fluids or induce vomiting if victim is unconscious or is having convulsions. Contact a physician or Poison Control Center and transport to a medical facility.

SECTION 7. SPILL, LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Evacuate all personnel from area, except for those involved in clean-up. Close the leak immediately, if possible. Absorb small spills on paper, vermiculite or other absorbent and place in a closed metal container for disposal. Dike large spills and allow material to cool and solidify. Shovel solid into steel containers for disposal. Flush spill area thoroughly with water and collect flushings and wash water for disposal. Do not allow phenol to enter sewer, watersheds, or waterways! Notify proper authorities including the National Response Center (800-424-8802). Clean-up personnel must wear a self-contained breathing apparatus and full personal protective clothing and equipment. DISPOSAL: Burn contaminated waste in an approved incinerator. Phenol may be recovered by charcoal absorption, solvent extraction or steam stripping. A concentration of 1% by weight is required for economical recovery. Phenol is water soluble and is amenable to biological or chemical oxidation. Solutions can be chemically oxidized by chlorine, chlorine dioxide, or other oxidants. Phenol content of water supply not to exceed 0.001 mg/L. (DO NOT flush phenol down drains.) RCRA Hazardous Waste # U188 Reportable Spill Quantity ... 1000 lbs.

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation (explosion-proof) to meet TLV requirements. When phenol is heated, vapor inhalation can be a serious hazard without proper precaution. For emergency or nonroutine exposures where the TLV may be exceeded, use an appropriate NIOSH-approved full face respirator. Fume hoods should maintain a minimum face velocity of 100 lfm. All electrical service in use or storage areas should have an explosion-proof design.

DANGER! Avoid any contact with this material. Full protective equipment, including splash goggles, faceshield, impervious gloves, apron, boots, impervious shirt and trousers, hard hat with brim, acid suit and respirator should be available and worn as appropriate. Remove contaminated clothing immediately and do not reuse until it has been properly laundered.

Eyewash stations and safety showers should be readily available in use and handling areas.

Contact lenses pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from heated surfaces, open flame and ignition sources. Outside or detached storage is preferred. Protect containers from physical damage.

Phenol is a very dangerous compound. Do not breathe vapor or allow liquid to come in contact with the skin. Wear appropriate protective equipment and remove contaminated clothing immediately. Use extreme caution when transporting phenol to prevent leaks. Vent containers before heating and do not heat above 140°F (60°C). Do not eat or smoke in areas where this material is being used or handled. Do not allow employees who have diseases of the central nervous system, liver, kidney, or lungs to work in area of phenol exposure. Provide preplacement and periodic medical exams to employees working with phenol. Do not allow untrained workers to handle this material (see also ASTM D2286-Sampling and Handling Phenol).

ICC & DOT - Class B Poison. LABEL: POISON

DATA SOURCE(S) CODE (See Glossary) 2-12, 15, 19, 23 24, 31, 34, 37, 38, 59, 79, R.

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APPROVALS 11/85

INDUST. HYGIENE/SAFETY 11-85

MEDICAL REVIEW: Dec 85

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Material Safety Data Sheet

From Genium's Reference Collection
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GENIUM PUBLISHING CORP.

No. 359
ETHYLENE DICHLORIDE
(Formerly 1,2-Dichloroethane)
(Revision C)
Issued: November 1978
Revised: August 1987

SECTION 1. MATERIAL IDENTIFICATION

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CHEMICAL NAME: ETHYLENE DICHLORIDE (Changed to reflect common industrial practice)
DESCRIPTION (Origin/Uses): Made from acetylene and HCl. Used as a degreaser, a scavenger in leaded gasoline, as an intermediate in the manufacture of vinyl chloride, in paint removers, in wetting and penetration agents, in ore flotation processes, as a fumigant, and as a solvent for fats, oils, waxes, and gums.
OTHER DESIGNATIONS: 1,2-Dichloroethane; *sym*-Dichloroethane; Dutch Liquid; Dutch Oil; EDC; Ethane Dichloride; Ethylene Chloride; 1,2-Ethylene Dichloride; Glycol Dichloride; $C_2H_4Cl_2$; NIOSH *RTECS* KI0525000; CAS #0107-06-2
MANUFACTURERS/SUPPLIERS: Available from several suppliers, including: Dow Chemical USA, 2020 Dow Center, Midland, MI 48640; Telephone: (517) 636-1000

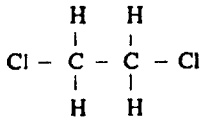
COMMENTS: Ethylene dichloride is a flammable, toxic liquid.

HMIS			
H	1	R	1
F	3	I	4
R	0	S	2
PPE		K	4

* See Sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Ethylene Dichloride, CAS #0107-06-2; NIOSH *RTECS* #KI0525000	100	ACGIH Values 1987-88 TLV-TWA: 10 ppm, 40 mg/m^3 OSHA PEL* 1986-87 8-Hr TWA: 50 ppm; Ceiling: 100 ppm (15 Min.) NIOSH REL 1986-87 10-Hr TWA: 1 ppm Ceiling: 2 ppm (15 Min.) Toxicity Data Man, Inhalation, TC_{Lo}: 4000 ppm/1 Hr Human, Oral, TD_{Lo}: 428 mg/kg Man, Oral, TD_{Lo}: 892 mg/kg Man, Oral, LD_{Lo}: 714 mg/kg Rat, Oral, LD_{50}: 670 mg/kg



*The maximum allowable peak concentration (above the ceiling level value) of ethylene dichloride is 200 ppm for 5 minutes in any 3-hour period.
COMMENTS: Additional data concerning toxic doses and tumorigenic, reproductive, and mutagenic effects is listed (with references) in the NIOSH *RTECS* 1983-84 supplement, pages 865-66.

SECTION 3. PHYSICAL DATA

Boiling Point ... 182.3°F (83.5°C)
Vapor Pressure ... 87 Torr at 77°F (25°C)
Water Solubility ... Soluble in about 120 Parts Water
Vapor Density (Air = 1) ... 3.4
Evaporation Rate (n-BuAc = 1) ... Not Listed
Specific Gravity ... 1.2569 at 69°F (20°C)
Freezing Point ... -31.9°F (-35.5°C)
Molecular Weight ... 98.96 Grams/Mole

Appearance and odor: Colorless, clear liquid. Sweet, chloroformlike odor is typical of chlorinated hydrocarbons. The recognition threshold (100% of test panel) for ethylene dichloride is 40 ppm. Odor detection probably indicates an excessive exposure to vapor. High volatility and flammability, coupled with its toxicity and carcinogenic potential, make this material a major health hazard.
COMMENTS: Ethylene dichloride is miscible with alcohol, chloroform, and ether.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
See Below	775°F (413°C)	% by Volume	6.2	15.9

EXTINGUISHING MEDIA: Use chemical, carbon dioxide, alcohol foam, water spray/fog, or dry sand to fight fires involving ethylene dichloride. Direct water sprays may be ineffective extinguishing agents, but they may be successfully used to cool fire-exposed containers. Use a smothering effect to extinguish fires involving this material. UNUSUAL FIRE/EXPLOSION HAZARDS: Ethylene dichloride is a dangerous fire and explosion hazard when exposed to sources of ignition such as heat, open flames, sparks, etc. Its vapors are heavier than air and can flow along surfaces to distant, low-lying sources of ignition and flash back. If it is safe to do so, remove this material from the fire area. Ethylene dichloride burns with a smoky flame.
SPECIAL FIRE-FIGHTING PROCEDURES: Wear a self-contained breathing apparatus with a full facepiece operated in a pressure-demand or another positive-pressure mode.
COMMENTS: Flash Point and Method: 56°F (13°C) CC; 65°F (18°C) OC.
OSHA Flammability Class (29 CFR 1910.106): IB. DOT Flammability Class (49 CFR 173.115): Flammable Liquid

SECTION 5. REACTIVITY DATA

Ethylene dichloride is stable. Hazardous polymerization cannot occur.

CHEMICAL INCOMPATIBILITIES include strong oxidizing agents. Explosions have occurred with mixtures of this material and liquid ammonia or dimethylaminopropylamine. Finely divided aluminum or magnesium metal may be hazardous in contact with ethylene dichloride.
CONDITIONS TO AVOID: Eliminate sources of ignition such as excessive heat, open flames, or electrical sparks, particularly in low-lying areas, because the explosive, heavier-than-air vapors will concentrate there.
PRODUCTS OF HAZARDOUS DECOMPOSITION can include vinyl chloride, chloride fumes, and phosgene. Phosgene is an extremely poisonous gas. Products of thermal-oxidative degradation (i.e., fire conditions) must be treated with appropriate caution.

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SECTION 6. HEALTH HAZARD INFORMATION

Ethylene dichloride is listed as an anticipated human carcinogen by the NTP and as a probable human carcinogen (Group 2B), by the IARC. It was found to be an animal-positive carcinogen by the IARC. NCI reported positive results (mouse, rat) from its carcinogenesis bioassay. SUMMARY OF RISKS: Ethylene dichloride is considered to be one of the more toxic of the common chlorinated hydrocarbons. Deaths from accidental ingestion of this material have been reported. Inhalation of vapors reportedly caused three fatalities. Excessive inhalation of ethylene dichloride vapors can cause respiratory irritation, intoxication, narcotic and anesthetic effects, vomiting, dizziness, depression, and diarrhea. The hepatoxic (injurious to liver) effects of this material are significant. The systemic effects from overexposure can appear in the liver, kidneys, digestive tract, blood, lungs, adrenal glands, and the central nervous system. Tests on animals have revealed reproductive failure and fetal resorption. There may be increased risk to nursing infants of exposed mothers. TARGET ORGANS: Central nervous system, eyes, kidneys, liver, heart, adrenal glands, and skin. PRIMARY ENTRY: Inhalation, absorption through skin, oral, or eye contact. ACUTE EFFECTS: Skin contact causes irritation, defatting, and, if repeated or prolonged, burning. Eye contact causes irritation and serious injury (clouding of the cornea) if it is not removed promptly. CHRONIC EFFECTS: Injuries to the liver (hepatoxicity) and kidneys, weight loss, low blood pressure, jaundice, oliguria (reduced excretion of urine), or anemia. MEDICAL CONDITIONS AGGRAVATED BY LONG-TERM EXPOSURE: Persons taking anticoagulants could experience an increase in tendency to bleed. Persons taking insulin face an increased risk of lowered blood sugar. FIRST AID: Be prepared to restrain a hyperactive victim. EYE CONTACT: Flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. Get medical help.* SKIN CONTACT: Immediately flush the affected area with water. Wash thoroughly with soap and water. Remove and launder contaminated clothing before wearing it again; clean material from shoes and equipment. Get medical help.* INHALATION: Remove victim to fresh air; restore and/or support his breathing as needed. Get medical help.* INGESTION: Never give anything by mouth to someone who is unconscious or convulsing. Rinse victim's mouth with water. Oxygen and artificial respiration may be needed. Get medical help.* * GET MEDICAL ASSISTANCE = IN PLANT, PARAMEDIC, COMMUNITY. Get prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Before using ethylene dichloride, it is essential that proper emergency procedures be established and made known to all personnel involved in handling it. Notify safety personnel of ethylene dichloride spills or leaks and implement containment procedures. Remove and eliminate all possible sources of ignition such as heat, sparks, and open flames from the area. Cleanup personnel should use protection against inhalation of vapors and contact with liquid. Contain spills by using an absorbent material such as dry sand or vermiculite. Use nonsparking tools to mix waste material thoroughly with absorbent and place it in an appropriate container for disposal. Flush trace residues with large amounts of water. Do not flush waste to sewers or open waterways. WASTE DISPOSAL: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Waste may be burned in an approved incinerator equipped with an afterburner and a scrubber. Follow Federal, state, and local regulations.

Ethylene dichloride is designated as a hazardous substance by the EPA (40 CFR 116.4). Ethylene dichloride is reported in the 1983 EPA TSCA Inventory.

EPA Hazardous Waste Number (40 CFR 261.33): U077

EPA Reportable Quantity (40 CFR 117.3): 5000 lbs (2270 kgs)

Aquatic Toxicity Rating, TLm 96: 1000 - 100 ppm

SECTION 8. SPECIAL PROTECTION INFORMATION

GOGGLES: Always wear protective eyeglasses or chemical safety goggles. Ethylene dichloride is particularly harmful to the eyes, and direct contact results in corneal opacity (permanent clouding of the eye). GLOVES: Wear impervious rubber gloves to prevent skin contact. RESPIRATOR: Use a NIOSH-approved respirator per the NIOSH *Pocket Guide to Chemical Hazards* (Genium ref. 88) for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. Any detectable concentration of ethylene dichloride requires an SCBA, full facepiece, and pressure-demand/positive-pressure modes. Warning: Air-purifying respirators will not protect workers from oxygen-deficient atmospheres. OTHER: Wear rubber boots, aprons, and other protective clothing suitable for use conditions to prevent skin contact. Remove contaminated clothing and launder it before wearing it again. Discard contaminated shoes. VENTILATION: Provide maximum explosion-proof local fume exhaust ventilation systems to maintain the airborne concentrations of ethylene dichloride vapors below the exposure limits cited in section 2. Install properly designed hoods that maintain a minimum face velocity of 100 lfm (linear feet per minute). SAFETY STATIONS: Make eyewash stations, washing facilities, and safety showers available in areas of use and handling. SPECIAL CONSIDERATIONS: Vapors are heavier than air and will collect in low-lying areas. Eliminate sources of ignition in these areas and again provide good ventilation there. COMMENTS: Practice good personal hygiene. Keep materials off of your clothes and equipment. Avoid transferring this material from hands to mouth while eating, drinking, or smoking. Immediately remove ethylene dichloride-saturated clothing to avoid flammability and health hazards. Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Store ethylene dichloride in tightly closed containers in a cool, dry, well-ventilated area away from sources of ignition. Protect containers from physical damage and from exposure to excessive heat. Avoid direct physical contact with strong acids, bases, oxidizing agents, and reducing agents. SPECIAL HANDLING/STORAGE: Use nonsparking tools. Outside or detached storage is preferred. Store and handle ethylene dichloride in accordance with the regulations concerning OSHA class IB flammable liquids. ENGINEERING CONTROLS: During transfer operations involving ethylene dichloride, the liquid and its vapors must not be exposed to nearby sources of ignition from engineering systems that are not explosion proof. Preplan emergency response procedures.

TRANSPORTATION DATA (per 49 CFR 172.101-2):

DOT Hazard Class: Flammable Liquid

DOT Label: Flammable Liquid

IMO Class: 3.2

DOT Shipping Name: Ethylene Dichloride

DOT ID No. UN 1184

IMO Label: Flammable Liquid, Poison

References: 1-9, 12, 19, 21, 26, 43, 47, 73, 97-102. CK

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Approvals JO. Recchio

Indust. Hygiene/Safety D/W 11-18-87

Medical Review Gail Goldsmith 11-30-87

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MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

NO. 380

LIQUEFIED PROPANE
Revision A

DATE October 1984

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: LIQUEFIED PROPANE
OTHER DESIGNATIONS: Liquefied Petroleum Gas*, LP-Gas*, LPG*, High volatility LPG, Propane HD-5(95%), ASTM D1835, CAS #000 074 986. GE Material D27A20.
DESCRIPTION: Propane-based hydrocarbon. Grade determines propane content. Supplied as pressurized liquid in tanks under its own vapor pressure.
MANUFACTURER: Available from many sources.

*These terms are also used for butane-based gas. (See MSDS #481)

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Ethane (C_2H_6) (CAS #000 074 840)	<4	
Propane (C_3H_8) (CAS #000 074 986)	>65	8-hr TWA 1000 ppm**
Propylene (C_3H_6) (Cas #000 115 071)	0-35	
C_4 and Higher Hydrocarbons	<2.5	

**Current OSHA Standard for propane and LPG mixtures. ACGIH (1984) labels ethane, propane, propylene and butane as simple asphyxiants (control at 18 Vol % minimum oxygen).

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg C (propane) ---------- -43.7
Vapor pressure, psig at 70 F -- 109 min
at 100 F -- 208 max
Vapor density (Air=1) ---------- ~1.8
Water solubility (propane) ----- Slightly soluble

Specific gravity, -42.2/4C -- 0.58
Volatile, % ---------- ~100
(95% min at -37 F)
Molecular weight ---------- 44.09

Appearance & Odor: A colorless gas at room temperature and 1 atm pressure. It can be liquefied by lowering the temperature, increasing the pressure or both. It can have an odor like "natural gas", but propane is odorless when pure.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
-156 F (propane)	874 F (propane)	% by volume (approx)	>2	10

Extinguishing precedure: If feasible, stop flow of gas. Use water to cool fire-exposed tanks, surroundings and to protect personnel working on shut off. Water spray, dry powder or carbon dioxide can be directed at flame area, if gas flow cannot be stopped, to reduce fire intensity. Do not completely extinguish flame unless gas flow is shut off!
Vapors may flow on surfaces for considerable distances, reach an ignition source, and flash back. It can be a dangerous fire and explosion hazard when mixed with air.
Those putting out fire must use self-contained breathing apparatus and protective equipment. Continue cooling containers with water well after fire has been extinguished.

SECTION V. REACTIVITY DATA

This flammable material is stable when stored as a liquid in steel tanks under its own vapor pressure. It does not undergo hazardous polymerization. Keep separate from oxidizing agents.

It burns with a luminous, smoky flame; it can produce carbon monoxide when oxidized with a deficiency of oxygen.

One volume of propane requires about 25 volumes of air for complete combustion.

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NO. 380

SECTION VI. HEALTH HAZARD INFORMATION

TLV 1000 ppm

This material is an asphyxiant (and it may have anesthetic properties at very high concentrations). If it is present in sufficient concentration to reduce the oxygen level below 18% in inhaled air, symptoms such as rapid respiration, mental dullness, incoordination, poor judgement, nausea, and unconsciousness may result. (Oxygen deficiency may occur without warning in areas where this gas may displace air.)

Contact with liquefied gas can produce frostbite.

FIRST AID:

Inhalation: Remove victim to fresh air. Restore and/or support breathing. Prompt mouth-to-mouth resuscitation may be indicated. Administer oxygen if exposure was serious or if oxygen deficiency symptoms persist. Get medical help. (Caution! Would be rescuers need to be concerned with their own safety in oxygen-deficient areas. Use self-contained or air-supplied breathing apparatus only.)

Liquid Contact: Promptly flush affected area with tepid water. If freezing burns have occured, apply a bulky, dry, sterile bandage to protect area. Get medical help.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Personnel involved in leak stoppage should use self-contained breathing equipment and should have protection against direct contact with liquid hydrocarbon. Ventilate closed spaces before entering them.

Evacuate area. Eliminate sources of ignition. Supply maximum air ventilation (explosion-proof equipment) to keep concentration well below lower flammability limit. Stop leak or remove leaky cylinder or tank. Place cylinder or tank in remote place and allow gas to slowly bleed off to atmosphere or place in pit and ignite escaping gas.

Incinerate waste gas by laying a pipe line to a furnace and burning with caution in accordance with Federal, State and Local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide adequate explosion-proof ventilation where this material is used to meet TLV requirements and to keep conc. in air below 25% of LEL. Provide special ventilation in sumps and confined areas.

Self-contained respirators should be available for non-routine and emergency use.

Electrical services and equipment should be explosion-proof where propane is used.

Where contact with liquid propane is possible, use protective clothing, gloves, and face shield.

Monitoring methods for LPG - NIOSH #593 - and for propane - NIOSH #587.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store and use propane cylinders and tanks in well-ventilated areas, away from heat, direct sunlight, and sources of ignition. No smoking in areas of storage or use. Electrically bond and ground all lines and equipment used with propane. Keep away from oxidizing agents and from cylinders of oxygen or chlorine.

Follow standard procedures for handling cylinders and tanks of flammable, compressed gas. Provide protection against damaging cylinders and tanks. See NFPA #58 and #59 for handling and storage of LPG.

DOT Flammable Gas: UN1978 (Propane), UN1075 (LPG) UN1965 (Hydrocarbon gas liquefied) Label: FLAMMABLE GAS

DATA SOURCE(S) CODE: 1,2,4-9,11-12,17,27,47

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APPROVALS: MIS/CRD

INDUST. HYGIENE/SAFETY 10-1-84

MEDICAL REVIEW: 5 October 1984

MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

NO 414

DI(2-ETHYLHEXYL)PHTHALATE

Revision A

DATE December 1984

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: DI(2-ETHYLHEXYL)PHTHALATE
OTHER DESIGNATIONS: DEHP, "DOP", $o\text{-}C_6H_4[COOCH_2CH(C_2H_5)C_4H_9]_2$, bis(2-Ethylhexyl)Phthalate, GE Material D5B9, ASTM D1249 Type I, CAS #000 117 817, Dioctyl Phthalate

TRADE NAME &	KODAFLEX DOP		HATCOL-101
MANUFACTURER:	Eastman Chemical Products Coatings Chemicals Div. Kingsport, TN 37662	U.S. Steel Corp. Chemicals Div. 600 Grant Avenue Pittsburgh, PA 15230	W.R. Grace & Co. Hatco Chemicals Div. Fords, NJ 08863
Phone:	(800)327-8626	(412)433-7711	(201)738-1000

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Di(2-ethylhexyl)phthalate Listed as a "suspected carcinogen" by the National Toxicology Program (NTP). (Long term, high level animal feeding tests have produced neoplasms.) National Center for Toxicological Research is currently testing (FY1984) for reproductive development toxicity. *Current (1984) OSHA PEL and ACGIH TLV. ACGIH STEL is 10 mg/m^3 for 15 minutes exposure	ca 99	8-hr TWA 5 mg/m^3* Man, Oral TDLo 143 mg/kg GI tract effects Rat (5-15 days Preg.) interperitoneal TDLo 15 g/kg Teratogenic effects Rat, Oral LD_{50} 31 g/kg

SECTION III. PHYSICAL DATA

Boiling point, 760 mm, deg C	ca 385	Specific gravity, 20/20 C	0.99
54 mm, deg C	230	Pour point, deg C	ca -48
Vapor pressure at 200 C, mm Hg	1.3	Viscosity, 20 C, cps	81.4
Vapor density (Air=1)	~13.5	Freezing point, deg C	below - 50
Water solubility	Nearly insoluble (<0.01% at 20 C)	Molecular weight	390.5

Appearance & Odor: Colorless to pale yellow oily liquid. Odorless to faint, mild odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits in Air	Lower	Upper
425 F (COC)	770 F	Volume % @ 474F (245C)	0.3	-

Extinguishing media: Use foam, water spray, carbon dioxide or dry chemical. Water or foam may cause frothing of hot oil. Use water spray to cool fire-exposed containers of this material and to flush spills away from sensitive area.
This material is a slight fire hazard when exposed to heat or flame; it presents no unusual fire hazard.
Firefighters should use self-contained breathing equipment and full protective clothing.

SECTION V. REACTIVITY DATA

This is a stable material under normal storage and handling conditions. It does not undergo hazardous polymerization.
It is a combustible liquid (OSHA Class III-B) and is incompatible with strong oxidizing agents.
Thermal-oxidative degradation products include carbon dioxide and carbon monoxide.

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NO. 414

SECTION VI. HEALTH HAZARD INFORMATION

TLV 5 mg/m^3 (See Sect II)

The low vapor pressure of this material essentially eliminates acute inhalation hazard unless the liquid is heated or misted. The TLV has been established to prevent inhaling of excessive levels of airborne DEHP which can cause nausea and be irritating to mucous membranes and the respiratory tract. Eye contact with liquid or mist is irritating. Ingestion can cause abdominal cramps, nausea, and diarrhea. Excessive skin contact can be irritating. (Rabbit, skin, LD_{50} 25g/kg)

FIRST AID:

Eye Contact: Flush eyes with running water for 15 minutes, including under eyelids. Get medical help if irritation persists.

Skin Contact: Wash exposed areas well with soap and water. Get medical help if irritation persists or if large areas of the body are affected. Remove contaminated clothing promptly.

Inhalation: Remove to fresh air. Support breathing if necessary. Get medical help. Keep warm and at rest.

Ingestion: Contact physician. Stomach lavage may be needed.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Contain spill and pick up with absorbent solid, rags, or paper for disposal by burning. Prevent losses into the environment whenever possible. Do not send to sewer. (DEHP degrades in fresh water sediments under aerobic conditions; half life about 14 days. It does not degrade under anaerobic conditions. It is readily concentrated by aquatic organisms.) Clean up trace residues with water and detergent.

DISPOSAL: Scrap material can be disposed of by controlled incineration. Mix liquid scrap with a more flammable solvent and spray into incinerator's firebox. Follow Federal, State, and Local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Use general ventilation, combined with local exhaust ventilation (especially when material is heated or misted) to meet the TLV requirements. For nonroutine and emergency conditions where the TLV is exceeded, use an approved air-supplied mask or organic canister respirator for protection against mist and vapors.

Use rubber gloves and apron to avoid repeated or prolonged contact with liquid and safety glasses or goggles to avoid eye contact by splashing. Depending on how the material is used and conditions of use, additional body protection may be desirable.

Eyewash fountain and safety showers should be available to areas of use and handling.

DEHP contaminated clothing should be removed and laundered before reuse.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in a ventilated area away from oxidizing agents and sources of heat or ignition.

Follow good hygienic practice to avoid chronic effects. Wear clean work clothing. Avoid prolonged or repeated contact with liquid and inhalation of mist or vapors. Do not eat or smoke in areas where this material is used or stored. Wash exposed skin areas after working with this material and before using restroom facilities, eating or smoking. Do not take internally.

DATA SOURCE(S) CODE: 1-12,14,23,38,47

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APPROVALS: MIS CRD J. M. [signature]

INDUST. HYGIENE. SAFETY [signature] 12-4-84

MEDICAL REVIEW: December 1984

Material Safety Data Sheet

From Genium's Reference Collection
Genium Publishing Corporation
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GENIUM PUBLISHING CORP.

No. 464
n-HEPTANE
(Revision A)

Issued: September 1981
Revised: February 1987

SECTION 1. MATERIAL IDENTIFICATION

22

MATERIAL NAME: n-HEPTANE

DESCRIPTION/USES: An aliphatic hydrocarbon. Used as the standard for octane-rating determinations, an anesthetic, and a solvent; used in organic synthesis and preparation of laboratory reagents.

OTHER DESIGNATIONS: Heptane, Normal Heptane, Dipropylmethane, $CH_3(CH_2)_5CH_3$, CAS #0142-82-5.

MANUFACTURER/SUPPLIER: Available from several suppliers, including: American Burdick & Jackson, 1953 S. Harvey St., Muskegon, MI 49442; Telephone: (616) 726-3171

HMIS
H 1
F 3
R 0
PPE*
*See Sect. 8

R 1
I 2
S 2
K 4

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
n-Heptane, CAS #0142-82-5	>99	8-Hr. TWA: 400 ppm or 1600 mg/m^3* STEL: 500 ppm or 2000 mg/m^3* Human, Inhalation, TCLo: 1000 ppm/6 minutes Mouse, Intravenous, LD_{50}: 222 mg/kg

*ACGIH (1986-87) TLV. Current OSHA PEL is 500 ppm or 2000 mg/m^3. NIOSH recommends a 10-hour TWA of 85 ppm with a ceiling level (15 minutes) of 400 ppm.

SECTION 3. PHYSICAL DATA

Boiling Point, 1 atm ... 209°F (98.4°C)
Vapor Pressure, 25°C, mm Hg ... 47.7
Water Solubility ... Insoluble
Vapor Density (Air = 1) ... 3.45
Evaporation Rate (BuAc = 1) ... ca 4

Specific Gravity (H_2O = 1), 20/4°C ... 0.684
Melting Point ... -131°F (-90.5°C)
% Volatile by Volume ... 100
Molecular Weight... 100.2

Appearance and odor: Clear, colorless liquid; mild gasolinelike odor.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air Volume %	LOWER	UPPER
25°F (-3.9°C) CC	433°F (223.5°C)		1.1	6.7

EXTINGUISHING MEDIA: Use carbon dioxide, dry chemical, or foam. Water is ineffective in putting out an n-heptane fire, and a water stream will spread flames; but a water spray should be used to cool fire-exposed containers to prevent pressure rupture. This flammable liquid is a dangerous fire hazard and a dangerous explosion hazard when heated. Fight the fire from a safe distance. Vapors can flow along surfaces, reach a distant ignition source, and flash back.

SPECIAL FIRE-FIGHTING PROCEDURES: This is an OSHA class IB flammable liquid. Fire fighters should use self-contained breathing apparatus and fully protective clothing.

SECTION 5. REACTIVITY DATA

n-Heptane is stable. Hazardous polymerization cannot occur.

This material is incompatible with oxidizing agents.

Products of hazardous decomposition of this material can include oxides of carbon.

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SECTION 6. HEALTH HAZARD INFORMATION | TLV

n-Heptane is not listed as a carcinogen by the NTP, IARC, or OSHA.

Excessive inhalation of this material causes irritation of the mucous membrane and central nervous system depression. Its vapors have a low solubility in water or blood and are rapidly eliminated from the body when inhalation of vapors is discontinued. Concentrations of 5000 parts per million (0.5%) for 4 minutes can cause marked vertigo, inability to walk in a straight line, giddiness, and muscular incoordination. After 5 minutes of exposure a state of stupor can occur with loss of appetite, nausea, and a lingering gasolinelike taste in the mouth. Narcosis occurs at higher concentrations. n-Heptane is lipid soluble. Its prolonged or repeated contact with skin causes drying, cracking, and dermatitis. Contact with the eyes can cause irritation. Ingestion may cause gastrointestinal irritation. TARGET ORGANS: Skin, respiratory system, peripheral nervous system. PRIMARY ENTRY: Inhalation, ingestion, dermal absorption. ACUTE EFFECTS: Dizziness, loss of appetite, nausea. CHRONIC EFFECTS: Dermatitis. FIRST AID: EYE CONTACT: Flush thoroughly, including under the eyelids, with running water for 15 minutes. Get medical help.* SKIN CONTACT: Remove contaminated clothing. Flush affected area with water; wash with soap and water. Get medical help.* INHALATION: Remove victim to fresh air. Restore and/or support his breathing as required. Get medical help.* INGESTION: Get medical help!* Aspiration hazard. Do not induce vomiting! Never give anything by mouth to someone who is unconscious or convulsing.

* GET MEDICAL ASSISTANCE = In plant, paramedic, community. Get medical help for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of n-heptane leaks or spills. Remove sources of heat or ignition. Provide maximum explosion-proof ventilation. Cleanup personnel need protection against inhalation of vapors and contact with liquid. Flush waste to the ground and away from sensitive areas with a *cold* water spray. Small spills can be absorbed with vermiculite, picked up with nonsparking tools, and allowed to evaporate with good ventilation or in a hood or open area. Pick up a large spill if it is safe to do so and place it into an appropriate container for recovery or disposal. Keep waste out of sewer or places where it can vaporize into confined spaces.

Burn waste properly (it has a low flash point) in an approved incinerator. Follow Federal, state, and local regulations.

Aquatic Toxicity TLm 96: >1000 ppm.

EPA, Clean Water Act, Reportable Spill Quantity: Not Listed.

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local explosion-proof exhaust ventilation to meet TLV requirements. For emergency or nonroutine exposures above the TLV, use a NIOSH-approved chemical-cartridge respirator with an organic-vapor cartridge. Below concentrations of 850 ppm, use an air-supplied or self-contained breathing apparatus. Between concentrations of 850 and 1000 ppm, use a chemical-cartridge respirator with a full facepiece and an organic-vapor cartridge.

• Prevent contact of n-heptane with the eyes by wearing chemical safety goggles. Wear neoprene or rubber gloves and other appropriate protective clothing to prevent skin contact with liquid. Clothing contaminated with this material is a health and fire hazard. Remove it and launder it before wearing it again. Provide an eyewash station and safety shower in areas of use and handling.

Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store n-heptane in tightly closed containers in a cool, well-ventilated area away from oxidizing agents and sources of heat and ignition. Protect containers from physical damage. Ground and bond them from transfers to prevent static sparks. Use nonsparking tools. Use metal safety cans for handling small amounts of this material. Storage and handling must be suitable for an OSHA class IB flammable liquid. *No smoking* where this material is stored or used. Meet the code for electrical services. Avoid breathing vapors! Prevent prolonged or repeated contact with skin. Do not drink n-heptane. Prevent its contact with eyes. Exposure-monitoring and record-keeping requirements that have been proposed by NIOSH for alkanes should be instituted. Do not take n-heptane out of your work area or to your home on your clothing or equipment.

EPA Hazardous Waste No. D001 (40 CFR 261.21).

n-Heptane is not designated as a hazardous substance by EPA (40 CFR 116).

DOT Classification: Flammable Liquid DOT ID No. UN1206

Data Source(s) Code: 1, 2-12, 14, 16, 23, 25-26, 31, 37-38, 42, 47, 54, 55, 58, 63, 82, 84. CK

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Approvals	
Indust. Hygiene/Safety	4-87
Medical Review	May 87

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MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

No. 465

METHYL MERCAPTAN

Date October 1981

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: METHYL MERCAPTAN
DESCRIPTION: Used in the synthesis of methionine and the manufacture of fungicides, plastics, jet fuels.
OTHER DESIGNATIONS: Methanethiol, CH_3SH, Methyl Sulfhydrate, Thiomethyl Alcohol, CAS #000 074 931
MANUFACTURER: Available from several suppliers, including:
Matheson Gas Products, 1275 Valley Brook Ave., Lyndhurst, NJ 07071, Tel: (201) 935-6660

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Methyl Mercaptan	>99	8hr TWA 0.5 ppm or 1 mg/m^3 Rat, Inhalation LC_{50} 675 ppm Mouse, Subcutaneous LD_{50} 2.4 mg/kg
*ACGIH (1981) TLV. OSHA ceiling level 10 ppm or 20 mg/m^3 (15 minute sampling period).		
TLV set at a level to prevent irritation.		

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg C	5.96	Specific gravity, 20/4 C	.866
Vapor pressure, 21.1 C, atm	2.02	Melting point, deg C	-123
Vapor density, 15 C, 1 atm (Air=1)	1.66	Critical temperature, deg C	196.8
Solubility in water, 15 C, % by wt	2.4	Critical pressure, atm	71.4
		Molecular weight	48.10

Appearance and Odor: Clear white liquid (below b.p.) or a colorless gas with an unpleasant odor (decayed cabbage). Odor detection, 50% recogn: 0.80 ppb.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
<20 C (0 C)		% by volume	3.9	21.8

Extinguish Media: Dry chemical, carbon dioxide, alcohol foam. Extinguish fire by stopping flow of gas.
Highly flammable. Will emit toxic fumes when exposed to heat or fire.
Methyl mercaptan can flow along surfaces for considerable distances, reach a distant ignition source and flash back.
Firefighters should wear self-contained breathing apparatus.

SECTION V. REACTIVITY DATA

This is a stable material in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.
Incompatible with strong oxidizing agents.
Mercury (II) oxide causes a violent reaction in absence of a diluent.
Thermal-oxidative degradation emits highly toxic fumes of SO_x.
In the atmosphere, the thiol reacts readily with ozone to form sulfur dioxide and predominantly methanesulfonic acid.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 0.5 ppm or 1 mg/m^3 (See Sect II)

Mercaptan vapors are irritating to the skin, eyes, and mucous membrane of the upper respiratory tract. Symptoms due to low exposures are headache, dizziness, staggering gait, and vomiting. Inhalation of high concentrations affects the CNS and causes muscular weakness, tremors, pulmonary edema, narcosis, convulsions, and pronounced paralysis of the respiratory center and locomotor muscles. Liquid contact may cause contact dermatitis.

FIRST AID:

Eye Contact: Flush thoroughly with running water for 15 min. including under the eyelids.

Skin Contact: Wash affected area with soap and water.

Inhalation: (Caution! Would be rescuers need self-contained breathing equipment.) Remove to fresh air. Quickly restore and/or support breathing as required. If not breathing, administer artificial respiration. If breathing is difficult, have qualified personnel administer oxygen.

Seek prompt medical assistance for further treatment, observation and support.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of leaks or spills. Remove sources of heat or ignition.

Provide adequate ventilation. Clean-up personnel need respiratory protection and appropriate protective clothing. Gas leaks can be detected by painting the suspected area with a soapy water solution and checking for bubble formation. Cover spills with liquid household bleach, calcium or sodium hypochlorite in aqueous solution. Do not use powdered bleach. (FIRE HAZARD)

DISPOSAL: Remove leaking cylinder to outdoor area or place into a hood with good forced ventilation and allow to discharge at a moderate rate. Or oxidize to CH_3SSCH_3 with a 5-10% oxidizing solu. (H_2O_2, calcium or sodium hypochlorite, sodium hypobromite.)

EPA (CWA) Reportable Quantity in event of spills is 100 lb. (44FR 8/29/79 pg 50777)

Follow Federal, State, and Local regulations.

AQUATIC TOXICITY: FISH, SALMONIDES: TLm 0.55-0.9 mg/l

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements; exhaust hoods should maintain 100 lfm minimum face velocity. Use an OSHA/NIOSH approved self-contained breathing apparatus for concentrations above the TLV and below 100 ppm. Levels between 100-400 ppm, use a supplied-air respirator with full facepiece operated in a positive pressure mode.

Those handling CH_3SH should wear chemical safety goggles, rubber gloves and apron, and safety shoes.

Eyewash stations and washing facilities should be available in areas of use, and also safety showers, especially where large amounts are used.

Preplacement and annual medical examination with emphasis on CNS, respiratory tract, liver and kidneys. Blood studies are helpful in following acute intoxication from methyl mercaptan.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in cylinders in a cool, dry, well-ventilated area away from sources of heat and ignition. Protect containers from physical damage. Do not subject cylinders to temperatures above 125 F. Store separate from oxidizing and flammable materials. Stainless steel and steel alloys (copper free) are preferred materials of construction for handling CH_3SH.

Ground all lines and equipment, use non-sparking tools and explosion-proof apparatus when working with CH_3SH.

Avoid inhalation of vapors. Extremely disagreeable odor provides adequate warning properties at levels far below toxicological effects. (Sense of smell temporarily desensitized after initial exposure). LABEL: FLAMMABLE GAS, red label

DOT Classification: FLAMMABLE GAS

DATA SOURCE(S) CODE: 2-8,10-12,14,17,25,26,31,38,43

APPROVALS: MIS CRD J. M. [signature]

Industrial Hygiene and Safety [signature] 10-9-81

MEDICAL REVIEW: 21 October 1981

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GENIUM PUBLISHING CORP.

NO. 467

AUTOMOTIVE
GASOLINE, LEAD-FREE

Date October 1981

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: AUTOMOTIVE GASOLINE, LEAD-FREE
DESCRIPTION: A volatile blend of hydrocarbons for automotive fuel
OTHER DESIGNATIONS: Petrol, CAS #008 006 619, ASTM D439
MANUFACTURER: Available from several suppliers.

SECTION II. INGREDIENTS AND HAZARDS

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Gasoline A hydrocarbon blend that can include normal and branched chain alkanes, cycloalkanes, alkenes, aromatics and other additives.** (Lead max 0.013 g/L, phosphorus max 0.0013 g/L, sulfur max 0.10 wt%. May contain benzene, <5%; see ASTM D3606). *ACGIH 1981 TLV (Intended Changes List). See also Am. Ind. Hyg. A. 39 110-117 (1978) **The composition of fuel is varied with altitude and seasonal requirements for a locality. The blend must meet antiknock requirements. (Antiknock Index min 85, ASTM D439.)	100	8-hr TWA 300 ppm or 900 mg/m^3* Man Eye: 500 ppm/1H Moderate irritation Inhalation: TCLo 900 ppm/1H TFX:CNS

SECTION III. PHYSICAL DATA

Distillation at 1 atm, Initial, deg C >39
50% distilled - 77-121
End point ----- <240

Specific gravity, 60/60 F - 0.72-0.76
Melting point, deg C ------ -90.5-95.4
Evaporation rate --------- N/A

Vapor density (Air=1) ---------- 3.0-4.0
Solubility in water ---------- Insoluble

Appearance and Odor: A clear, mobile liquid with a characteristic odor which can be recognized at about 10 ppm in air. (Gasoline may be colored with dye.)

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air % by volume	LOWER	UPPER
-45 F	536-853 F		1.4	7.6

Extinguishing Media: Dry chemical, carbon dioxide, alcohol foam. Use of water may be ineffective to extinguish fire, but use water spray for cooling fire-exposed drums and tanks to prevent pressure rupture. It is a dangerous fire and explosion hazard when exposed to heat and flames. Vapors can flow along surfaces, reach distant ignition sources and flash back. Can react violently with oxidizing agents.
Firefighters should wear self-contained breathing apparatus and full protective clothing.

SECTION V. REACTIVITY DATA

This is a stable material in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.
This is an OSHA Class IA flammable liquid. A mixture of gasoline vapors and air can be explosive. It is incompatible with oxidizing agents.
Thermal-oxidative degradation can yield carbon monoxide and partially oxidized hydrocarbons.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 300 ppm (See Sect. II)

Inhalation causes intense burning of the mucous membranes, throat and respiratory tract; overexposure to vapors can lead to bronchopneumonia. Inhalation of high conc. can cause fatal pulmonary edema. Repeated or prolonged skin exposure causes dermatitis. Can cause blistering of skin due to its defatting properties. Exposure to eyes can cause hyperemia of the conjunctiva.

Ingestion or excessive vapors can cause inebriation, drowsiness, blurred vision, vertigo, confusion, vomiting and cyanosis (2000 ppm produces mild anesthesia in 30 min, higher conc. are intoxicating in less time.) Aspiration after ingestion causes bronchitis, pneumonia, or edema which can be fatal.

FIRST AID:

Eye Contact: Flush thoroughly with running water for 15 min. including under eyelids.
Skin Contact: Remove contaminated clothing. Wash affected area with soap and water.
Inhalation: Remove to fresh air. Restore breathing and administer oxygen if needed.
Ingestion: Do not induce vomiting. Aspiration hazard. Contact physician.

Seek prompt medical assistance for further treatment, observation and support.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of leaks or spills. Remove sources of heat or ignition. Provide adequate ventilation. Clean-up personnel require protection against liquid contact and vapor inhalation. If a leak or spill has not ignited, use water spray to disperse vapors and to protect men attempting to stop the leakage. Contain spill. Do not allow to enter sewer or surface water. Add absorbent solid to small spills or residues and pick up for disposal.

DISPOSAL: Burn scrap material in an approved incinerator. Burn contaminated liquid by spraying into an incinerator. Follow Federal, State, and Local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Use general and local exhaust ventilation (explosion-proof) to keep vapors below the TLV requirements in the workplace. Respirators should be available for nonroutine or emergency use above the TLV.

Avoid eye contact by use of chemical safety goggles and/or full faceshield where splashing is possible. Wear protective clothing appropriate for the work situation to minimize skin contact such as rubber gloves and boots. Clothing to be changed daily and laundered.

Eyewash fountains, showers and washing facilities should be readily accessible

Provide suitable training to those handling and working with this material.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from sources of heat, ignition and strong oxidizing agents. Protect containers from physical damage. Avoid direct sunlight. Storage must meet requirements of OSHA Class IA liquid.

Outdoor or detached storage preferred. No smoking in areas of use. Prevent static electric sparks and use explosion-proof electrical services. (Must meet code.)

Avoid skin and eye contact. Avoid inhalation of vapors. Wear clean work clothing daily.

Indoor use of this material requires exhaust ventilation to remove vapors.

ICC Flammable Liquid, Red Label. LABEL: Flammable Liquid DOT I.D. No. UN 1203.

DOT Classification: FLAMMABLE LIQUID

DATA SOURCE(S) CODE: 2,4-9,34,37

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APPROVALS: MIS CRD J. M. [signature]

Industrial Hygiene and Safety [signature] 10-27-81

MEDICAL REVIEW: 14 November 1981

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(518) 377-8855

GENIUM PUBLISHING CORP.

No. 468

FUEL OIL NO. 1

Date March 1982

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: FUEL OIL NO. 1
DESCRIPTION: Kerosine-like mixture of petroleum hydrocarbons; a distillate of controlled sulfur content.
OTHER DESIGNATIONS: Heating Fuel; ASTM D396, Grade No 1; CHEVRON Heating Fuel No. 1
MANUFACTURER: Available from many suppliers, including:
Standard Oil Co. of California
Chevron Research Co.
PO Box 1272
Richmond, CA 94802 Tel: (415) 233-3737

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Fuel Oil No. 1		8-hr TWA 5 mg/m^3 (mineral oil mist)*
Mixture of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons		
Sulfur content	<0.5	

*Current OSHA Standard and ACGIH (1981) TLV.

SECTION III. PHYSICAL DATA

Boiling range, 1 atm, deg C (F) --------- 166-318 (330-605)
Vapor pressure, 38C (100F) --- ca 5
Solubility in water ----- Insoluble
Specific gravity (H_2O=1) --- ca 0.83
Pour point, deg C, max ----- -18
Volatiles, vol % ---------- >99
Viscosity @ 40C, cSt -------- 1.3-2.1

Appearance and Odor: Light amber liquid with a mild petroleum odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air % by volume	LOWER	UPPER
>100F (CC)	490F		ca 1.0	-

Extinguishing media: Dry chemical, carbon dioxide, foam, water fog or spray. Use a water spray to cool fire exposed containers. Use a smothering technique for extinguishing fire of this combustible liquid. Do not use a forced water stream directly on burning oil as this will scatter the fire.
Firefighters should wear self-contained breathing apparatus and full protective clothing.

SECTION V. REACTIVITY DATA

This is a stable material in closed containers at room temperature under normal storage and handling conditions. It does not polymerize.
Incompatible with strong oxidizing agents; heating greatly increases fire hazard.
Thermal-oxidative degradation products can include hydrocarbons and hydrocarbon derivatives (partial oxidation products), CO_2, CO and SO_2.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 5 mg/m^3 (mineral oil mist)

Excessive inhalation of vapor or mist irritates the respiratory tract, and can cause headache, dizziness, nausea, stupor, convulsions or loss of consciousness, depending on conc. and time of exposure. High vapor conc. or liquid contact can irritate eyes.
Liquid contact with the skin is irritating; prolonged or repeated contact can cause dermatitis.
Chemical pneumonitis may result when vomiting occurs after ingestion and oil is aspirated into the lungs.
FIRST AID:
Eye Contact: Flush eyes with plenty of running water for at least 15 minutes. If irritation persists, get medical help.
Skin Contact: Remove contaminated clothing. Wash exposed areas of the body with soap and water. Get medical help when large areas of the body have been exposed or if irritation persists.
Inhalation: Remove to fresh air. Restore and/or support breathing as needed. (administer oxygen if necessary). Call a physician.
Ingestion: Contact physician! Do not induce vomiting (aspiration hazard)!

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of leaks or spills. Remove sources of heat or ignition.
Evacuate area for large spills. Provide maximum explosion-proof ventilation. Those involved in clean-up should use protection against liquid contact and vapor inhalation. Contain spill. Do not send to sewer or allow to enter streams or surface water. Pick up liquid for reclaim or disposal. Use absorbent solid to pick up small spills or residues. Clean up spills promptly to reduce fire or vapor hazards.
DISPOSAL: Burn in an approved incinerator or furnace or dispose of via a licensed waste disposal company. Follow Federal, State and local regulations. Report large oil spills.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general ventilation and local exhaust ventilation where operating conditions may create excessive workplace vapors or mists. Use explosion-proof equipment. Provide an approved respirator with mist filter & organic vapor cartridge for nonroutine or emergency use when vapor/mist concentrations are high.
Wear impermeable gloves to prevent prolonged liquid contact. Use eye protection where splashing liquid or high mist or vapor conc. may occur. Other protective clothing may be required, depending on working conditions.
An eyewash fountain and washing facilities should be readily available near handling and use areas.
Launder contaminated clothing before reuse (at least weekly routine laundering of work clothes is recommended).

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a well-ventilated area away from sources of heat, ignition and strong oxidizing agents. Protect containers from physical damage. Use non-sparking tools and explosion-proof electrical equipment. Prevent static electric sparks. Use and storage conditions should be suitable for OSHA Class II combustible liquid.
Avoid prolonged skin contact and breathing of vapors or mist. No smoking in areas of use. Follow good hygienic practice with this material. Do not wear oil contaminated clothing. Do not put oily rags into pockets. Wash exposed skin areas several times a day with soap and warm water when working with this material. DOT I.D. No. UN1993
DOT Classification: COMBUSTIBLE LIQUID
DATA SOURCE(S) CODE: 1,6,7,12

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CRD
Industrial Hygiene and Safety [illegible] 3-12-82
MEDICAL REVIEW: 21 March 1982

MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

No. 469

FUEL OIL NO. 2

Date October 1981

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: FUEL OIL NO. 2
DESCRIPTION: Mixture of petroleum hydrocarbons; a distillate oil of low sulfur content.
OTHER DESIGNATIONS: ASTM D396, GE Material D27B1A, CAS #068 476 302
MANUFACTURER: Available from many suppliers, including:
AMOCO Oil Co.
200 East Randolph Drive
Chicago, Illinois 60601

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Fuel Oil No. 2		
Complex mixture of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons		8-hr TWA 5 mg/m^3 (mineral oil mist)*
Sulfur content	<0.5	
Benzene**	<100 ppm	

*Current OSHA standard and ACGIH (1981) TLV

**A low benzene level reduces carcinogenic risk. Fuel oils are exempted under the benzene standard (29 CFR 1910.1028)

SECTION III. PHYSICAL DATA

Boiling point range, deg F, -------- Ca 340-675
Solubility in water ---------- negligible
Viscosity at 38 C, cSt ---------- 2.0-3.6
Specific gravity (H_2O=1) -- <0.876
Pour point, deg C ------ below -6

Appearance and Odor: Clear, bright liquid with a mild petroleum odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air % by volume	LOWER	UPPER
100F min (TCC)	257 C (495F)		0.6	7.5

Extinguishing Media: Dry chemical, carbon dioxide, foam, water spray. Use a water spray to cool fire exposed containers. Use a smothering technique for extinguishing fire of this combustible liquid. Do not use a forced water stream directly on oil fire as this will only scatter the fire. Material is an OSHA Class II combustible liquid.
Firefighters should wear self-contained breathing apparatus and full protective clothing.

SECTION V. REACTIVITY DATA

This is a stable material in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.
Imcompatible with strong oxidizing agents; heating greatly increases fire hazard.
THermal-oxidative degradation may yield various hydrocarbons and hydrocarbon derivatives (partial oxidation products), CO_2 and CO and SO_2.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 5 mg/m^3 oil (mist) (See Sect II)

Inhalation of excessive concentrations of vapor or mist can be irritating to the respiratory passages and can cause the following symptoms: headache, dizziness, nausea, vomiting, and loss of coordination. Prolonged or repeated skin contact may cause irritation of the hair follicles and block the sebaceous glands. This produces a rash of acne pimples and spots, usually on the arms and legs. (Good personal hygiene will prevent this).

Chemical pneumonitis may result when ingestion occurs and oil is aspirated in the lungs.

FIRST AID:

Eye Contact: Flush thoroughly with running water for 15 min. including under eyelids.

Skin Contact: Remove contaminated clothing. Wipe excess oil off with a dry cloth. Wash affected area well with soap and water.

Inhalation: Remove to fresh air. Restore and/or support breathing as required.

Ingestion: Do not induce vomiting.

Seek medical assistance for further treatment, observation and support.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of leaks or spills. Remove sources of heat or ignition.

Provide adequate ventilation. Clean-up personnel to use protection against liquid contact and vapor or mist inhalation. Contain spill by diking. Small spills can be contained by using absorbants, such as rags, straw, polyurethane foam, activated carbon, and sand. Clean up spills promptly to reduce fire or vapor hazards.

DISPOSAL: May be disposed of by a licensed waste disposal company, or by controlled incineration or burial in an approved landfill.

Follow Federal, State and Local regulations. Report large oil spills.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide adequate ventilation where operating conditions (heating or spraying) may create excessive vapors or mists. Use explosion proof equipment. Provide approved respiratory apparatus for nonroutine or emergency use. Use an approved filter & vapor respirator when vapor/mist concentrations are high. Wear protective rubber gloves and chemical safety glasses where contact with liquid or high mist conc. may occur. Additional suitable protective clothing may be required depending on working conditions. An eye-wash fountain and washing facilities to be readily available near handling and use areas.

Launder soiled or contaminated clothing before reuse (at least weekly laundering of work clothes is recommended) .

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from sources of open flame, heat, strong oxidizing agents, and ignition. Protect containers from physical damage. Use non sparking tools and explosion-proof electrical equipment. Prevent static electric sparks.

Avoid prolonged skin contact and breathing of vapors or mists.

No smoking in areas of use. Follow good hygienic practice in the use of this material. Do not wear oil contaminated clothing. Do not put oily rags into pockets. Wash exposed skin areas several times a day with soap and warm water when working with this material. DOT Classification: COMBUSTIBLE LIQUID

DATA SOURCE(S) CODE: 1,6,7,12

APPROVALS: MIS J. M. Nielsen
CRD

Industrial Hygiene and Safety 10-12-81

MEDICAL REVIEW: 21 October 1981

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MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

No. 470

DIESEL FUEL OIL NO. 2-D

Date October 1981

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: DIESEL FUEL OIL NO. 2-D
DESCRIPTION: Mixture of petroleum hydrocarbons; a distillate oil of low sulfur content
OTHER DESIGNATIONS: ASTM D975, CAS # 068 476 346
MANUFACTURER: Available from many suppliers

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Diesel Fuel Oil No. 2-D		
Complex mixture of paraffinic, olefinic, naphthenic and aromatic hydrocarbons**	>95	8-hr TWA 5mg/m^3* (mineral oil mist)
Sulfur content	<0.5	
Benzene***	<100 ppm	

*Current OSHA standard and ACGIH (1981) TLV
**Diesel fuels tend to be low in aromatics and high in paraffinics. A min. Cetane No. of 40 is required (ASTM D613).
***A low benzene level reduces carcinogenic risk. Fuel oils can be exempted under the benzene standard (29 CFR 1910.1028)

SECTION III. PHYSICAL DATA

Boiling point range, deg F, ------- Ca 340-675
Solubility in water ---------- negligible
Viscosity at 40 C, cSt ---------- 1.9-4.1
Specific gravity (H_2O=1) ---- <0.86
Cloud point (wax), deg C --- Ca 0

Appearance and Odor: Clear, bright liquid with a mild petroleum odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air % by volume	LOWER	UPPER
125F min (PM)	>500F		0.6	7.5

Extinguishing Media: Dry chemical, carbon dioxide, foam, water spray. Use a water spray to cool fire exposed containers. Use a smothering technique for extinguishing fire of this combustible liquid. Do not use a forced water stream directly on oil fire as this will only scatter the fire. Material is a OSHA Class II combustible liquid.
Firefighters should wear self-contained breathing apparatus and full protective clothing.

SECTION V. REACTIVITY DATA

This is a stable material in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.
Incompatible with strong oxidizing agents; heating greatly increases fire hazard.
Thermal -oxidative degradation may yield various hydrocarbons and hydrocarbon derivatives (partial oxidation products), CO_2 and CO and SO_2.

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No. 470

SECTION VI. HEALTH HAZARD INFORMATION

TLV 5 mg/m^3 oil (mist) (See Sect II)

Inhalation of excessive concentrations of vapor or mist can be irritating to the respiratory passages and can cause the following symptoms: headache, dizziness, nausea, vomiting, and loss of coordination. Prolonged or repeated skin contact may cause irritation of the hair follicles and block the sebaceous glands. This produces a rash of acne pimples and spots, usually on the arms and legs. (Good personal hygiene will prevent this).

Chemical pneumonitis may result when ingestion occurs and oil is aspirated in the lungs.

FIRST AID:

Eye Contact: Flush thoroughly with running water for 15 min. including under eyelids.

Skin Contact: Remove contaminated clothing. Wipe excess oil off with a dry cloth. Wash affected area well with soap and water.

Inhalation: Remove to fresh air. Restore and/or support breathing as required.

Ingestion: Do not induce vomiting.

Seek medical assistance for further treatment, observation and support.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of leaks or spills. Remove sources of heat or ignition.

Provide adequate ventilation. Clean-up personnel to use protection against liquid contact and vapor or mist inhalation. Contain spill by diking. Small spills can be contained by using absorbants, such as rags, straw, polyurethane foam, activated carbon, and sand. Clean up spills promptly to reduce fire or vapor hazards.

DISPOSAL: May be disposed of by a licensed waste disposal company, or by controlled incineration or burial in an approved landfill.

Follow Federal, State and Local regulations. Report large oil spills.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide adequate ventilation where operating conditions (heating or spraying) may create excessive vapors or mists. Use explosion-proof equipment. Provide approved respiratory apparatus for nonroutine or emergency use. Use an approved filter & vapor respirator when vapor/mist concentrations are high. Wear protective rubber gloves and chemical safety glasses where contact with liquid or high mist conc. may occur. Additional suitable protective clothing may be required depending on working conditions. An eyewash fountain and washing facilities to be readily available near handling and use areas.

Launder soiled or contaminated clothing before reuse (at least weekly laundering of work clothes is recommended).

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from sources of open flame, heat, strong oxidizing agents, and ignition. Protect containers from physical damage. Use non sparking tools and explosion-proof electrical equipment. Prevent static electric sparks.

Avoid prolonged skin contact and breathing of vapors or mists.

No smoking in areas of use. Follow good hygienic practice in the use of this material. Do not wear oil contaminated clothing. Do not put oily rags into pockets. Wash exposed skin areas several times a day with soap and warm water when working with this material.

DOT Classification: COMBUSTIBLE LIQUID

DATA SOURCE(S) CODE: 1,6,7,12

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APPROVALS: MIS CRD J. M. Nielsen

Industrial Hygiene and Safety DJW 10-12-81

MEDICAL REVIEW: 21 October 1981

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GENIUM PUBLISHING CORP.

No. 473

FUEL OIL #5

Date October 1981

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: Fuel Oil #5
DESCRIPTION: Medium viscosity residual fuel oil; "light" and "heavy" types
OTHER DESIGNATIONS: GE Material D27B1, ASTM D396, Bunker Fuel, Navy special, CAS # 068 476 335
MANUFACTURER: Available from many suppliers, including: AMOCO Oil Company
200 East Randolph Drive
Chicago, IL 60601
Phone: (312) 856-5371

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
FUEL OIL #5 Complex mixtures of paraffinic, olefinic, naphthenic and aromatic hydrocarbons.	ca 100	8-hr TWA 5 mg/m^3 (mineral oil mist)*
Benzene**	<100	

*Current OSHA standard and ACGIH (1981) TLV. Current OSHA 8-hr TWA standard for petroleum distillates (naphtha) is 500 ppm or 2,000 mg/m^3.
**A low benzene level reduces carcinogenic risk. Fuel oils can be exempt under the benzene standard (29 CFR 1910.1028).

SECTION III. PHYSICAL DATA

Initial boiling point, 1 atm, deg C	>220	Specific gravity (H_2O=1)	0.93-1.05
Vapor pressure, 20 C, mmHg	<0.1	Evaporation rate (n-BuAc=1)	<0.01
Vapor density (Air=1)	>6	Viscosity @ 40 C, cSt:	
Solubility in water	negligible	Light type	24-58
		Heavy type	58-168

Appearance and Odor: Homogeneous, black oily liquid with a strong asphalt-like odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air % by volume	LOWER	UPPER
>140 F* (PM)	--		1.0	5

Extinguishing Media: Dry chemical, carbon dioxide, alcohol foam, water spray. Use water spray to cool fire exposed containers. This combustible liquid needs a smothering technique for extinguishment. Do not use a forced water stream directly on oil fire as this can scatter burning oil. Material is an OSHA Class IIIA combustible liquid.
Firefighters should wear self-contained breathing apparatus and full protective clothing.
*A flash point >130 F is allowed under ASTM D396.

SECTION V. REACTIVITY DATA

This is a stable material in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.
Incompatible with strong oxidizing agents; heating increases its fire hazard.
Thermal-oxidative degradation may produce various low molecular weight hydrocarbons and hydrocarbon derivatives, carbon monoxide, and oxides of sulfur.

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No. 473

SECTION VI. HEALTH HAZARD INFORMATION

TLV 5 mg/m^3 (oil mist) (See Sect II)

When heated or misted inhalation of this material can be irritating to the respiratory passages. Prolonged or repeated skin contact may cause irritation and block the sebaceous glands, with a rash of acne-like pimples and spots, usually on the arms and legs. (Good personal hygiene will prevent this condition).

Chemical pneumonitis may result when ingestion occurs and is aspirated into the lungs.

FIRST AID:

Eye Contact: Flush thoroughly with running water for 15 min. including under eyelids.

Skin Contact: Remove contaminated clothing, wipe off excess oil. Wash affected area with soap and water.

Inhalation: Remove to fresh air, restore and/or support breathing as required.

Ingestion: Do not induce vomiting.

Seek medical assistance for further treatment, observation and support.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of leaks or spills. Remove sources of heat or ignition.

Provide adequate ventilation. Clean-up personnel to use protection against liquid contact and vapor or mist inhalation. Contain spill and collect oil. Small spills and residues can be picked up with absorbants. Clean up spills promptly. Prevent from entering sewers or surface waters.

DISPOSAL: Waste may be disposed of through a licensed waste disposal company or by controlled incineration. Report large oil spills.

Follow Federal, State, and Local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation if heated or misted. Provide approved respiratory apparatus for nonroutine or emergency requirements, but it is not usually needed.

Wear protective rubber gloves and chemical safety glasses where contact with liquid is possible. An apron or additional suitable protective clothing may be desirable depending on working conditions.

Launder work clothes weekly, or if contaminated, before reuse.

An eyewash fountain and washing facilities to be readily accessible in areas of use and handling.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a well-ventilated area away from sources of strong oxidizing agents, heat and ignition. Protect containers from physical damage. Storage and handling conditions to be suitable for OSHA Class IIIA combustible liquid.

Prevent repeated or prolonged skin contact, and avoid inhalation if vaporized or misted.

Follow good hygiene practices in the use of this material. Do not wear soiled or contaminated clothing. Wash exposed skin frequently during work day.

DOT Classification: COMBUSTIBLE LIQUID.

DOT ID No. UN1993

DATA SOURCE(S) CODE: 1,6,7,12

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APPROVALS: MIS J. M. Nelson

CRD

Industrial Hygiene and Safety 10-29-81

MEDICAL REVIEW: 14 November 1981

MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

NO. 474

FUEL OIL NO. 6

Date October 1981

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: FUEL OIL NO. 6
DESCRIPTION: A high-viscosity residual oil; Preheating required for use.
OTHER DESIGNATIONS: ASTM D396, Bunker C, GE Material D27B1D, CAS # 068 553 004
MANUFACTURER: Available from many suppliers, including:
Amerada Hess Corp.
1 Hess Plaza
Woodbridge, N.J. 07095 Tel: (201) 636-3000

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Fuel Oil No. 6 Complex mixture of paraffinic, olefinic, naphthenic, and aromatic hydrocarbons, including polycylic aromatic hydrocarbons.		8-hr TWA 5 mg/m^3 (mineral oil mist)*
Sulfur content**	<2.8	

*Current OSHA standard and ACGIH (1981) TLV
**No. 6 fuel oil with low sulfur (0.2 and 1.2%) is commercially availble.

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg C --- >260
Vapor pressure, 70F, mmHg ----- ca 0.2
Solubility in water ---------- negligible
Specific gravity (H_2O=1) (approx) -- 0.966
Viscosity at 122 F, cSt ---------- 92-638

Appearance and Odor: Black liquid to heavy paste, petroleum odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air % by volume	LOWER	UPPER
>140 F (PMCC)	765F		3.9	20.1

Extinguishing Media: Dry chemical, carbon dioxide, foam, water spray. Use a water spray to cool fire exposed containers. Use a smothering technique for extinguishing fire of this combustible liquid. Do not use a forced water stream directly on oil fire as this will only scatter the fire. Material is an OSHA Class IIIA combustible liquid. Exhibits "boil-over" characteristics.
Firefighters should wear self-contained breathing apparatus and full protective clothing.

SECTION V. REACTIVITY DATA

This is a stable material in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.
Incompatible with strong oxidizing agents; heating greatly increases fire hazard.
Thermal-oxidative degradation may yield various hydrocarbons and hydrocarbon derivatives (partial oxidation products), CO_2 and CO and SO_2.

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No. 474

SECTION VI. HEALTH HAZARD INFORMATION

TLV 5 mg/m^3 (oil) (mist) (See Sect II)

Inhalation of excessive concentrations of fume or mist can be irritating to the respiratory passages and can cause the following symptoms: headache, dizziness, nausea, vomiting, and loss of coordination. Prolonged or repeated skin contact may cause irritation of the hair follicles and block the sebaceous glands. This produces a rash of acne pimples and spots, usually on the arms and legs. (Good personal hygiene will prevent this). Heavy repeated application of #6 oil to rabbit skin gave severe skin changes & systemic toxicity: EPA(TOSCA)Document 8EHQ-0181-0377, Dec '80.

FIRST AID:

Eye Contact: Flush thoroughly with running water for 15 min. including under eyelids.

Skin Contact: Remove contaminated clothing. Wipe excess oil off with a dry cloth. Wash affected area well with waterless cleanser. Then wash residue with soap and water. Caution: Hot liquid may cause minor burns; apply ice compresses.

Inhalation: Remove to fresh air. Restore and/or support breathing as required.

Ingestion: Do not induce vomiting. Contact physician.

Seek medical assistance for further treatment, observation and support.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of leaks or spills. Remove sources of heat or ignition. Provide adequate ventilation. Clean-up personnel to use protection against liquid contact and vapor or mist inhalation. Contain spill by diking. Small spills can be contained by using absorbants, such as rags, straw, polyurethane foam, activated carbon, and sand. Clean up spills promptly to reduce fire or vapor hazards.

DISPOSAL: May be disposed of by a licensed waste disposal company, or by controlled incineration or burial in an approved landfill.

Follow Federal, State and Local regulations. Report large oil spills.

NOTE: Establish a plan to prevent/control spills where material used or handled.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide adequate ventilation where operating conditions (heating or spraying) may create excessive fumes or mists. Use explosion-proof equipment. Provide approved respiratory apparatus for nonroutine or emergency use. Use an approved filter & vapor respirator when fume/mist concentrations are high. Wear protective neoprene rubber gloves and chemical safety glasses where contact with liquid or high mist conc. may occur. Additional suitable protective clothing may be required depending on working conditions. An eyewash fountain and washing facilities to be readily available near handling and use areas.

Launder soiled or contaminated clothing before reuse. (At least weekly laundering of work clothes is recommended). Minimize skin contact with No. 6 fuel oil.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from sources of open flame, heat, strong oxidizing agents, and ignition. Protect containers from physical damage. Use non sparking tools and explosion-proof electrical equipment. Prevent static electric sparks.

Avoid prolonged skin contact and breathing of vapors or mists.

No smoking in areas of use. Follow good hygienic practice in the use of this material. Do not wear oil contaminated clothing. Do not put oily rags into pockets. Wash exposed skin areas several times a day with soap and warm water when working with this material. DOT Classification: COMBUSTIBLE LIQUID DOT I.D. No. UN1993

DATA SOURCE(S) CODE: 1,6,7,12

APPROVALS: MIS CRD J. M. [illegible]

Industrial Hygiene and Safety [illegible] 10-29-81

MEDICAL REVIEW: 14 November 1981

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MSDS # 572

DICHLOROTETRAFLUOROETHANE

Issued:
Revised: December 1985

om Genium's MSDS Collection, to be used as a reference.

SECTION 1. MATERIAL IDENTIFICATION

18

MATERIAL NAME: DICHLOROTETRAFLUOROETHANE
OTHER DESIGNATIONS: $C_2CL_2F_4$; Refrigerant 114; FREON (duPont); GENETRON 114 (Allied Corp.); UCON (Union Carbide); Cryofluoran ; other Trade Name products available as indicated. CAS #0076 14 2
MANUFACTURER: E.I. duPont de Nemours
FREON Products Division
Wilmington, DE 19898
Tel.: (302) 774-2421

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Dichlorotetrafluorethane	ca 100	8-Hr. TWA 1000 ppm or 7600 mg/m^3*
* Current OSHA PEL and ACGIH (1985-86) TLV.		Rat, Inhalation: LC50 720,000 ppm/30 min.
DESCRIPTION: Gaseous perfluorinated ethane. Liquid when pressurized and/or kept cold.		Rat, Oral: LD50 >2250mg/kg
Not classified as carcinogenic by IARC, NTP, or OSHA.		

SECTION 3. PHYSICAL DATA

Boiling point @ 1 atm ..... 3.7°C, 38.7°F
Vapor pressure, 77°F, mmHg ... 1621
Vapor density (Air = 1) 5.9
Solubility in water ..... Insoluble

Density 77°F (g/cc) 1.456
Freezing point ..... -94.0°C
Volatile by volume, % 100
Critical pressure, atm ... 32.3
Molecular weight 170.9

APPEARANCE & ODOR: Colorless liquid, slight ethereal odor. (Gaseous at room conditions.)

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
Nonflammable	NA	Nonflammable	NA	NA

EXTINGUISHING MEDIA: Use that which is appropriate for surrounding fire.
This is a nonflammable material. Vapors are five times heavier than air. High concentrations may tend to accumulate in low areas.
Firefighters should wear self-contained breathing apparatus and full protective clothing against suffocating vapors and toxic and corrosive decomposition products.

SECTION 5. REACTIVITY DATA

This is a very stable material in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.
Prevent exposure to alkali or alkaline earth metals such as sodium, potassium, etc. Aluminum may also be reactive, especially in the finely ground or powdered state or at high temperatures.
Thermal-oxidative degradation can produce toxic and corrosive materials such as halogens and carbonyl halides.

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SECTION 6. HEALTH HAZARD INFORMATION

TLV See Section 2

High concentrations of vapors may cause asphyxiation due to dilution of available oxygen in air below levels necessary to sustain life. Symptoms can include light-headedness, giddiness, disorientation, shortness of breath and possible cardiac arrhythmias. Vapors may have little or no effect on the eyes, but liquid contact can cause serious eye damage from freezing. Skin contact with liquid can cause frostbite (freezes tissue on contact as liquid rapidly vaporizes).

FIRST AID: Flush thoroughly with running water for 15 minutes, including under eyelids.

SKIN CONTACT: Remove contaminated clothing. Flush affected area with water. Treat for frostbite if symptoms are present.

INHALATION: Remove to fresh air. Restore and/or support breathing as needed.

INGESTION: Seek physician (materials not expected to be a hazard).

Seek prompt medical assistance for further treatment, observation, and support. DO NOT USE epinephrine or similar drugs for they can produce cardiac arrhythmias, including ventricular fibrillation.

SECTION 7. SPILL, LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of leaks or spills. Remove sources of heat or ignition. Provide adequate ventilation. Cleanup personnel to use self-contained respirator and protective clothing. Stop leakage if possible; remove leaking containers to safe area for discharge and allow to evaporate in an area remote from buildings and people or transfer and recover material if possible.

DISPOSAL: Material can be reclaimed by vaporization and condensation. Avoid discharge to environment when possible. Return scrap to supplier, if possible.

Follow Federal, State and Local regulations.

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide adequate mechanical ventilation to keep vapors below the TLV level. Supply ventilation for sumps and low-lying areas where the dense vapors of this material might collect. Local exhaust should be used where large amounts are released. Use approved self-contained or air-supplied breathing apparatus and life-lines for emergencies. Use chemical safety goggles and/or face shield to prevent liquid contact with eyes where splashing is possible. Wear neoprene or lined butyl gloves and clothing appropriate for the work situation to minimize skin contact with liquid.

Eyewash stations and safety showers should be readily accessible near use areas.

Follow general safety requirements for compressed gases.

Contact lenses may pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

Vaporization of excessive amounts can displace oxygen necessary for breathing and may cause suffocation when used in confined spaces or areas without ventilation.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed steel pressurized containers in a cool (below 125°F), dry, well-ventilated area away from combustibles and heat sources. Protect containers from physical damage. High-density vapors may displace air and present an asphyxiation hazard. Concentrations well below the TLV level can damage space heaters when drawn into the combustion chamber. Heater should have independent air supply.

Prevent skin and eye contact with liquid. Avoid inhalation of vapors. Thermal decomposition products can form halogen acids that have very sharp stringent effects and can be detected by odor. Such odor is a hazard warning; when detected, immediately evacuate the area and ventilate.

DOT CLASSIFICATION: Nonflammable Gas. UN 1958

DATA SOURCE(S) CODE (See Glossary) 1, 2, 4, 5, 7, 12, 14, 38, 47. CK

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APPROVALS JO Accrocco, 3/86.

INDUST. HYGIENE/SAFETY 3-86

MEDICAL REVIEW:

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Material Safety Data Sheet

From Genium's Reference Collection
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(518) 377-8855

GENIUM PUBLISHING CORP.

No. 624

NAPHTHALENE

Issued: November 1987

SECTION 1. MATERIAL IDENTIFICATION

24

Material Name: NAPHTHALENE

Description (Origin/Uses): Used as a moth repellant and in many industrial processes.

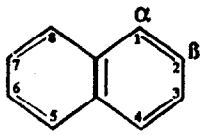
Other Designations: Naphthalin; Naphthene; Tar Camphor; $C_{10}H_8$; NIOSH *RTECS* No. QJ0525000; CAS No. 0091-20-3

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyer's Guide* (Genium ref. 73) for a list of suppliers.

HMIS			
H	2		
F	2	R	1
R	0	I	4
PPG*		S	1
*See sect. 8		K	2

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Naphthalene, CAS No. 0091-20-3	ca 100	IDLH* Level: 500 ppm **ACGIH TLVs, 1987-88** TLV-TWA: 10 ppm, 50 mg/m³ **OSHA PEL** 8-Hr TWA: 10 ppm, 50 mg/m³ **Toxicity Data**** Child, Oral, LD_{Lo}: 100 mg/kg Man, Unknown, LD_{Lo}: 74 mg/kg Rat, Oral, LD_{50}: 1250 mg/kg



*Immediately dangerous to life and health
**See NIOSH *RTECS* for additional data with references to irritative, mutagenic, reproductive, and tumorigenic effects.

SECTION 3. PHYSICAL DATA

Boiling Point: 424°F (218°C)
Vapor Density (Air = 1): 4.4
Vapor Pressure: 0.087 Torr at 77°F (25°C)
Water Solubility: Insoluble

Specific Gravity (H_2O = 1): 1.162 at 68°F (20°C)
Melting Point: 176°F (80°C)
Molecular Weight: 128 Grams/Mole
% Volatile by Volume: ca 100

Appearance and Odor: White crystalline flakes; strong coal tar odor.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
174°F (79°C) OC; 190°F (88°C) CC	979°F (526°C)	% by Volume	0.9	5.9

Extinguishing Media: Use water spray, dry chemical, or carbon dioxide to fight fires involving naphthalene. **Caution:** Foam or direct water spray applied to molten naphthalene may cause extensive foaming.

Unusual Fire or Explosion Hazards: Naphthalene is a volatile solid that gives off flammable vapor when heated (as in fire situations). This vapor is much denser than air and will collect in enclosed or low-lying areas like sumps. In these areas an explosive air-vapor mixture may form, and extra caution is required to prevent any ignition sources from starting an explosion or fire.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Naphthalene is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.

Chemical Incompatibilities: Naphthalene is incompatible with strong oxidizing agents, chromic anhydride, and mixtures of aluminum trichloride and benzoyl chloride.

Conditions to Avoid: Ignition sources like open flame, unprotected heaters, excessive heat, lighted tobacco products, and electric sparks must not occur in work areas where naphthalene vapor may become concentrated.

Hazardous Products of Decomposition: Toxic gases like carbon monoxide are produced during fire conditions. Irritating, flammable vapor forms below the melting point because even solid naphthalene has a significant vapor pressure.

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SECTION 6. HEALTH HAZARD INFORMATION

Naphthalene is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks: Renal shutdown (kidney failure), hemolytic effects (breakdown of red blood cells), hematuria (blood in the urine), oliguria (low volume of urine), jaundice, eye damage, and depression of the central nervous system (CNS) are the primary health concerns associated with exposure to naphthalene. The ACGIH TLVs in section 2 are set to prevent eye damage. These recommended exposure limits may not be low enough to prevent blood changes in genetically hypersensitive individuals.
Medical Conditions Aggravated by Long-Term Exposure: Diseases of the blood, liver, and kidneys. Administer medical exams emphasizing these organs. **Target Organs:** Eyes, skin, kidneys, liver, blood (red blood cell effects), and CNS.
Primary Entry: Inhalation, skin contact. **Acute Effects:** Inhalation of naphthalene vapor causes excitement, confusion, headache, nausea, and loss of appetite. **Chronic Effects:** Increased incidence of cataracts.
FIRST AID
Eye Contact: Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes to remove particles.
Skin Contact: Immediately wash the affected area with soap and water.
Inhalation: Remove victim to fresh air; restore and/or support his breathing as needed.
Ingestion: Call a poison control center. Never give anything by mouth to someone who is unconscious or convulsing. Administer a gastric lavage followed by saline catharsis. Monitor blood and electrolytic balance. Other sources recommend giving the victim several glasses of water to drink.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, provide ventilation, and eliminate all ignition sources immediately. Cleanup personnel need protection against contact and inhalation of vapor (see sect. 8). Contain large spills and collect waste. Use nonsparking tools to place naphthalene into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways.
Waste Disposal: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations
Air Contaminant (29 CFR 1910.1000, Subpart Z)
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste, No. U165
CERCLA Hazardous Substance, Reportable Quantity: 100 lbs (45.4 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Follow the eye- and face-protection guidelines of 29 CFR 1910.133. **Respirator:** Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* (Genium ref. 88) for the maximum-use concentrations and/or the exposure limits cited in section 2. Respirator usage must be in accordance with the OSHA regulations of 29 CFR 1910.134. IDLH or unknown concentrations require an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres.
Other Equipment: Wear impervious gloves, boots, aprons, gauntlets, etc., as required by the specific work environment to prevent skin contact. **Ventilation:** Install and operate general and local maximum explosion-proof ventilation systems of sufficient power to maintain airborne levels of naphthalene below the OSHA PEL standard cited in section 2. **Safety Stations:** Make eyewash stations, washing facilities, and safety showers available in areas of use and handling. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove and launder contaminated clothing before wearing it again; clean this material from shoes and equipment.
Comments: Practice good personal hygiene; always wash thoroughly after using this material. Keep this material off of your clothing and equipment. Avoid transferring this material from hands to mouth while eating, drinking, or smoking. Do *not* smoke, eat, or drink in any immediate work area. Avoid inhalation of vapor!

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage Segregation: Store naphthalene in a cool, dry, well-ventilated area away from chemical incompatibles (see sect. 5).
Special Handling/Storage: Protect containers from physical damage. All bulk storage facilities must be built with an explosion-proof design. All containers used in shipping/transferring operations must be electrically grounded to prevent static sparks. Use monitoring equipment to measure the extent of vapor present in any storage facility containing naphthalene because of potential fire and explosion hazards.
Comments: All operations with naphthalene must be done carefully to prevent accidental ignition of its flammable/explosive vapor. If the weather is warm, more naphthalene vapor forms and the potential for explosion increases. Do *not* smoke in any use or storage area!
Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Naphthalene
DOT Hazard Class: ORM-A
IMO Class: 4.1
DOT ID No. UN1334
IMO Label: Flammable Solid
DOT Label: None

References: 1, 2, 12, 73, 84-94, 103, PH

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Approvals
Indust. Hygiene/Safety
Medical Review

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MATERIAL SAFETY DATA SHEET

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(518) 377-8855

GENIUM PUBLISHING CORP.

No. 1200

AROCLOR 1254

Date May 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: AROCLOR 1254
DESCRIPTION: Distillation cut of polychlorinated biphenyl (or diphenyl), containing 54% Cl.
OTHER DESIGNATIONS: PCB, an Askarel, PYRANOL, GE Material A13B1, CAS # 027 323 188
MANUFACTURER: Material was a product of Monsanto Co., but dropped in 1977. Except for uses specifically exempted and regulated by EPA (for example power transformers), legal manufacture, distribution in commerce, and use of PCB's in USA ended in 1979 under TSCA.

SECTION II. INGREDIENTS AND HAZARDS

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Mixture of Chlorinated Biphenyls, $C_{12}H_{10-x}Cl_x$:	ca 100	EPA exemption or authorization needed for any measurable exposure*
		Rat, Oral LD_{50} Adult 4-10 g/kg Weaning 1.2 g/kg
		Rat, Intravenous LD_{50} 358 mg/kg
		Rat, Oral, TDLo 1220 mg/kg/35 wk (neoplastic effect)

x	Approx. %
2	0.5
3	1
4	21
5	48
6	23
7	6

Includes 69 or more compounds with average of 4.98 Cl atom/molecule. Mixture may contain 0-2 ppm chlorinated dibenzofurans.

*Current ACGIH 8-hr TWA is 0.5 mg/m^3. NIOSH has proposed a 10-hr TWA of 1.0 µg/m^3. Materials with over 50 ppm PCB content are regulated for handling, storage, records, and waste disposal. EPA criterion in navigable waters is 0.001 µg/L. PCB's.

SECTION III. PHYSICAL DATA

Boiling range at 1 atm, deg C	ca 360-390	Specific gravity (65/15.5 C)	1.5
Vapor pressure at 150 C, mm Hg	<1	Pour point, deg C	10
Water solubility at 25 C, ppm	ca 0.01	Molecular weight (Av)	327
Viscosity at 100 F, cstk	ca 460	Partition Coef. (octanol/water)	>10^4

Appearance & Odor: A light yellow, viscous fluid.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
None to boiling point				

Extinguishing Media: Use media appropriate to the surrounding fire conditions. This material has very low combustibility, but it can undergo thermal-oxidative degradation in a fire situation.

Firefighters should use full protective clothing and self-contained breathing equipment when fighting fire where any PCB's are involved.

SECTION V. REACTIVITY DATA

AROCLOR 1254 and other PCB's are nearly inert materials with very high chemical stability; the higher chlorine levels usually give the greater stability. At about 300 to 600 C some PCB's can oxidize to produce chlorinated dibenzofurans which are much greater in toxicity than the PCB's. For complete incineration of PCB's a 2-second dwell time above 2000 F (1090 C) with 3% excess oxygen in the stack is suitable (see Sect. VII).

AROCLOR 1254 shows very little degradation after 3 weeks exposure to direct sunlight.

PCB's are strongly absorbed on particulates or sediments in aquatic systems (streams, lakes, ocean, etc.).

Mixed in activated sludge, biodegradation occurs slowly, but only very slowly or almost not at all with compounds above Cl_4.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV (See Sect. II)

PCBs show high levels of bioaccumulation in fatty tissue and very slow metabolism, especially for Cl_5 compounds and above. They have become widely dispersed in world-wide environment and in the food chain (much like DDT) since their introduction in 1929. Effective control of PCB discharge into the environment began after 1970.

AROCLOR 1254 has a low vapor pressure, but it can be irritating to the eyes, nose, and throat if misted or heated to produce vapors. Excessive acute and chronic exposures may cause liver damage. Chronic exposure to or ingestion of PCB's (especially when thermally oxidized) can result in chloracne after 1-6 months. There is some evidence of possible carcinogenic risk and adverse reproductive effects with this material. PCB's may appear in the breast milk of an exposed mother.

FIRST AID:

Skin Contact: Clean exposed skin with waterless cleaner, wipe with a disposable towel, then wash with soap and water. Promply remove contaminated clothing. (Control separate disposal of PCB-contaminated materials.)

Eye Contact: Flush promptly & thoroughly with lots of running water for 15 minutes.

Inhalation: Remove to fresh air. Get medical help if symptoms continue.

Ingestion: Get medical help. NIOSH has recommended that vomiting be induced.

Get medical help in all cases of severe exposure, repeated exposures, or persistent symptoms.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of all PCB spills or leaks. Promptly contain spilled material! Prevent its release into the environment! Restrict PCB spill area to trained clean-up personnel; use proper protective gear; follow an established emergency plan.

Stop leakage if possible. Pick up spill. Absorb small spills and residues using a powdered, dry clay. Place leaking containers, picked-up PCBs, and PCB-contaminated materials and refuse into approved, properly labeled, closed containers for storage under controlled, EPA regulated conditions prior to disposal. EPA allows approved storage to 1/1/84.(See Sect.IX.) Storage: 40CFR761.42; Annual report: 40CFR761.45

DISPOSAL: Destroy PCB-containing material by burning in an EPA approved facility. Liquid 50-500 ppm PCB material can be burned as above or landfilled if not ignitable. Non-flowing, PCB-contaminated debris can be disposed of in an EPA approved landfill. (See 40CFR 761; Federal Register, Vol. 44, 31551-4, 66989; Vol.45, 20473.)

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide highly effective local exhaust ventilation (trap for exhaust vapors) especially if this material is heated or misted. Unless authorized by EPA an isolated system must be used for PCBs.

For nonroutine and emergency conditions of exposure use an approved canister respirator or self-contained breathing equipment.

Prevent skin contact for those who work with PCBs. Use neoprene or polyethylene gloves and apron, safety glasses and/or face shield, and other protective clothing as determined by use conditions. An eyewash station and washing facilities should be available to the work area.

Provide for special handling and disposal of PCB-contaminated materials, including paper towels and clothing (see Sect. VII). Provide locker and shower facilities. Workers must be trained for PCB work, and they must follow good hygienic practice.

Provide pre-placement medical exams for workers with emphasis on liver function, skin condition, and reproductive history. Provide annual medical exams for exposed workers.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

PCB materials in containers and in equipment must have proper labeling including the date of storage. Short term (up to 30 days) storage of non-leaking PCBs can be done. Long term storage requires an EPA approved facility, including such criteria as roof and walls to shield from rain, impervious base and diking which will contain 25% of stored volume or twice the volume of the largest container, no drains or openings to allow flow loss, and the base must be located above the 100-year flood water elevation. Prevent physical damage to containers. Inspect storage frequently.

Prevent skin contact with PCBs, or with solid products contaminated with PCBs. Prevent inhalation of airborne PCBs. Properly contain PCBs until legally disposed of; do not allow them to escape into the environment!

PCBs, and especially used PCBs, can contain higher toxicity contaminants.

DATA SOURCE(S) CODE: 1-6,20,26,31,36

APPROVALS: MIS CRD J.M. Nielsen

Industrial Hygiene and Safety 5-29-80

MEDICAL REVIEW: June 1980

MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

No. 1257

VARSOL 1

Date May 1982

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: VARSOL 1
DESCRIPTION: Petroleum solvent or mineral spirits.
OTHER DESIGNATIONS: GE Material D5B8, ASTM D235, ASTM D484, Type 1
MANUFACTURER: Exxon Co.
P.O. Box 2180
Houston, Texas Tel: (713) 656-3424

SECTION II. INGREDIENTS AND HAZARDS

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Mixture of petroleum hydrocarbons	100	8-hr TWA 100 ppm*
Typical Composition: Vol %		
Aromatics (C_8 and higher) 18		
Olefins 1		Rat, Oral
Saturates 81		LD_{50} >5 g/kg
Sulfur content 1 ppm		
*ACGIH(1982) TLV for Stoddard Solvent. Animal studies by Exxon Corp. medical research has shown that male rats exposed to similar vapors at 100 ppm had kidney damage. Additional studies are being conducted to validate these findings and to determine if a revised TLV should be recommended.		Rabbit, Dermal LD_{50} >2 g/kg

SECTION III. PHYSICAL DATA

Boiling range, 1 atm, deg C ----	155-205	Specific gravity, 15.6/15.6C --	ca 0.79
Vapor pressure, 25C, mmHg ------	<10	Evaporation rate (nBuAc=1) ----	<0.1
Vapor density (Air=1) ----------	ca 4.8	Volatiles, % ----------	100
Solubility in water ----------	Negligible	Molecular weight (avg) --------	ca 140

Appearance & odor: Water-white liquid; mineral spirits odor (no long-lasting odor after evaporation).

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air % by Volume @ 25C	LOWER	UPPER
ca 42C (108F) TCC	254C (ASTM D2155)		0.9	6.0

Extinguishing Media: Dry chemical, carbon dioxide, foam, water spray or fog. Water spray can be used to keep fire-exposed containers cool to avoid pressure rupture.
This material is an OSHA Class II Combustible Liquid. It is a dangerous fire hazard if heated or sprayed in air.
Firefighters should wear self-contained breathing apparatus for fighting fires in enclosed areas.

SECTION V. REACTIVITY DATA

This is a stable material in closed containers at room temperature under normal storage and handling conditions. It does not polymerize.
Incompatible with strong oxidizing agents such as chlorine, conc. oxygen, calcium hypochlorite, nitric acid, etc.
Thermal-oxidative degradation may produce carbon monoxide and partially oxidized hydrocarbons.

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No. 1257

SECTION VI. HEALTH HAZARD INFORMATION

TLV 100 ppm (See Sect II)

Varsol, like all petroleum distillates, is a central nervous system depressent. Symptoms of overexposure to high vapor conc. range from headache and dizziness to possible convulsions and unconsciousness.

Eye contact with the liquid may cause conjunctivitis. Prolonged or repeated skin contact causes a defatting effect, resulting in irritation, drying, cracking and dermatitis.

FIRST AID:

Eye Contact: Flush thoroughly with running water for 15 min. including under eyelids. Get medical help if irritation persists.

Skin Contact: Remove contaminated clothing. Wash affected area with soap and water. Get medical help if large area contacted or if irritation persists.

Inhalation: Remove to fresh air. Restore and/or support breathing as required. (Administer oxygen if breathing difficult). Contact physician for further treatment, observation and support.

Ingestion: Do not induce vomiting. Contact physician immediately. Aspiration hazard. Give a few ounces of USP mineral oil to drink.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of leaks or spills. Remove sources of heat or ignition.

Provide explosion-proof ventilation. Clean-up personnel need protection against inhalation and skin contact. Contain spill and recover free liquid if possible. Use absorbent (sand, earth, sawdust, etc) to clean up residue. Do not discharge into sewers or surface waters. (Notify authorities if product enters, or may enter, sewer or waterway.)

DISPOSAL: Waste material may be burned in an approved incinerator.

Follow Federal, State, and Local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide adequate general and local exhaust ventilation to meet TLV requirements. Local exhaust hoods should have at least 60 fpm face velocity. Use explosion-proof electrical equipment and services. Have air-supplied or self-contained respiratory apparatus available for nonroutine or emergency use or when working in a confined or enclosed area. (Canister respirator may be suitable for short time usage.)

Wear impermeable gloves and additional protective clothing to prevent prolonged or repeated skin contact. Use safety goggles and/or faceshield for eye protection where splashing is possible. An eyewash station is desirable where splashing is probable. A safety shower may be desirable where large amounts are used.

Launder contaminated clothing before reuse. thoroughly dry contaminated shoes before reuse.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, well-ventilated area away from sources of heat, flame, ignition and strong oxidizing agents. Protect containers from physical damage. Keep containers closed when not in use. Use safety cans for small amounts.

Handling and storage conditions must be suitable for OSHA Class II Combustible liquid.

Bond and ground containers for transfers to avoid static sparks.

Avoid inhalation of vapors. Avoid prolonged or repeated contact with skin. Prevent eye contact with liquid. Prohibit smoking or flame in use areas. Ventilate area where used. Electrical services to meet code.

DOT Classification: COMBUSTIBLE LIQUID

DATA SOURCE(S) CODE: 1, 2, MSDS #334

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APPROVALS: MIS J. M. Nielsen
CRD

Industrial Hygiene and Safety 5-12-82

MEDICAL REVIEW: 19 May 1982

MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

No. 1258

VARSOL 18

Date May 1982

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: VARSOL 18
DESCRIPTION: Highly aliphatic petroleum solvent or mineral spirits of low photoreactivity to meet air pollution regulations.
OTHER DESIGNATIONS: GE Material D5B8A2, ASTM D235, ASTM D484, Type 1
MANUFACTURER: Exxon Co.
P.O. Box 2180
Houston, Texas Tel: (713) 656-3424

SECTION II. INGREDIENTS AND HAZARDS

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Mixture of petroleum hydrocarbons Typical Composition: Aromatics 7.7 (Vol %) Olefins 0.2 Saturates 92.1 Sulfur content 2 ppm *Exxon has recommended this 8-hr TWA and indicates that further toxicology study is being conducted. (ACGIH (1982) TLV for Stoddard Solvent is 100 ppm.) This low aromatic content material meets requirements of Southern California Air Pollution District Rule 102 (formerly Rule 66).	100	8-hr TWA 200 ppm* Rat, Oral LD_{50}>5 g/kg Rabbit, Dermal LD_{50}>2 g/kg

SECTION III. PHYSICAL DATA

Boiling range, 1 atm, deg C	155-205	Specific gravity, 15.6/15.6C	ca 0.77
Vapor pressure, 25C, mmHg	<10	Evaporation rate (n-BuAc=1)	0.1
Vapor density (Air=1)	ca 5	Volatiles, %	100
Solubility in water	Negligible	Molecular weight (avg)	ca 140

Appearance & Odor: Water-white liquid; mineral spirits odor (no long-lasting odor after evaporation).

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air % by Volume @ 25C	LOWER	UPPER
ca 43C (110F) (TCC)	254C (ASTM D2155)		0.9	6.0

Extinguishing Media: Dry chemical, carbon dioxide, foam, water spray or fog. Water spray can be used to keep fire-exposed containers cool to avoid pressure rupture.
This material is an OSHA Class II Combustible Liquid. It is a dangerous fire hazard if heated or sprayed in air.
Firefighters should wear self-contained breathing apparatus for fighting fires in enclosed areas.

SECTION V. REACTIVITY DATA

This is a stable material in closed containers at room temperature under normal storage and handling conditions. It does not polymerize.
Incompatible with strong oxidizing agents such as chlorine, conc. oxygen, calcium hypochlorite, nitric acid, etc.
Thermal-oxidative degradation may produce carbon monoxide and partially oxidized hydrocarbons.

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NO. 1258

SECTION VI. HEALTH HAZARD INFORMATION

TLV Estimate 200 ppm (See Sect II)

Varsol, like all petroleum distillates, is a central nervous system depressent. Symptoms of overexposure to high vapor conc. range from headache and dizziness to possible convulsions and unconsciousness.

Eye contact with the liquid may cause conjunctivitis. Prolonged or repeated skin contact causes a defatting effect, resulting in irritation, drying, cracking and dermatitis.

FIRST AID:

Eye Contact: Flush thoroughly with running water for 15 min. including under eyelids. Get medical help if irritation persists.

Skin Contact: Remove contaminated clothing. Wash affected area thoroughly with soap and water. Get medical help if large area contacted or if irritation persists.

Inhalation: Remove to fresh air. Restore and/or support breathing as required. (Administer oxygen if breathing difficult). Contact physician for further treatment, observation and support.

Ingestion: Do not induce vomiting; Contact physician immediately. Aspiration hazard. Give a few ounces of USP White mineral oil.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of leaks or spills. Remove sources of heat or ignition.

Provide explosion-proof ventilation. Clean-up personnel need protection against inhalation and skin contact. Contain spill and recover free liquid if possible. Use absorbent (sand, earth, sawdust, etc) to clean up small spills and residues. Do not discharge into sewers or surface waters. (Notify authorities if product enters, or may enter, sewer or waterway.)

DISPOSAL: Waste material may be burned in an approved incinerator.

Follow Federal, State, and Local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet estimated TLV requirements. Local exhaust hoods should have at least 60 fpm face velocity. Use explosion-proof electrical equipment and services. Have air-supplied or self-contained respiratory apparatus available for nonroutine or emergency use or when working in a confined or enclosed area. (Canister respirator may be suitable for short-time usage.)

Wear impermeable gloves and additional protective clothing to prevent prolonged or repeated skin contact. Use safety goggles and/or faceshield for eye protection where splashing is possible. An eyewash station is desirable where splashing is probable. A safety shower may be desirable where large amounts are used.

Launder contaminated clothing before reuse. Thoroughly dry contaminated shoes before reuse.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, well-ventilated area away from sources of heat, flame, ignition and strong oxidizing agents. Protect containers from physical damage. Keep containers closed when not in use. Use safety cans for small amounts.

Handling and storage conditions must be suitable for OSHA Class II Combustible Liquid.

Bond and ground containers for transfers to avoid static sparks.

Avoid inhalation of vapors. Avoid prolonged or repeated contact with skin. Prevent eye contact with liquid. Prohibit smoking or flame in use areas. Ventilate area where used. Electrical services to meet code.

DOT Classification: COMBUSTIBLE LIQUID

DATA SOURCE(S) CODE: 1,2, MSDS #334

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APPROVALS: MIS / CRD — J. M. Nielsen

Industrial Hygiene and Safety — 5-12-82

MEDICAL REVIEW: 19 May 1982

APPENDIX C

SAMPLE MEDICAL DATA SHEET

CONFIDENTIAL

THE FOLLOWING INFORMATION IS REQUESTED TO DETERMINE YOUR CURRENT MEDICAL STATUS

Date

1. Name (Last, First, Middle Initial)

3. Social Security Number

2. Employee Address (Number & Street) | City - State | Zip Code

4. Telephone Number

5. Sex* ☐ M ☐ F

6. Birth Date*

7. Name and Address of Person to Notify in an Emergency

8. Telephone Number

9. Personal Physician

Address

Telephone Number

11. Type of Examination
☐ Pre-Placement
☐ Periodic
☐ Other (Specify)

10. Which Division or Facility

Position

12. I.D. or Clock No.

13. Work Location

14. Please Check if You Have Been Immunized For:

☐ Tetanus	☐ Smallpox	☐ Polio	☐ Others
☐ Don't Know	☐ Don't Know	☐ Don't Know	☐ Don't Know
LAST DATE	LAST DATE	LAST DATE	LAST DATE

15. Are You:
☐ Right Handed
☐ Left Handed
☐ Ambidextrous

16. Family History*

RELATION	AGE	STATE OF HEALTH	IF DEAD, CAUSE AND AGE
Father			
Mother			
Spouse			
Grandparents			
Brothers and Sisters			
Children			

CHECK EACH BOX (If answer is yes, state blood relationship).

	YES	NO	RELATION
Cancer			
Diabetes			
Stomach Trouble			
Kidney Trouble			
Heart Trouble			
Tuberculosis			
Mental Disorder			
Convulsions			
Arthritis			
Allergies			
Other			

17. Personal History*

DO YOU HAVE, OR HAVE YOU EVER HAD ANY OF THE FOLLOWING: (Check Each Box)

	YES	NO		YES	NO		YES	NO
nemia			Female Disorders			Malaria		
ithma			Foot Trouble			Nervous Breakdown		
Cancer, Cyst, Tumor or Growth			Frequent Indigestion or Heartburn			Nervous Trouble of Any Sort		
Chest Pain or Shortness of Breath			Frequent or Painful Urination			Numbness, Weakness		
hills, Fever, Night Sweats			Frequent Trouble Sleeping			Palpitation or Pounding Heart		
Chronic Cough or Colds			Gall Bladder Trouble			Prostate Trouble		
Convulsions, Fits,			Goiter or Thyroid Problem			Reaction from Medicines		
or Falling Sickness			Hayfever or Allergies			Recent Gain or Loss of Weight		
oughing Up, Spitting, or			Headaches, Frequent or Severe			Rheumatism or Arthritis		
Vomiting Blood			Heart Trouble			Scarlet Fever or Rheumatic Fever		
epression or Excessive Worry			Hemorrhoids or Rectal Trouble			Skin Rash or Hives		
iabetes, or Sugar in Urine			Hernia or Rupture			Stomach Trouble, Ulcers		
Dizziness			High Blood Pressure			Swelling of Ankles or Feet		
Ear, Nose, or Throat Trouble			Jaundice or Hepatitis			Swollen or Painful Joints		
Epilepsy			Kidney Trouble or Blood in Urine			Tuberculosis or Pleurisy		
Eye Trouble			Liver Trouble			Varicose Veins		
Fainting			"Locked" Knee or "Trick Joint"			Veneral Disease		
atigue, Chronic or Frequent			Loss of Appetite, Chronic			Other		

18. Injuries: Please Check Any Injuries You Have Had

- ☐ Fractures/Broken Bones
- ☐ Severe Cuts
- ☐ Loss of Consciousness
- ☐ Back Injury
- ☐ Severe Burns
- ☐ Dislocations
- ☐ Low Back Pain
- ☐ Loss of Arm, Leg, Finger, Toe
- ☐ Other Injury
- ☐ None

19. Check Yes or No. If Yes, Give Details in Blank Area.

	YES	NO	
a. Any Time Loss From Work Past Two Years Due to Illness.			
b. Any Brace or Support Worn			
c. Discharged or Disqualified From Armed Services for Any Reason.			
d. Military Service - Dates and Locations.			
e. Applied for, or Received Workmen's Compensation.			
f. Been Exposed to Work With Dusts, Radiation, Excessive Noise, Chemicals.			
g. Have You Been Unable to Hold a Job Because of:			
1. Sensitivity to Chemicals, Dust, Sunlight, etc.			
2. Inability to Perform Certain Motions.			
3. Inability to Assume Certain Positions.			
4. Other Medical Reasons.			
h. Been a Patient in a Hospital or Sanitarium.			
i. Had Surgery Recommended or Performed Date and Type.			
j. Are You Taking Medicines Now.			
k. Have You Been Turned Down on a Physical Examination or Been Informed of Any Abnormal Findings From a Physical Examination.			
l. Do You Smoke - If Yes, Quantity Per Day.			
m. Do You Use Alcoholic Beverages - If Yes, Quantity Per Day.			
n. Have You Lived or Travelled Outside the Continental U.S.A.			
o. Allergies.			

APPENDIX D

ACCIDENT REPORT FORM

ACCIDENT REPORT Report No. _____

SITE: _____ PROJECT NO.: _____

Location: _____

Date of Report: _____ Preparers Name: _____

Name and Address of Injured: _____ SSN: _____ Age: _____

_____ Sex: _____

Years of Service: ___ Time on Present Job: ___ Title/Classification: _

Division/Department: _____ Date of Accident: _____ Time: _____

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: _____

Estimated Number of Days Away from Job: _____

Nature of Injury or Illness: _____

CLASSIFICATION OF INJURY:

___ Fractures
___ Dislocations
___ Sprains
___ Abrasions
___ Lacerations
___ Punctures
___ Bites

___ Heat Burns
___ Chemical Burns
___ Radiation Burns
___ Bruises
___ Blisters
___ Toxic Respiratory Exposure
___ Toxic Ingestion

___ Cold Exposure
___ Frostbite
___ Heat Stroke
___ Heat Exhaustion
___ Concussion
___ Faint/Dizziness
___ Toxic Respiratory Allergy
___ Dermal Allergy

Part of Body Affected: _____

Degree of Disability: _____

Date Medial Care was Received: _____

Where Medical Care was Received: _____

Address (if off-site): _____

ACCIDENT LOCATION: _____

Was weather a factor: _____

Unsafe act by injured and/or others contributing to the accident (Be specific, must be answered):

_____

_____

_____

Personal factors (Improper attitude, lack of knowledge of skill, slow reaction, fatigue):

_____

_____

_____

Level of personal protection equipment required in Site Safety Plan: _____

_____

Modifications: _____

Was injured using required equipment: _____

If not, how did actual equipment use differ from plan: _____

_____

Detailed narrative description (How did accident occur, why; objects, equipment, tools used, circumstance assigned duties) (Be specific):

_____

_____

_____

(Use back of sheet, as required)

Witnesses to accident: _____

_____

Signature of Preparer _____

Signature of Site Leader _____

APPENDIX E

OSHA FORM 200

Bureau of Labor Statistics
Log and Summary of Occupational Injuries and Illnesses

U.S. Department of Labor

For Calendar Year 19 _____ Page ____ of ____

Form Approved
O.M.B. No. 1220-0029

NOTE: This form is required by Public Law 91-596 and must be kept in the establishment for 5 years. Failure to maintain and post can result in the issuance of citations and assessment of penalties. *(See posting requirements on the other side of form.)*

RECORDABLE CASES: You are required to record information about every occupational death; every nonfatal occupational illness; and those nonfatal occupational injuries which involve one or more of the following: loss of consciousness, restriction of work or motion, transfer to another job, or medical treatment (other than first aid). *(See definitions on the other side of form.)*

Company Name

Establishment Name

Establishment Address

Case or File Number	Date of Injury or Onset of Illness	Employee's Name	Occupation	Department	Description of Injury or Illness	Extent of and Outcome of INJURY: Fatalities — Injury Related	Nonfatal Injuries — Injuries With Lost Workdays				Nonfatal Injuries — Injuries Without Lost Workdays	Type, Extent of, and Outcome of ILLNESS: Type of Illness — CHECK Only One Column for Each Illness (See other side of form for terminations or permanent transfers.)							Fatalities — Illness Related	Nonfatal Illnesses — Illnesses With Lost Workdays				Illnesses Without Lost Workdays
Enter a nonduplicating number which will facilitate comparisons with supplementary records.	Enter Mo./day.	Enter first name or initial, middle initial, last name.	Enter regular job title, not activity employee was performing when injured or at onset of illness. In the absence of a formal title, enter a brief description of the employee's duties.	Enter department in which the employee is regularly employed or a description of normal workplace to which employee is assigned, even though temporarily working in another department at the time of injury or illness.	Enter a brief description of the injury or illness and indicate the part or parts of body affected. Typical entries for this column might be: Amputation of 1st joint right forefinger; Strain of lower back; Contact dermatitis on both hands; Electrocution—body.	Enter DATE of death. Mo./day/yr.	Enter a CHECK if injury involves days away from work, or days of restricted work activity, or both.	Enter a CHECK if injury involves days away from work.	Enter number of DAYS away from work.	Enter number of DAYS of restricted work activity.	Enter a CHECK if no entry was made in columns 1 or 2 but the injury is recordable as defined above.	Occupational skin diseases or disorders	Dust diseases of the lungs	Respiratory conditions due to toxic agents	Poisoning (systemic effects of toxic materials)	Disorders due to physical agents	Disorders associated with repeated trauma	All other occupational illnesses	Enter DATE of death. Mo./day/yr.	Enter a CHECK if illness involves days away from work, or days of restricted work activity, or both.	Enter a CHECK if illness involves days away from work.	Enter number of DAYS away from work.	Enter number of DAYS of restricted work activity.	Enter a CHECK if no entry was made in columns 8 or 9.
(A)	(B)	(C)	(D)	(E)	(F)	(1)	(2)	(3)	(4)	(5)	(6)	(7) (a)	(b)	(c)	(d)	(e)	(f)	(g)	(8)	(9)	(10)	(11)	(12)	(13)
					TOTAL ▶																			
					TOTALS (subtotals on each side of form) ▶																			

INJURIES

ILLNESSES

OSHA No. 200

FOLD

Certification of Annual Summary Totals By _____ Title _____ Date _____

OSHA No. 200

POST ONLY THIS PORTION OF THE LAST PAGE NO LATER THAN FEBRUARY 1.

APPENDIX F

EMPLOYER'S FIRST REPORT OF INJURY FORM

1. INSURER FILE NUMBER/LARS Loc. Code

2. EMPLOYER FILE NUMBER:

3. EMPLOYER'S CONNECTICUT REGISTRATION NUMBER (CRN):

WORKERS' COMPENSATION COMMISSION OF CONNECTICUT

EMPLOYER'S FIRST REPORT OF OCCUPATIONAL INJURY OR DISEASE

(Please type or print in ink)

4. WCC FILE NUMBER

5. REASON FOR REPORT CHECK ALL THAT APPLY
- LOST TIME — ONE OR MORE DAYS ☐
- MEDICAL/HEALTH CARE ☐
- OCCUPATIONAL DISEASE (Note item 41 below) ☐
- CORRECT PRIOR REPORT ☐

EMPLOYER INFORMATION

6. EMPLOYER NAME:

7. EMPLOYER MAILING ADDRESS AND PHONE, Including Town

8. LOCATION IF DIFFERENT FROM MAILING ADDRESS:

9. NATURE OF BUSINESS:

10. NAME OF WC INSURER:

11. POLICY NUMBER: POLICY PERIOD

EMPLOYEE INFORMATION

12. LAST NAME: FIRST NAME: M. I.

13. SOCIAL SECURITY NUMBER:

14. ADDRESS — NUMBER AND STREET:

15. CITY: STATE: ZIP:

16. HOME PHONE:

17. DATE OF BIRTH:

18. AGE:

19. SEX: MALE ☐ FEMALE ☐

20. OCCUPATION:

21. DEPARTMENT:

22. DATE OF HIRE:

23. DATE CURRENT DUTIES BEGAN:

24. WEEKLY WAGE AT TIME OF INJURY:

INJURY OR EXPOSURE INFORMATION

25. DATE AND TIME OF INJURY: : AM ☐ PM ☐

26. DID INJURY OR EXPOSURE OCCUR ON EMPLOYER'S PREMISES SHOWN ABOVE? YES ☐ NO ☐

27. IF NO, PLACE WHERE INJURY OR EXPOSURE OCCURRED, INCLUDING TOWN

IBE THE EVENTS WHICH RESULTED IN THE INJURY OR DISEASE. (GIVE FULL DETAILS ON ALL FACTORS THAT LED OR CONTRIBUTED E INJURY OR THE ONSET OF DISEASE.)

N

P

S

T

A

29. NAME THE OBJECT, SUBSTANCE, OR EXPOSURE WHICH DIRECTLY BROUGHT ABOUT THE INJURY OR DISEASE.

30. DESCRIBE THE INJURY OR DISEASE AND INDICATE PART OF BODY AFFECTED.

31. PHYSICIAN (NAME AND ADDRESS):

32.
- ☐ FIRST AID
- ☐ HOSPITAL
- ☐ EMERGENCY ROOM
- ☐ OUT-PATIENT

33. HOSPITAL (NAME AND ADDRESS):

34. DATE EMPLOYER NOTIFIED:

35. TIME EMPLOYEE'S WORKDAY BEGAN: AM ☐ PM ☐

36. DID EMPLOYEE LOSE ONE OR MORE DAYS WORK? YES ☐ NO ☐ IF NO, SKIP BOXES 38, 39, 40, AND 41.

37. EXTENT OF ACCIDENT/HEALTH AND LIFE INSURANCE COVERAGE FOR EMPLOYEE:

38. DATE INCAPACITY BEGAN:

39. HAS EMPLOYEE RETURNED TO WORK? YES ☐ NO ☐ IF YES, GIVE DATE:

40. DID EMPLOYEE DIE? YES ☐ NO ☐ IF YES, GIVE DATE:

41. FOR OCCUPATIONAL DISEASE DATE OF LAST EXPOSURE: DATE OF DIAGNOSIS AS OCCUPATIONALLY RELATED:

PREPARER INFORMATION

42. PREPARER'S NAME AND TITLE (TYPE OR PRINT):

SIGNATURE (FORM MUST BE SIGNED)

DATE:

SEE REVERSE SIDE FOR WAGE STATEMENT

APPENDIX G

RECORD OF SAFETY MEETINGS

SAFETY MEETING RECORD

Safety Meeting Date/Time: _____

Given By: _____

Topics
Discussed: _____

_____

_____

Present At Safety Meeting (signature):

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____

FINAL

QUALITY ASSURANCE/QUALITY CONTROL AND DATA MANAGEMENT PLAN

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

PREPARED FOR:

NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
PHILADELPHIA, PENNSYLVANIA

APRIL 1989

ATLANTIC PROJECT NO. 1256-03-01
NAVY CONTRACT NO. N62472-88-C-1294

ATLANTIC
ENVIRONMENTAL SERVICES, INC. 188 NORWICH AVENUE COLCHESTER, CONNECTICUT 06415 (203) 537-0751

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1.0 PROJECT DESCRIPTION

1.1 Introduction

This Quality Assurance/Quality Control Plan (QA/QC) has been developed for use in conjunction with the Field Sampling Plan for the Naval Submarine Base (Subase) in Groton, Connecticut. This QA/QC Plan was developed specifically for activities planned for the IR Study at the Subase and is based on guidance provided in "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program", NEESA 20.2-047B.

The field sampling plan describes the recommended field investigation program which will be performed by Atlantic Environmental Services, Inc. (Atlantic) as part of the Naval Installation Restoration (IR) Program (formerly NACIP). The program consists of two levels of investigation and evaluation. The Step I Site Inspection phase is applicable to seven of the eleven identified sites. The objectives of the site inspection (Step I) are to determine the presence or absence, as well as the order of magnitude, of specific toxic or hazardous contaminants identified or other contaminants which may be present in concentrations considered to be hazardous. Step I includes an initial field sampling program to identify if contamination is present onsite and warrants a Step II remedial investigation. The Step I sites to be investigated include:

1. CBC Drum Area (Site No. 1)
2. Rubble Fill at Bunker A-86 (Site No. 4)
3. Torpedo Shops (Site No. 7)
4. Goss Cove Landfill (Site No. 8)
5. Over Bank Disposal Area Northeast (OBDANE) (Site No. 14)
6. Spent Acid Storage and Disposal Area (Site No. 15)
7. Former Gasoline Station (Site No. 18)

The Step II Remedial Investigation/Feasibility Study (RI/FS) is applicable to the remaining four sites, where onsite contamination was identified by earlier investigations. It involves comprehensive onsite investigations in order to determine the extent of contamination, assess health and environmental risks and evaluate remediation alternatives. The Step II sites to be investigated include:

1. Area A Landfill (Site No. 2)
2. Over Bank Disposal Area (Site No. 3)
3. DPDO Area (Site No. 6)
4. Lower Subase

1.2 Data Quality Objective (DQO)

The program to be implemented at the Subase will be performed under a Level C quality control, which the EPA stipulates, is required for populated areas, not on the NPL (National Priorities List) and not likely to be undergoing litigation. The Level C QC includes review and approval of the laboratory QA and the field sampling plan. The laboratory must successfully analyze a performance sample, undergo an audit, correct deficiencies found during the audit, and provide monthly progress reports on QA. The laboratory that performs Level C QC must have passed the performance sample furnished by the Superfund CLP in the past year. The laboratory does not need to be receiving CLP bid lots of samples.

Level C allows the use of non-CLP methods but requires that the methods be accepted EPA methods which listed in Tables 5-5 and 5-6. All methods used must be EPA methods or be equivalent to EPA methods. Audits will be administered and evaluated by NCR. The Navy audit and performance samples are required in addition to any specified by the EPA Superfund Program.

The purpose of this document is to specify the requirements for the control of the accuracy, precision, and completeness of the samples, and data from the point of collection through reporting. The QA/QC Plan outlines the organization, objectives, and all QA/QC activities which will ensure achievement of desired data quality goals.

1.3 Site Description and History

The Subase was established as an official Navy yard in July 1886. The site initially moored small craft and obsolete warships and was used as a coaling station for the Atlantic Fleet. The property was officially established as a permanent submarine base in 1916. The overall base facilities were expanded and a Submarine School training facility was established in 1917, and the Submarine Medical Center was established in 1918. During World Wars I and II, the Subase expanded greatly in size and in the number of buildings to support the Submarine fleet.

The Subase currently provides a base command for naval submarine fleet activities in the Atlantic Ocean. Additionally, the Subase consists of naval housing, submarine training facilities, military offices, medical facilities, and facilities designed for the maintenance, repair, and overhaul of submarines.

1.4 Previous Data

Under the IR program (formerly NACIP), an Initial Assessment Study (IAS) for the Subase sites was completed in 1982. The IAS identified sites where contamination from past waste disposal or handling practices may pose health or environmental risks. The IAS recommended further investigation of three sites at the Subase. The Verification Step of a Confirmation Study was performed from 1985-1988 on the three sites. Additionally, an investigation of petroleum contamination at the Lower Base was performed in 1985.

1.5 Project Scope

The objectives of the Step I Site Inspection program is to conduct a screening level sampling program to determine the presence or absence, as well as the order of magnitude, of specific toxic or hazardous contaminants identified which may be present in concentrations considered to have health or environmental effects.

The objectives of the Step II RI/FS program involves comprehensive onsite investigations in order to determine the extent and concentrations of contamination, assess health and environmental risks and evaluate remediation alternatives.

The field activities, sample matrices, and analyses for the eleven sites being investigated at the Subase are presented in the Field Sampling Plan.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Introduction

This project will be managed by Atlantic Environmental Services, Inc. (Atlantic). The names and addresses of Navy contact personnel appear below.

Specific Atlantic personnel have been identified who are responsible for implementing the quality aspects of the project. Primary responsibility rests with the Project Manager. Figure 2-1 presents the organizational structure for the IR Study at the Subase. The names of the primary contacts with the NAVY are given below:

Engineer-in-Charge
Adrienne Townsel
c/o Commanding Officer
Northern Division, Naval Facilities Engineering Command
Building 77-L, U.S. Naval Base
Philadelphia, PA 19112-5094
Attn: Code 1421/APT
Phone: (215) 897-6431

Point-of-Contact
William Mansfield
c/o Commanding Officer
Naval Submarine Base New London
Groton, CT
Attn: Code 803
Phone: (203) 449-4481

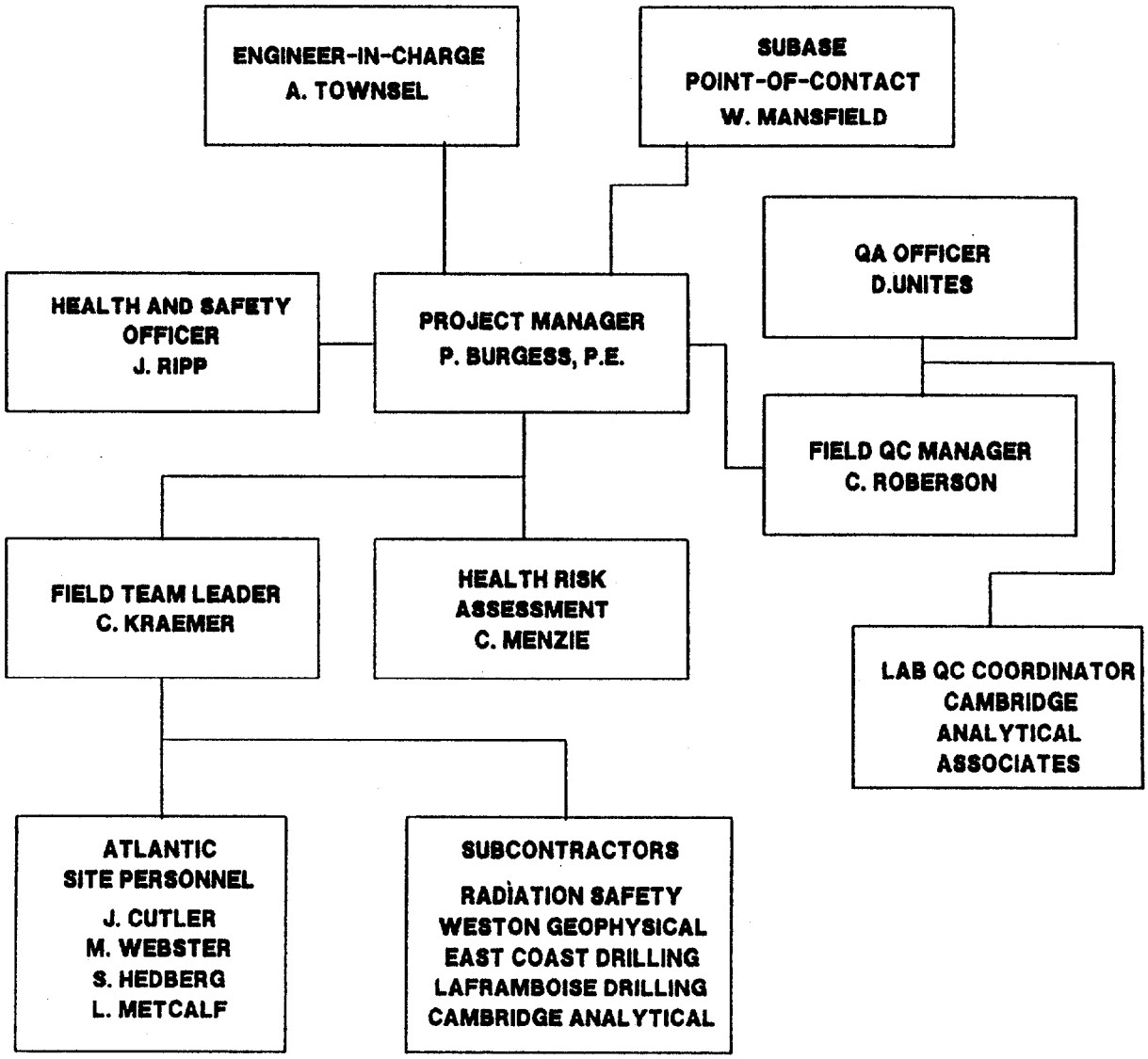
Responsibilities of Atlantic's Project Manager and QA/QC staff are presented below.

2.2 Project Manager's Responsibility

The Project Manager will provide overall direction to the project team and will be held responsible for overall technical, financial and scheduling matters. The Project Manager will be the primary contact for the Northern Division's Engineer-in-Charge (EIC) and Subase Point-Of-Contact (POC).

2.3 QA Officer's Responsibility

The QA Officer reports independently to Atlantic's President and has full authority to act independently from the technical management of the IR program. He will serve as Atlantic's primary contact with the Northern Division's QA staff, if so requested by the EIC. He



INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE
NEW LONDON
GROTON, CT

FIGURE 2-1
PROJECT ORGANIZATION

ATLANTIC ENVIRONMENTAL SERVICES, INC.

will monitor compliance of the project with the QA/QC Plan and perform any necessary audits, initiate and report corrective actions, and he will assist in preparing QA/QC project summaries for the Final Report.

2.4 Field QC Coordinator - QA/QC Manager's Responsibilities

A Field QC Coordinator has been selected for this project. The Field QC Coordinator will work with the field team during preparations for the sampling events, and also during conduct of field work. He/she will be onsite to ensure all required QC procedures are followed; will initiate informal and/or formal corrective actions, as necessary; and will maintain and report QC records and results to the Atlantic Project Manager and QA Officer. The QC field coordinator will also serve as the QA/QC Manager for the project. This person will be responsible for ensuring all analytical deliverables have been received and subsequently validated according to NEESA Level C Guidelines.

2.5 Laboratory QC Coordinator

The laboratory selected for this project, (is Cambridge Analytical Associates (CAA) who will also designate a QC Coordinator (CAA lists this person as Quality Assurance Officer). The Laboratory QC Coordinator will perform the following, in accordance with the NEESA-approved QA/QC plan:

1. Assist the Project/Task Manager in specifying QA/QC procedures to be used during the study.

2. Implement QC procedures and techniques to assure that the laboratory achieves established standards of quality.

3. Evaluate data quality and maintain records on related QC charts and other pertinent information.

4. Monitor laboratory activities to determine conformance with authorized QA policy.

5. Coordinate internal audits.

6. Review performance evaluation results.

7. Administer intralaboratory and interlaboratory QA efforts.

8. Prepare QA reports to management.

3.0 SAMPLING PROCEDURES

3.1 Introduction

The following matrices will be collected during the field investigation study at the eleven Subase sites: soil, sediment, surface water, and ground water. All sample collection and monitoring procedures are discussed in the Field Sampling Plan and a list of procedures to be followed is found in Appendix A of this document (the actual procedures are in Appendix A of the Field Sampling Plan). All media samples collected will be handled in accordance with this Quality Assurance/Quality Control Project Plan, and Atlantic's Procedures.

3.2 Selection of Sampling Locations

The locations of samples for each of the eleven sites at the Subase appear in the Field Sampling Plan. A summary of samples to be collected at each site appears in Section 4.0 of the Field Sampling Plan and are presented in Appendix B of this document.

3.3 Sample Collection, Handling and Shipping

Sample bottles will be prepared and shipped to the field by the laboratory Sample Coordinator. Where possible, preservatives will be placed in the appropriate containers by the laboratory to minimize chemical handling in the field.

Sample containers, preservatives and holding times are listed in Tables 3-1 and Table 3-2.

The general listing of QC samples to be included in each sampling event is provided in Table 3-3.

A sequentially numbered sample label will be filled out at the time of sampling by Atlantic's field personnel according to the proper procedures it will be attached to each container with the following information:

1. Site number/project number
2. Field identification or sample station number
3. Date and time of collection
4. Designation as grab or composite
5. Matrix
6. Signature of samples
7. Preservation used
8. General type of analysis to be conducted

TABLE 3-1

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

PRESERVATIVE AND HOLDING TIMES FOR THE CLP

Parameter	Container	Preservative	Holding Time	
			Soil	Water
Volatiles by gas chromatography/mass spectroscopy (GC/MS)	Water - 40-ml glass vial with Teflon-lined septa Soil-glass with Teflon-lined septa	Cool, 4°C	14 days	14 days
PCB/pesticides	G, Teflon-lined-lid	Cool, 4°C	Extract within 10 days, analyze 40 days	Extract within 5 days, analyze 40 days
Extractable organics	G, Teflon-lined-lid	Cool, 4°C	Extract within 10 days, analyze 40 days	Extract within 5 days, analyze 40 days
Metals	P, G	HNO_3 to pH<2	6 months	6 months
Mercury	P, G	HNO_3 to pH<2	30 days	30 days
Cyanide	P, G	NaOH to pH>12 Cool 4°C and 0.6 g ascorbic acid if residual chlorine present	14 days	14 days
Chromium VI	P, G	HNO_3 to pH<2	24 h	24 h

TABLE 3-2

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

PRESERVATIVE AND HOLDING TIMES FOR EPA-DOCUMENT SW-846 (3rd ed.)

Parameter	Container	Preservative	Holding Time	
			Soil	Water
Volatiles by GC/MS and GC	Water - 40-ml glass vial with Teflon-lined septa Soil-glass with Teflon-lined septa	Cool, 4°C	14 days	14 days
PCB/pesticides	G, Teflon-lined-lid	Cool, 4°C	Extract within 7 days, analyze 40 days	Extract within 7 days, analyze 40 days
Extractable organics	G, Teflon-lined-lid	Cool, 4°C	Extract within 7 days, analyze 40 days	Extract within 7 days, analyze 40 days
Metals	P, G	HNO_3 to pH<2	6 months	6 months
Mercury	P, G	HNO_3 to pH<2	30 days	30 days
Cyanide	P, G	NaOH to pH>12 Cool 4°C add 0.6 g ascorbic acid if residual chlorine present	14 days	14 days
Chromium	P, G	HNO_3 to pH<2	24 h	24 h

TABLE 3-3

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

FIELD QC SAMPLES PER SAMPLING EVENT

Type of Sample	Level C	
	Metal	Organic
Trip Blank (for volatiles only)	NA[1]	1/cooler
Equipment Rinsate[2]	1/day	1/day
Field Blank	1/source/event for all levels and all analytes	
Field Duplicates[3]	10%	10%
Referee Duplicate[3]	Collect at direction of HAZWRAP Project Manager	

1. NA - Not Applicable
2. Samples are collected daily; however, only samples from every other day are analyzed. Other samples are held and analyzed only if evidence of contaminated exists.
3. The duplicate must be taken from the same sample which will become the laboratory matrix/spike duplicate for organics or for the sample used as a duplicate in inorganic analysis.

After samples have been collected, they will be placed in a shipping cooler and kept cool with frozen blue ice packs. Each sample container will be wrapped in bubble packing for shipment to the laboratory by an overnight carrier service. Sample containers will be secured using nylon strapping tape and custody seals.

The chain-of-custody (COC) record will accompany all samples to provide documentation of all samples collected and to trace sample possession. Chain-of-custody procedures are discussed in detail in Section 4.0 of this document.

After all the sample containers have been filled and properly stored, field testing will be performed. Three parameters will be measured in the field for all aqueous samples: pH, temperature, and conductivity. These measurements will be taken from a separate container which will not be submitted to the laboratory for analysis. Temperature will be measured immediately upon collection of all ground water and surface water samples, as it is subject to the most rapid change. Conductivity and pH will be measured with electronic probes, which will be cleaned with organic-free distilled water in between each usage. Atlantic will use a YSI Model 33 SCT Meter for temperature and conductivity measurements and an ORION 407A specification meter for pH measurements.

Upon receipt, the laboratory shall sign and keep copies of the air bill. The COC shall be signed. The temperature of the cooler shall be measured and documented. The condition of the samples shall be documented. If any breakage or discrepancy arises between COC, sample labels, and requested analysis, the sample custodian will notify the Atlantic Project Manager. The pH of incoming samples shall be checked and documented upon receipt. Any discrepancy or improper preservation shall be noted by the laboratory as an out-of-control event and shall be documented on a corrective action request form with the corrective action taken.

3.4 Field Quality Control (QC) Samples

Trip blanks, equipment rinsates, field blanks, field duplicates and potentially referee duplicates will be collected as part of each sampling event, in order to ascertain a measure of quality control during each sampling round. The following sections described the purpose behind each of these types of samples.

3.4.1 Trip Blanks

Trip blanks are defined as samples which originate from analyte-free water taken from the laboratory to the sampling site and returned to the laboratory with the volatile organic (VOA) samples. One trip blank will accompany each cooler containing VOAs, will be stored at the laboratory with the samples, and analyzed by the laboratory. Trip blanks are only analyzed for VOAs.

3.4.2 Equipment Rinsates

Equipment rinsates are the final analyte-free water rinse from equipment cleaning collected daily during a sampling event. Initially, samples from every other day will be analyzed. If analytes pertinent to the project are found in the rinsate, the remaining samples will be analyzed. The results from the blanks will be used to flag or assess the levels of analytes in the samples. This comparison is made during data validation. The rinsates are analyzed for the same parameters as the related samples.

3.4.3 Field Blanks

Field blanks consist of the source water used in decontamination and steam cleaning. At a minimum, one field blank from each event and each source of water will be collected and analyzed for the same parameters as the related samples.

3.4.4 Field Duplicates/Splits

Duplicates or splits for soil samples are collected, homogenized, and split. All samples except VOAs are homogenized and split. Volatiles are not mixed, but select segments of soil are taken from the length of the split-spoon and placed in 40-ml glass vials. Split-spoon liners can be used, sealed and shipped to the laboratory for subsampling if the project deems this appropriate. The duplicates for water samples will be collected simultaneously. Field duplicates will be collected at a frequency of 10% per sample matrix for Level C QC. All the duplicates will be sent to the laboratory. The sample samples used for field duplicates will be split by the laboratory and be used as the laboratory duplicate or matrix spike. This means that for the duplicate sample, there will be analyses of the normal sample, the field duplicate, and the laboratory matrix spike/duplicate.

3.4.5 Referee Duplicates

Duplicates/splits will be sent to a designated referee QA laboratory if regulators (state or region) collect split samples or if a special problem occurs in sample analysis or collection. These duplicates/splits are collected and analyzed in addition to the field duplicates mentioned in the previous paragraph.

3.5 Field Decontamination Procedures

Drill rigs will be steam cleaned prior to entering the Subase and drilling equipment will be decontaminated prior to moving to individual sites. Drilling equipment used for multiple boreholes will be decontaminated prior to each boring at the site. All major

decontamination will be conducted at the central decontamination area near Atlantic's base of operation. Minor decontamination such as cleaning of split-spoons and other sampling equipment will be performed at each site. Split-spoons along with stainless steel or teflon spatulas, and stainless steel mixing pans will be decontaminated using the following procedures:

1. Wash and scrub with alconox detergent in tap water;

2. Rinse with tap water;

3. Rinse with 10% nitric acid (only if metals are being analyzed);

4. Rinse with distilled/deionized water;

5. Rinse with methanol;

6. Rinse with distilled/deionized water (demonstrated to be analyte-free);

7. Air dry - on clean polyethylene sheeting

NOTE: Step 3 and 4 may be omitted if sampling devices are not used for inorganic sample collection.

In order to minimize logistical difficulties and the spread of contaminated cleaning fluids, a procedure has been established for well to well decontamination. All drilling will be done over plastic liners and once the boreholes or wells are complete, the plastic liner, cuttings and development water may be drummed onsite for possible offsite disposal as specified in the Field Sampling Plan. All contaminated drilling tools will be wrapped in plastic and moved to the central decontamination area for cleaning prior to moving to the next location.

4.0 CHAIN-OF-CUSTODY

Along with the sample labelling requirements presented in Section 3.3, a chain-of-custody record will be completed at the time of sampling and accompany samples between the field and the laboratory. The following information will be provided on the chain-of-custody form:

1. Project name/number
2. Signature of sampling personnel
3. Sample site number/sample number
4. Date and time of collection
5. Grab or composite
6. Signatures and dates and times of individuals involved in transferring samples
7. Sample matrix (included in the sample number)

The field chain-of-custody is complete when samples are transferred to overnight carriers. EPA does not require overnight carriers to continue COC within their organization to complete the COC. When samples are received at the laboratory, the receiver will sign the chain-of-custody form.

Sample analysis request sheets serve as official communication to the laboratory of the particular analysis required for each sample and provide further evidence that the COC is complete.

COC records initiated in the field shall be placed in a plastic cover and taped to the inside of the shipping container used for transport.

5.0 ANALYTICAL PROCEDURES

EPA-approved methods will be used for all chemical and physical analyses undertaken during this Installation Restoration Study. Target Compound List (TCL) parameters will be analyzed by CLP protocols for both organic and inorganic analyses. This approval also applies to SW 846, ASTM and Federal Register.

A QA/QC Management Plan from the proposed analytical laboratory is submitted together with this document. Upon final approval of the contract laboratory, this QA/QC Plan will be revised to include more laboratory specific pertinent QA/QC information. However, presented below is a list of the chemical parameters planned for analysis during the Step 1 and Step 2 investigations. The Target Compound List (TCL) is the suite of parameters to be determined on samples of soil, sediment, surface water, and ground water. In the revised QA/QC Plan, additional analytical groups may be incorporated. Atlantic is planning on a combination of GC plus GC/MS for analysis, however, in screening new sites, low detection limit procedures will be preferred. GC/MS analysis will be used judiciously to either analyze non-recognizable or unknown contamination or to verify clean areas.

Atlantic also is planning on incorporating recently developed field analytical procedures it has used which have not been officially sanctioned. These are with regard to soil gas analysis. Atlantic will use procedures developed from attending EPA seminars on the use of portable gas chromatographs for field screening. Atlantic will not, however, use the results of field GC analysis for reporting soil or water contamination. It is the intent to use soil gas analysis as a tool for the identification of high contaminant zones and the final design of the drilling program.

5.1 Target Compound List - Organic Compounds

All organic compounds analyses will be conducted according to the U.S. EPA CLP, Statement of Work, dated September 3, 1985, or the latest version at the time of analysis. The organic compounds contained in the TCL will be determined using proven instruments and techniques to identify and quantify volatile, semi-volatile and pesticide compounds. The TCL compounds are shown in Tables 5-1 through 5-4, respectively.

Soil extraction for organic and inorganic leaching behavior will be performed using the Toxicity Characteristic Leaching Procedure (TCLP) analysis described in the November 7, 1986 Federal Register. Atlantic and its proposed laboratory recognize that the procedure is only proposed and new revisions are pending. The latest TCLP Method at the time of analysis will be incorporated into the program.

TABLE 5-1

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

TARGET COMPOUND LIST (TCL)
VOLATILE COMPOUNDS

VOLATILES	
Chloromethane	Bromomethane
Vinyl chloride	Chloroethane
Methylene chloride	Acetone
Carbon disulfide	1,1-Dichloroethene
1,1-Dichloroethane	1,2-Dichloroethene (cis and trans)
Chloroform	1,2-Dichloroethane
2-Butanone	1,1,1-Trichloroethane
Carbon tetrachloride	Vinyl acetate
Bromodichloromethane	1,1,2,2-Tetrachloroethane
1,2-Dichloropropane	trans-1,3-Dichloropropene
Trichloroethene	Dibromochloromethane
1,1,2-Trichloroethane	Benzene
cis-1,3-Dichloropropene	2-Chloroethyl vinyl ether
Bromoform	2-Hexanone
4-Methyl-2-pentanone	Tetrachloroethene
Toluene	Chlorobenzene
Ethyl benzene	Styrene
Total xylenes	

TABLE 5-2

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

TARGET COMPOUND LIST (TCL)
SEMI-VOLATILE COMPOUNDS

SEMI-VOLATILES	
Phenol	Bis(2-chloroethyl) ether
2-Chlorophenol	1,3-Dichlorobenzene
1,4-Dichlorobenzene	Benzyl alcohol
1,2-Dichlorobenzene	2-Methylphenol
Bis(2-chloroisopropyl) ether	4-Methylphenol
N-Nitroso-dipropylamine	Hexachloroethane
Nitrobenzene	Isophorone
2-Nitrophenol	2,4-Dimethylphenol
Benzoic acid	Bis(2-chloroethoxy) methane
2,4-Dichlorophenol	1,2,4-Trichlorobenzene
Naphthalene	4-Chloroaniline
Hexachlorobutadiene	4-Chloro-3-methylphenol (para-chloro-meta-cresol)
2-Methylnaphthalene	Hexachlorocyclopentadiene
2,4,6-Trichlorophenol	2,4,5-Trichlorophenol
2-Chloronaphthalene	2-Nitroaniline
Dimethyl phthalate	Acenaphthylene
3-Nitroaniline	Acenaphthene
2,4-Dinitrophenol	4-Nitrophenol
Dibenzofuran	2,4-Dinitrotoluene
2,6-Dinitrotoluene	Diethylphthalate
4-Chlorophenyl phenyl ether	Fluorene
4-Nitroaniline	4,6-Dinitro-2-methylphenol
N-nitrosodiphenylamine	4-Bromophenyl phenyl ether
Hexachlorobenzene	Pentachlorophenol
Phenanthrene	Anthracene
Di-n-butylphthalate	Fluoranthene
Pyrene	Butyl benzyl phthalate
3,3'-Dichlorobenzidine	Benzo(a)anthracene
Bis(2-ethylhexyl)phthalate	Chrysene
Di-n-octyl phthalate	Benzo(b)fluoranthene
Benzo(k)fluoranthene	Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene
Benzo(g,h,i)perylene	

TABLE 5-3

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

TARGET COMPOUND LIST (TCL)
PESTICIDES, PCBs

PESTICIDES	
alpha-BHC	beta-BHC
delta-BHC	gamma-BHC (Lindane)
Heptachlor	Aldrin
Heptachlor epoxide	Endosulfan I
Dieldrin	4,4'-DDE
Endrin	Endosulfan II
4,4'-DDD	Endrin adehyde
Endosulfan sulfate	4,4'-DDT
Endrin ketone	Methoxychlor
Chlordane	Toxaphene
AROCLOR-1016	AROCLOR-1221
AROCLOR-1232	AROCLOR-1242
AROCLOR-1248	AROCLOR-1254
AROCLOR-1260	

TABLE 5-4

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

TARGET COMPOUND LIST (TCL)
INORGANICS

ELEMENTS	
Aluminum	Antimony
Arsenic	Barium
Beryllium	Boron
Cadmium	Calcium
Chromium	Cobalt
Copper	Iron
Lead	Magnesium
Manganese	Mercury
Nickel	Potassium
Selenium	Silver
Sodium	Thallium
Vanadium	Zinc
Cyanide	

5.2 Analytical Methodologies

The analytical procedures to be used in this project are contained in the EPA Manuals Methods for Chemical Analysis of Water and Wastes, Methods for Organic Analysis of Municipal and Industrial Wastewater, Test Methods for Evaluating Solid Wastes (SW-846), Contract Laboratory Program Statement of Work for Inorganic Analysis, Multi-media, Multi-concentration, Revision No. 7/85, and Contract Laboratory Program Statement of Work for Organic Analysis, Multi-media, Multi-concentration, Revision No. 7/87. Other methods may be taken from APHA - Standard Methods for the Examination of Water and Wastewater and ASTM - The Annual Book of ASTM Standards. These methods are summarized in Table 5-5 for organic parameters and Table 5-6 for inorganic parameters.

TABLE 5-5

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

SUMMARY OF ORGANIC ANALYTICAL METHODS

Constituent	Method Reference	Method Description
Volatile Organic Compounds	Modified Method 624/8240/524 (1,2,5)	Purge and trap, gas chromatography/ mass spectrometry
Volatile Organic Compounds (Halogenated)	Modified Method 601/8010/502 (1,2,5)	Purge and trap, gas chromatography/ halogen specific (Hall) detection
Volatile Organic Compounds (Aromatic)	Modified Method 602/8020/503 (1,2,5)	Purge and trap, gas chromatography/ photoionization detection
Semivolatile Organics-Acid/Base/Neutral Extractables	Modified Method 625/8270 (1,2)	Solvent extraction, gas chromatography/mass spectrometry
Pesticides/PCBs	Modified Method 608/8080 (1,2)	Solvent extraction, gas chromatography/electron capture detection
Herbicides (Aqueous)	Modified Method 509B/8150 (2,5)	Solvent extraction, derivatization, gas chromatography/electron capture detection
Petroleum Hydrocarbons	Method 2/6 (3)	Solvent extraction, gas chromatography/flame ionization detection
Oil and Grease	Method 413.1 (4) 503 D (6)	Solvent extraction, gravimetric determination
	Method 413.2 (4)	Solvent extraction, infrared spectrophotometry
EDB and DBCP	Method 504 (5)	Microextraction, gas chromatography
CLP Organic Compounds	SOW 7/87 (7)	VOC, BNA, Pesticides/PCB

(Continued)

TABLE 5-5 (CONTINUED)

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

SUMMARY OF ORGANIC ANALYTICAL METHODS

1. U.S. EPA 1984. Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater. Appendix A. 40CFR Part 136. Federal Register, Vol. 49, No. 209, 1984.

2. U.S. EPA 1986. Test Methods for Evaluating Solid Waste-Physical/Chemical Methods. SW-846 Third Edition. Office of Solid Waste, U.S. EPA, Washington, D.C.

3. Warner, J.S. 1978. Chemical characteristics of Marine Samples. API Publication No. 4307. API, Washington, D.C.

4. U.S. EPA 1979. Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL, Cincinnati, Ohio.

5. U.S. EPA 1986. Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water. EPA/EMSL, Cincinnati, Ohio.

6. APHA 1985. Standard Methods for the Examination of Water & Wastewater. Sixteenth Edition. American Public Health Association, Washington, D.C.

7. U.S. EPA 1987. Organic Analysis for Multi-Media, Multi-Concentration, Statement of Work, Revision 7/87. U.S. Contract Laboratory Program. EPA/CLP, Washington, D.C.

TABLE 5-6

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

SUMMARY OF INORGANIC ANALYTICAL METHODS

Constituent	Method Reference	Method Description
Sample Preparation	Method 3010/3020/3050 (1)	Acid-digestion
(EP Toxicity) Sample Preparation	Method 1310 (1)	EP Toxicity Extraction
Metals -	As specified below Aqueous/Solids	
Aluminum	Method 200.7/6010 (1,2)	Inductively Coupled Argon Plasma Emission Spectroscopy (ICP)
Antimony	Method 200.7/6010; 204.2/7041 (1,2)	ICP; Graphite Furnace Atomic Absorption Spectrophotometry (GFAAS)
Arsenic	Method 200.7/6010; 206.2/7060 (1,2)	ICP; GFAAS
Barium	Method 200.7/6010 (1,2)	ICP
Beryllium	Method 200.7/6010 (1,2)	ICP
Cadmium	Method 200.7/6010; 213.2/7131 (1,2)	ICP; GFAAS
Chromium	Method 200.7/6010 (1,2)	ICP
Copper	Method 200.7/6010 (1,2)	ICP
Iron	Method 200.7/6010 (1,2)	ICP
Lead	Method 200.7/6010; 239.2/7421 (1,2)	ICP; GFAAS
Manganese	Method 200.7/6010 (1,2)	ICP

(Continued)

TABLE 5-6 (CONTINUED)

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

SUMMARY OF INORGANIC ANALYTICAL METHODS

Constituent	Method Reference	Method Description
Mercury	Method 245.5/7470 (1,2)	Cold-vapor Atomic Adsorption Spectroscopy
Nickel	Method 200.7/6010 (1,2)	ICP
Selenium	Method 200.7/6010; 270.2/7740 (1,2)	ICP; GFAAS
Silver	Method 200.7/6010 (1,2)	ICP
Sodium	Method 200.7/6010 (1,2)	ICP
Thallium	Method 200.7/6010; 279.2/78441 (1,2)	ICP; GFAAS
Zinc	Method 200.7/6010 (1,2)	ICP
CLP Metals	SOW 785 (3)	ICP; GFAAS
Hardness	Method 314A (3)	ICP; by calculation
<u>Conventional Pollutants</u> -		
Acidity	Method 305.1 (2)	Titrimetric
Alkalinity	Method 310.1 (2)	Titrimetric
Ammonia	Method 350.1 (2)	Automated Colorimetric
Biochemical Oxygen Demand (BOD)	Method 405.1 (2)	5 days at 20°C
Biochemical Oxygen Demand, Carbonaceous (CBOD)	Method 405.1 (2)	5 days at 20°C; Nitrogen Inhibited
Chemical Oxygen Demand (COD)	Method 410.4 (2)	Colorimetric

(Continued)

TABLE 5-6 (CONTINUED)

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

SUMMARY OF INORGANIC ANALYTICAL METHODS

Constituent	Method Reference	Method Description
Chloride	Method 300.1;325/3 (2)	Ion Chromatography; Titrimetric
Color	Method 110.2 (2)	Colorimetric, Pt-Co
Conductivity	Method 120.1 (2)	Specific Conductance
Cyanide (total)	Method 335.2;335.3/9010 (1,2,4)	Distillation, Colorimetric/ Automated
Cyanide (amenable)	Method 335.1/9010 (1,2)	Chlorination, Distillation, Colorimetric
Cyanide (CLP)	SOW 785 (4)	Distillation, Colorimetric/ Automated
Fluoride	Method 300.1;340.2 (2)	Ion Chromatography; Ion Selective Electrode
Hexavalent Cr	Method 218.3/218.5/7195 (1,2)	Coprecipitation, ICP
Nitrate	Method 300.0;353.2 (2)	Ion Chromatography; Automated Chlorimetric
Nitrite	Method 300.0;353.2 (2)	Ion Chromatography/Automated Colorimetric
Orthophosphate	Method 365.3 (2)	Colorimetric, Ascorbic Acid
pH	Method 150.1/9040 (1,2)	Electrometric
Phenols	Method 420.2/9066 (1,2)	Distillation, Automated Colorimetric
Phosphorus (total)	Method 365.3 (2)	Colormetric, Ascorbic Acid
Silica	Method 200.7 (2)	Filtration; ICP

(Continued)

TABLE 5-6 (CONTINUED)

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

SUMMARY OF INORGANIC ANALYTICAL METHODS

Constituent	Method Reference	Method Description
Solids -		
- dissolved (TDS)	Method 160.1 (2)	Gravimetric, dried at 180°C
- suspended (TSS)	Method 160.2 (2)	Gravimetric, dried at 103-105°C
- total (TS)	Method 160.3 (2)	Gravimetric, dried at 103-105°C
- volatile (TVS)	Method 160.4 (2)	Gravimetric, ignition at 550°C
- settleable (SS)	Method 160.5 (2)	Volumetric, Imhoff Cone
Sulfide	Method 376.1/9030 (1,2)	Titrimetric, iodine
Sulfate	Method 300.1;375.2;375.4/ 9038 (1,2)	Ion Chromatography; Colorimetric; Turbidimetric
Sulfite	Method 377.1 (2)	Titrimetric
Surfactants (MBAS)	Method 425.1 (2)	Colorimetric
Total Organic Carbon (TOC)	Method 415.2/9060 (1,2)	Persulfate Oxidation, UV Promoted
Total Kjeldahl Nitrogen (TKN)	Method 351.2 (2)	Semi-Automated Colorimetric
Turbidity	Method 180.1 (2)	Nephelometric

1. U.S. EPA 1982. Test Methods for Evaluating Solid Waste-Physical/Chemical Methods. SW-846 (Second Edition). Office of Solid Waste, U.S. EPA, Washington, D.C.

2. U.S. EPA 1979. Methods for Chemical Analysis of Water and Wastes. EPA 600/4-79-020 (Revised, March 1983). EPA/EMSL, Cincinnati, Ohio.

3. APHA, 1985. Standard Methods for the Examination of Water and Wastewater, Sixteenth Edition, American Public Health Associates, Washington, D.C. U.S. EPA 1985.

4. Inorganic Analysis for Multi-Media, Multi-Concentration, Statement of Work, 785. U.S. EPA Contract Laboratory Program. EPA/CLP, Washington, D.C.

6.0 DATA QUALITY OBJECTIVES

The data quality objectives for all measurements (field and laboratory) include considerations of precision, accuracy, and completeness as described below.

6.1 Precision

The precision of a measurement is an expression of mutual agreement of multiple measurement values of the same property conducted under prescribed similar conditions. Precision reflects the repeatability of the measurement. Precision is evaluated most directly by recording and comparing multiple measurements of the same parameter on the same sample under the same conditions. Precision is usually expressed in terms of standard deviation. The precision objectives for TCL parameters are specified in the CLP protocols. Except as otherwise specified by the method, the QC objective for precision under this project will be ±20 percent (relative percent difference) as determined by duplicate analyses. The relative percent difference (RPD) is calculated as:

$$RPD = 1/2 \times \frac{V1 - V2}{(V1 + V2)} \times 100$$

Where: V_1 V_2 = two values obtained by analyzing duplicates

6.2 Accuracy

The degree of accuracy of a measurement is based on a comparison of the measured value with an accepted reference or true value, or is a measure of system bias. Accuracy of an analytical procedure is best determined based on analysis of a known or "spiked" sample quantity. The degree of accuracy and the recovery of analyte to be expected for the analysis of QA samples and spiked samples is dependent upon the matrix, method of analysis, and compound or element being determined in the analysis. The concentration of the analyte relative to the detection limit is also a major factor in determining the accuracy of the measurement. Except as otherwise specified by a method, the QC objective for accuracy under this project will be 75 to 125 percent (percent recovery), as determined by sample spike recoveries. Alternatively, accuracy may be assessed through the analysis of appropriate standard reference materials, certified standards, or other samples, as available. The percent recovery is calculated as:

$$\% \text{ recovery} = \frac{Ss - So}{S} \times 100$$

Where: Ss = Value obtained by analyzing the sample with the spike added.
So = Background value, ie. the value obtained by analyzing the sample without a spike.
S = Concentration of the spike added to Ss.

6.3 Completeness

Completeness is a measure of the amount of valid data obtained from the measurement system relative to the amount anticipated under ideal conditions. This project's QC objective for completeness, as determined by the percentage of valid data generated, will be $\geq$90 percent. The formula to be used to estimate completeness is:

$$C = 100 \frac{V}{T}$$

Where: C = Percent Completeness
V = Number of judgements determined valid
T = Total number of measurements

7.0 CORRECTIVE ACTION

Atlantic and CAA recognize and have established methods to control nonconforming field and analytical procedures. The QA/QC Plan provided by the proposed analytical laboratory documents their corrective action plan. Corrective actions can be of three forms: immediate, long-term and those applied to out-of-control events. Each is discussed in light of the activities planned in the Installation Restoration Study at the Subase.

7.1 Immediate Corrective Action

Immediate action applies to field and analytical procedures that can be instituted as normal operating procedures that would prevent the generation of poor quality data. These types of actions are considered informal and only require noting problems and corrections in the field notebooks or laboratory notebooks. The use of trained field and laboratory personnel will increase the awareness of problems requiring immediate corrective action.

Types of situations which would require immediate corrective action in the field include:

1. Drill rig breaks a throw out bearing

2. HNu meter will not zero

3. Sampling pumps do not operate

4. Grout enters a well screen possibly contaminating a well

If immediate corrective actions are not performed then Atlantic will apply formalized long-term corrective action.

7.2 Long-Term Corrective Action

A long-term corrective action may be identified by problems with standard operating procedures, the use of control charts, or the result of performance or system audits. Any quality problem which cannot be solved by immediate corrective action falls into the long-term category. The Atlantic QA system ensures that the quality problem is reported to a person responsible for correcting it, and who is part of a closed-loop action and follow-up plan.

The essential steps in the closed-loop corrective action system are listed below:

Identify and define the problem;

Assign responsibility for investigating the problem;

Investigate and determine the cause of the problem;

Determine a corrective action to eliminate the problem;

Assign and accept responsibility for implementing the corrective action;

Establish effectiveness of the corrective action and implement it; and

Verify that the corrective action has eliminated the problem.

Documentation of the problem is important to the system. A Corrective Action Request and Reporting Form (Figure 7-1) is provided. This form identified the problem, possible causes, and the person responsible for action on the problem. If no person is identified as responsible for action, the QA Officer investigates the situation and determines who is responsible in each case.

The Corrective Action Request and Reporting Form also includes a description of the corrective action planned and the date it was taken, and space for follow-up. The QA Officer checks to be sure that initial action has been taken and appears effective and, at an appropriate later date, checks again to see if the problem has been fully solved. The QA Officer receives a copy of all Corrective Action Forms and enters them in the Corrective Action Log. This log is maintained as part of the QA records for the project.

7.3 Out-Of-Control Events and Corrective Action

Out-Of-Control events are usually associated with the analytical portion of an IR Study. Cambridge Analytical provides in their QA/QC Plan a statement for the resolution of Out-Of-Control events.

FIGURE 7-1

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

CORRECTIVE ACTION REQUEST FORM

CORRECTIVE ACTION REQUEST NO. _____

Originator _____ Date _____

Person Responsible for Replying _____ Contract Involved _____

Description of problem and when identified: _____

_____

_____

State cause of problem, if known or suspected: _____

_____

_____

Sequence of Corrective Action: (If no responsible person is identified, notify QA Officer immediately. Submit all CA forms to QA Officer for initial approval of CA.)

State Date, Person, and Action Planned: _____

_____

_____

CA Initially Approved by: _____ Date: _____

Follow-up Dates: _____

Final CA Approval by: _____ Date: _____

Information copies to:

RESPONSIBLE PERSON/QC COORDINATOR: _____

QA OFFICER: _____

PROJECT MANAGER: _____

8.0 DATA MANAGEMENT PLAN

The purpose of the Data Management Plan is to document and track investigation data and results.

8.1 Laboratory Data Management

All laboratory data will be managed by the Field QC Coordinator, Carol Roberson. She will be responsible for all chain-of-custody records and the master sample log notebook. All samples will be recorded in the master sample log notebook for future reference. This will include sample site, sample number, data, time, sampling personnel, sample media, containers, parameters for analysis, date/method of shipment, and sample preservation. The notebook will also be used to document the receipt of laboratory analysis data from the laboratory.

The chain-of-custody and master sample log notebook will be kept in the files for the IR Study under the custody of the Project Manager. The removal of the documents from the file will require a signature.

Laboratory data used for the generation of figures, maps, etc. must be reviewed by another Atlantic employee. A memorandum will be prepared to the Project Manager for the appropriate file noting the subject data, the information generated, the original person who tabulated the data, and the review person. Both signatures will appear on the memo.

8.2 Field Data Management

The data collected during the field investigation and sampling will be documented in field notebooks. Field notebook entries will include the following information:

- Name and title of author, date and time of entry, and weather conditions
- site name and location
- field investigation observations
- description of sample location
- sample collection method
- sample media, sample I.D. number
- sample preservation
- field measurements (pH, temperature, conductivity)
- location (distance measurement from known field locations)

All field entries will be made in waterproof ink. The field team leader, Curtis Kraemer, will conduct periodic checks of field entries to insure their accuracy and completeness.

Atlantic's Project Manager will control all field notebooks. Each field notebook will receive a serialized number and be issued to the field team leader. Field notebooks when complete will be returned to the project files.

Field data used for the generation of subsequent information (eg. boring logs, reports, ground water elevation, monitor well logs, etc.) must be reviewed by another Atlantic technical employee. A memo will be prepared to the Project Manager and appropriate file noting the subject data, the original person who interpreted the data, and the reviewer. Both signatures will appear on the memo.

8.3 Project Files

The following project files have been established for this project:

- Site History Information
- QA/QC Laboratory Data Management
- Internal Correspondence/Memos
- Health and Safety (HASP)
- FSP
- Contract
- Correspondence
- Past Reports
- Site Inspection Information/Field Notebooks
- Subase Video Documentation and Photographs

All file information will be placed chronologically in each file. Files removed from the file cabinets must be recorded on a signature sheet. All files must be returned to the cabinet at the conclusion of each day.

8.4 Technical Calculation Review

Technical calculations performed for this project will include, permeability, ground water flow directions and velocity, health risk calculations, material volumes, engineering calculations for remediation, etc. All calculations will be performed on Atlantic calculation paper with the project number, date, and person recorded. All technical assumptions, references will be fully documented. All calculations will be reviewed and initiated by a technical person with required expertise in the subject matter.

APPENDIX A

ATLANTIC'S QA PROCEDURES

QA PROCEDURES

Number	Title
1020	Field Procedures for Collection of Surface Soil Samples
1021	Field Procedures for Collection of Subsurface Soils
1022	Field Procedures for Collection of Surface Water and Sediment Samples for Hazardous Waste Determination
1023	Field Procedures for Collection of Ground Water Samples for Hazardous Waste Determination
1030	Field Procedures for Logging Subsurface Conditions During Test Boring and Well Logging
1031	Field Procedures for Logging Subsurface Conditions in Test Pit Excavations
1040	Sample Preservation for Solid and Liquid Matrices
1041	Sample Chain-Of-Custody Procedure
1042	Shipping Procedures for Environmental Field Samples
1050	Operation and Calibration of the Century Organic Vapor Analyzer Model OVA-128
1051	Operation and Calibration of the HNu Systems Photoionizer Model PI-101
1060	Cleaning Procedure for Sampling Devices used in Environmental Site Investigations

APPENDIX B

SUMMARY OF SAMPLES TO BE COLLECTED AT EACH SITE

APPENDIX B

INSTALLATION RESTORATION STUDY
NAVAL SUBMARINE BASE - NEW LONDON
GROTON, CONNECTICUT

SUMMARY OF SAMPLES TO BE COLLECTED AT EACH SITE

SITE NAME	SURFACE SOIL	BORING SOIL	SEDIMENT	SURFACE WATER	GROUND WATER	FIELD DUPLICATE	TRIP BLANK	EQUIPMENT RINSATE	FIELD BLANK SOURCE WATER	MATRIX SPIKE	MATRIX SPIKE DUPLICATES
CBC DRUM STORAGE AREA	7					1		1	1	1	1
RUBBLE FILL AT BUNKER A-86	5					1	1	1		1	1
TORPEDO SHOPS		9				1	2	2	1	1	1
			1			1	1	1		1	1
				1		1	1	1		1	1
					3	1	1	1	1	1	1
GOSS COVE LANDFILL		7				1	3	3	1	1	1
				1		1	1	1	1	1	1
					4	1	1	1	1	1	1
OBDANE	5					1	1	1	1	1	1
SPENT ACID STORAGE AND DISPOSAL AREA		7				1	2	2	1	1	1
			1			1	1	1		1	1
FORMER GASOLINE STATION		5				1	1	1	1	1	1
AREA A LANDFILL	2					1	1	1	1	1	1
		7				1	7	7	1	1	1
					12	2	2	2	1	2	2
AREA A WETLAND			9			1	5	5	1	1	1
				2		1	1	1		1	1
		45				5	13	13	1	5	5
					11	2	2	2	1	2	2
AREA A DOWNSTREAM WATERCOURSES			12			2	2	2	1	2	2
				12		2	1	1	1	2	2
		4				1	4	4	1	1	1
					8	1	1	1	1	1	1
OVERBANK DISPOSAL AREA	10					1	1	1	1	1	1
		1				1	1	1		1	1
					2	1	1	1	1	1	1
DPDO AREA	4					1		1		1	1
		24				3	12	12	1	3	3
				1		1	1	1	1	1	1
					6	1	1	1	1	1	1
LOWER SUBASE		17				2	17	17	1	2	2
					26	3	4	4	1	3	3
TOTAL	33	126	23	17	72	46	93	95	26	46	46