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CONTAMINATION ASSESSMENT/ REMEDIAL ACTIVITIES INVESTIGATION WORK PIAN - GROUP N NAVAL AIR STATION PENSACOLA PENSACOLA, FLORIDA

Industrial Waste Sewer (Site 36)

December 1992

Prepared for:

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1. INTRODUCTION

The purpose of this work plan is to outline the procedures and methodologies to be used in conducting a Contamination Assessment/ Remedial Activities Investigation at the Industrial Sewer Line (Site 36) located at the Naval Air Station (NAS) in Pensacola, Escambia County, Florida. This work plan has been prepared by Ecology and Environment, Inc., (E & E) for the Southern Division, U.S. Navy, Naval Facilities Engineering Command, under Contract No. N62467-88-C-0200. The work plan has been developed based on information and file documents provided by the Navy, and on information gathered by E & E during preliminary site inspections conducted during January 1989.

E & E has developed a phased approach for performing the NAS Pensacola site investigations. Phase I (Field Screening) is directed toward identifying the principal area(s) and primary contaminants of concern at a site, thereby providing a mechanism for focusing the sampling and analytical efforts during subsequent phases of the investigation. Phase II (Characterization) is directed toward the formal confirmation and quantification of the full spectrum of site contaminants (if any), thereby allowing determination of whether further investigation is warranted. Thus, the necessity of implementing phases III and IV (Extent Delineation) will be dependent on the results of phases I and 11. Phases III and IV, if required, will be directed not only toward fully identifying the horizontal and vertical extents of contamination, but also toward providing the quantitative data base necessary to support the screening and evaluation of potential remedial alternatives. The main objectives/advantages of this phased approach are as follows:

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- Efficient identification of those sites where environmental contamination has actually occurred as a result of past and/or present operations, thereby alloving non-contaminated sites to be eliminated from the program in the most environmentally sound, cost-effective, and timely manner possible;

- Focused placement of sampling locations and focused selection of analytical parameters in later phases of the investigation, thereby alloving full characterization of site contamination in the most environmentally sound, cost-effective, and timely manner possible; and

- Early screening of potential remedial alternatives, which, in turn, allovs critical parameters necessary to the evaluation of these alternatives to be incorporated into the analytical program in later phases of the investigation.

It is anticipated that some of the NAS Pensacola sites may not require investigation beyond Phase II and hence will comprise Contamination Assessment-type investigations. On the other hand, sites which have documented contamination will likely require the additional phases of work, and hence will comprise a full-scale Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation/Feasibility Study (RI/FS). For simplicity, the investigations for ill NAS Pensacola sites will be referred to as Contamination Assessment/ Remedial Activities Investigations. The final results of site investigations that do not require study beyond Phase II will be incorporated into a Contamination Assessment Report. If appropriate, these sites will be recommended for No Further Action. The final results of site investigations that require vork beyond Phase II will be incorporated into a Remedial Investigation Report, vhich will provide all the information necessary for the development and completion of a Feasibility Study (FS).

The Industrial Waste Sewer (Site 36) is knovn to contain or have contained potentially hazardous materials, and contamination in the site vicinity has been documented. Consequently, it is probable that the scope-of-vork at Site 36 will encompass a full-scale RI/FS effort.

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2. SITE DESCRIPTION

Site 36 is the Industrial Waste Treatment Plant (IWTP) sewer. The 15-inch-diameter sewer line has a total length of approximately 5.5 miles (see. figures 2-1 and 2-2) and occurs in an area approximately 1 mile wide by 1.5 miles long in the southeastern portion of NAS Pensacola. The surface elevations of the areas that are covered by Site 36 range from 5 feet above mean sea level (HSL) in the southeastern and northeastern portions of the site to 30 feet above HSL at the northwest portions of the site. Generally, this site exists in the areas around Chevalier Field and is associated with other NAS Pensacola sites to be investigated. These sites are: 2, 9, 10, 11, 20, 23, 25, 27, 28, 29, 30, 32, 33, 34, and 35. In general, the soil on this site area consists of fine- to medium-grained sands. Many sections of this sewer are paved with asphalt or lie under a concrete apron. The flow direction in the sewer is toward the IWTP, which is located in the northeastern corner of this site.

Buildings 18, 52, 71, and 105 are found in the southeastern corner of Site 36. The sewer extends north to the southern perimeter of Chevalier Field, turns west, then turns north again, along the southern and eastern edges of Chevalier Field, toward the IWTP. An 8-inch forced mainline begins at Building 782 and joins the sewer at the southwest corner of Chevalier Field. Another line flowing by gravity which collects the wastewater from the northwestern portion of this site (buildings 649, 692, 755, 2691, and *3220)* runs southeastward and connects with this system at the western edge of Chevalier Field (see figures 2-1 and 2-2). (In addition, Plate 1 (Plan Map) from the Site 36 Interim Data Report provides greater detail of the site. Plate 1 is located at the back of the work plan.]

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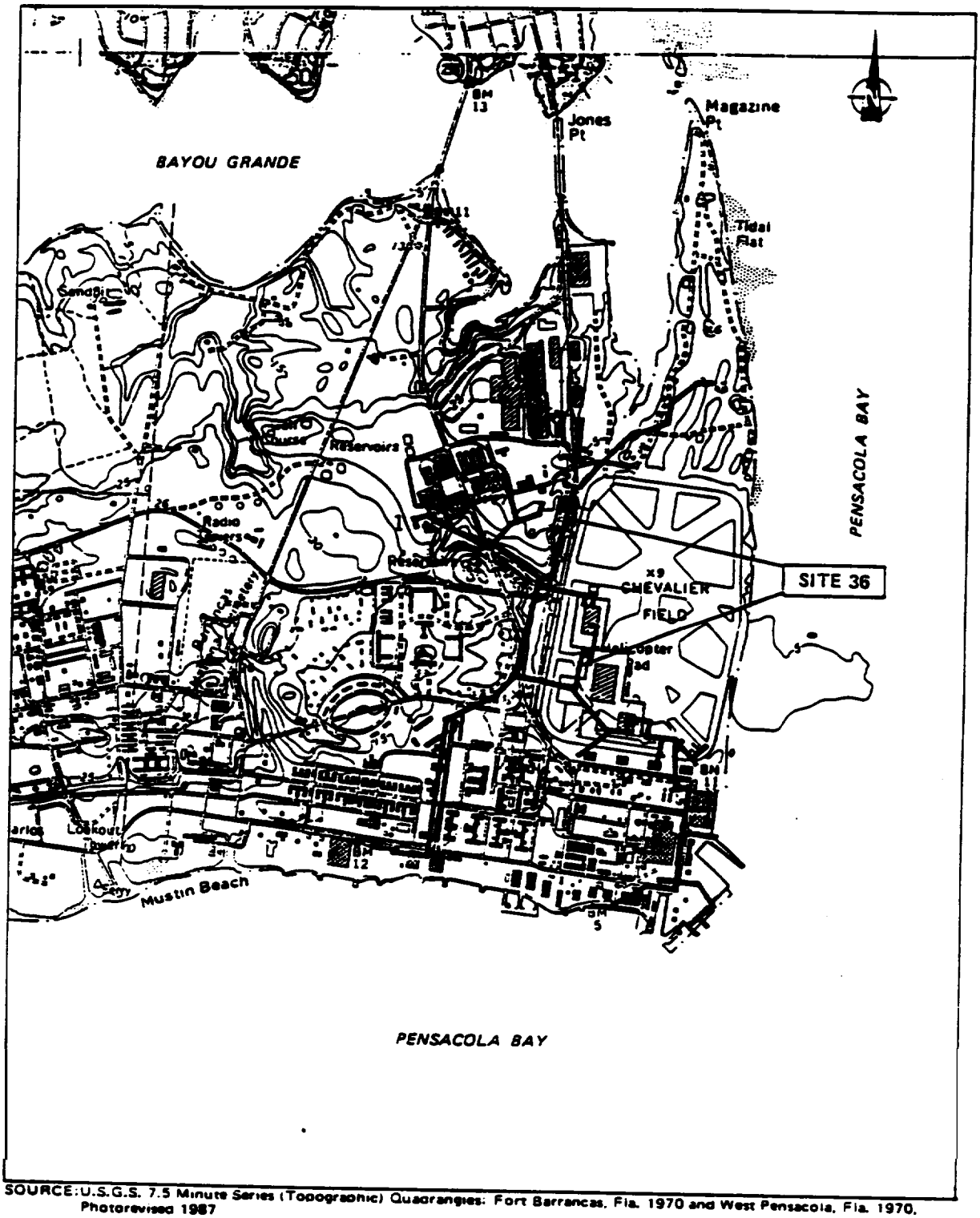

SOURCE: U.S.G.S. 7.5 Minute Series (Topographic) Quadrangles: Fort Barrancas, Fla. 1970 and West Pensacola, Fla. 1970. Photorevised 1987

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Figure 2-1 LOCATION MAP - NAS PENSACOLA SITE 36

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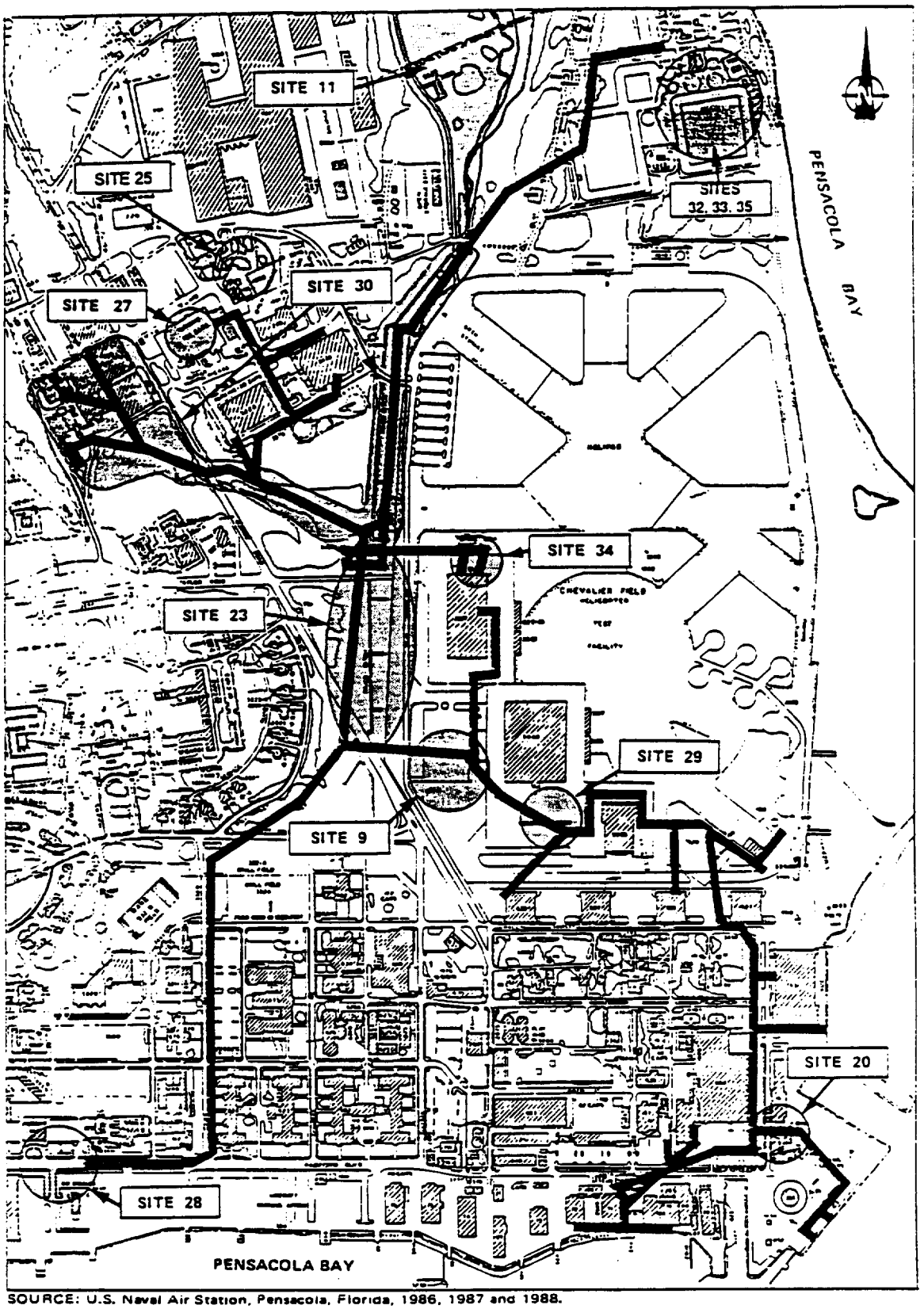

SOURCE: U.S. Naval Air Station, Pensacola, Florida, 1986, 1987 and 1988.

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0 250 500 1000 2000 FEET

Figure 2-2 SITE VICINITY MAP - NAS PENSACOLA SITE 36

Eighteen monitoring wells are located on site or within 500 feet of this site (associated vith the 14 sites listed above). The construction data of these wells are summarized in Table 2-1.

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TABLE 2-1

CONSTRUCTION DETAILS OF MONITORING WELLS NEAR SITE 36 AT NAS PENSACOLA

Well Designation	Surface Elevation (ft msl)	TOC Elevation (ft msl)	Total Depth Drilled (ft)	Screened Interval (ft)	Depth to Filter Pack (ft)
GM-1	28.4	29.69	26.3	23.8 - 26.3	18.5
GM-2	22.5	24.87	20.2	17.7 - 20.2	13.0
GM-6	6.0	6.40	12.0	9.7 - 12.2	5.7
GM-7	7.6	8.92	11.5	8.8 - 11.3	4.8
GM-26	3.6	4.48	11.5	9.2 - 11.7	5.2
GM-29	7.0	7.91	11.5	9.2 - 11.7	5.2
GM-30	5.1	6.14	11.5	9.2 - 11.7	5.0
GM-37	3.0	4.61	3.5	0 - 3.5	-
GM-49	4.9	7.36	15.0	12.5 - 15.0	8.0
GM-50	3.2	5.71	15.0	12.5 - 15.0	7.0
GM-51	2.3	4.84	63.0	58.0 - 63.0	55.0
GM-52	3.2	5.65	15.0	12.5 - 15.0	6.0
GH-53	3.7	6.20	15.0	12.5 - 15.0	6.0
GM-54	23.5	24.01	114.5	109.5 - 114 .5	100.0
GM-55	29.8	32.32	26.0	23.5 - 26.0	18.0
GM-56	9.3	8.98	12.5	10.0 - 12.5	4.0
GH-57	9.6	9.31	12.5	10.0 - 12.5	4.0
GH-58	30.7	33.22	25.5	23.0 - 25.5	15.0
GH-61	9.3	8.91	87.5	82.5 - 87.5	76.0

Source: Geraghty and Miller (G & M) 1984, 1986

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3. SITE HISTORY

The IWTP was upgraded from a sewage treatment plant built in 1948 to the present industrial waste system constructed in 1971. In 1973, Naval Air Rework Facility (NAVAIREUORKFAC) Pensacola operations were connected to the plant instead of discharging directly into Pensacola Bay. The IWTP sewer may consist of pipelines installed both prior to and after 1971 (Naval Energy and Environmental Support Activity [NEESA] 1983).

Most of the wastes from various types of operations enter the IWTP sewer without any pretreatment or segregation (NEESA 1983). Consequently, the waste stream may consist of everything that is generated or used in this facilty, including paint strippers, heavy metals, pesticides, radioactive wastes, fuels, cyanide wastes (prior to 1962), solvents, and waste oils.

In 1979, a pump failure [at the final industrial waste lift station, located approximately 2,000 feet southvest of the Industrial Waste Treatment Plant,] caused a spill of approximately 80,000 gallons of industrial waste [into a nearby unnamed creek, which leads into the south arm of Bayou Grande.] The spill was investigated by the Florida Department of Environmental Regulation (FDER), and a warning notice was issued to NAS Pensacola. The spill caused a minor fish kill [in the creek] (NEESA 1983).

In the spring of 1981, several people received minor skin burns from a black, slimy material in the soil. This incident occurred while these people were repairing a 16-inch water main south of Building 3460. A black layer of an unknown substance was floating on the water in a trench that had been excavated to repair the main. When the water was

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pumped out, the black, filmy residue coated the sides of the trench and the pipe. It is reported that there vas a noticeable odor, "similar to paint remover," during the excavation. *An* industrial [gravity line] from the old paint strip area (buildings 71 and 72) lies approximately 100 feet from the site of this incident. It is, therefore, suspected th industrial vaste from the force main might have leaked into the surrounding soil, creating a possible health hazard to anyone working in or near the open excavation (NEESA 1983).

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4. CLIMATOLOGY

NAS Pensacola is located in an area that typically experiences a mild, subtropical climate. This climate is a result of the latitude (approximately 30° North) and the stabilizing effect of the adjacent Gulf of Mexico (Wolfe ~~et al~~. 1988). The average annual temperature ranges from 55° Fahrenheit (F) in the winter to 81° F in the summer. Although the annual temperature range is fairly stable, actual daily values can be more extreme, ranging from less than 7° F in the winter to more than 102° F in the summer. Thunderstorms occur during approximately half of the days during the summer months and can cause a 10° to 20° F drop in temperature in only a few minutes (Wolfe et al. 1988).

Precipitation rates in the NAS Pensacola vicinity are relatively high with an average annual rainfall of approximately 60 inches. Rainfall amounts are highest in July and August during almost daily thunderstorms (averaging 7 inches per month) and lowest during spring and fall (averaging 4 inches per month; Kennedy 1982). High intensity thunderstorms are common, producing as much as 3 to 4 inches of rainfall during a single hour. Because evaporation rates are also highest in the summer months, the potential recharge resulting from heavy summer rains is reduced. Spring and fall rains are generally less intense, but longer in duration, producing less surface runoff and higher rates of infiltration and net recharge.

Wind velocities are generally moderate except during thunderstorms (Carlisle 1960). Prevailing winds are northerly during the winter and southerly during the summer. An ocean-land temperature differential

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produces a daily clockwise rotation of the surface wind direction near the coast, commonly known as the sea-breeze effect (Flood and Associates 1978). Hurricanes and tornadoes are infrequent but *can* cause substantial damage to the nearshore environment. *Six* hurricanes have passed within 50 miles of Pensacola since 1980.

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5. BIOLOGICAL RESOURCES

The NAS Pensacola facility consists of approximately 5,800 acres and encompasses approximately 15 terrestrial and aquatic habitats. The majority of the land on the eastern side of the facility is developed for military use or is designated as a historical or cultural resource. However, the NAS Pensacola installation has approximately 3,500 acres in natural or seminatural (plantation) condition, primarily in the western portion of the facility.

5.1 Regional Biological Resources

5.1.1 Terrestrial

Vegetation. The primary vegetated communities of the NAS Pensacola facility can be considered one of two types: north Florida coastal strand communities and sand pine scrub communities. The north Florida coastal strand communities are stabilized coastal dunes with a sand substrate, vegetatively characterized by the plants Uniola paniculata (sea oats), Hydrocotyle bonariensis (beach pennywort), Ipomoea stolonifera (beach morning-glory), Coccoloba uvifera (sea grape), Ouercus geminata (twin live oak), and the stunted shrubs species Yucca aloifolia (yucca), Opuntia, and Cereus. This community type has been ranked by the Florida Natural Areas Inventory (FNAI) as locally restricted and vulnerable to extinction due to developmental activities. This community type can have three to five distinct habitat types (Wolfe et al. 1988).

The sand pine scrub community is a more upland coastal community characterized by coastal dune formations from an older geologic age with deep, fine, white sand substrate and the plants Pinus clausa (sand

pine), Quercus spp. (scrub oak species, geminata, champanii, myrtifolia, and inopina), Cladonia species, and Ceratiola ericoides (rosemary). This community type has been ranked by FNAI as imperiled statevide because of its rarity and because of its vulnerability to extinction due to some artificial or biological factor. This community type can have three to five distinct habitats (Volfe et at. 1988).

Two other community types MY be found in the western portions of the NAS Pensacola facility. These are flatvoods and sandhill vegetative communities. Flatwoods vegetation occupies areas which were ocean bottoms in recent geologic times. Primary overstory vegetation is dominated by Pinus palustris (longleaf pine), Pinus elliottii (slash pine), and Serenoa repens (sav palmetto). Flatwoods communities also occupy areas of lov depressions and small creeks and drainage courses, but the overstory vegetation is usually replaced by Taxodium ascendens (pond cypress), Cliftonia monophylla (black titi), Cyrilla racemiflora (swamp titi), and other hydric or riparian species. Open moist savannah areas vithin flatvoods are dominated by the herbaceous plants Pinguicula spp. (butterwort), Sarracenia spp. (pitcher-plants), Uticularia spp. (bladderworts), Polygala spp. (milkworts), and Drosera spp. (sundews; Wolfe et at. 1988).

Sandhill communities are found in dry soils which are lower in fertility than flatvoods soils. The overstory of this community type is doainated by Pinus palustris (longleaf pine), Quercus laevis (turkey *oak),* Q. marilandica (bluejack *oak),* Q. stellata (post oak), and Q. falvata (southern red oak). The understory is dominated by Diospyros virginiana (vild persimmon) and Crataegus lacrimata (Pensacola hawthorn). The more abundant herbaceous plants found in moist areas are Pteridium aquilinum (bracken fern) and Aristida stricta (vire grass). These habitats vere verified vith walk-through surveys and ground truthing by the Navy in March 1986 (Navy 1986).

Freshvater Vetland Vegetation. Much of the geological material underlying the NAS Pensacola facility is deep, porous sand often containing relatively impermeable clay lenses. In combination vith high

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annual rainfall, this geologic condition causes the formation of small areas of perched groundwater. In areas with relatively steep slopes, groundwater seepage escapes into well-defined stream channels called steepheads as found near Site 30. In gently sloping areas, the presence of perched groundwater conditions results in the formation of wetland bogs, as found near Sherman Field. Wetland or seepage bogs are characterized by herbaceous plant species as described in the sections above for flatwoods and sandhill communities. Most of these communities and other vegetative communities east of Sherman Field have been considerably altered by development on the base that has changed surface and/or groundwater flow (NEESA 1983).

Shrub bogs are found within flatwoods, downslope of herbaceous bogs. These evergreen bogs are dominated by Cliftonia monophylla (black titi), and/or Cyrilla racemiflora (swamp titi). Associated species include Clethra almifolia (sweet pepperbush), Ilex cassine (dahoon holly), and Lyonia spp. (fetterbushes; Uolfe et at. 1988).

Intermittent streams found on NAS Pensacola have lost most of the original vegetation associated with this habitat. For example, at Site 30, the stream that empties the small swamp into Bayou Grande has lost a considerable amount of vegetation along the stream banks and near Bayou Grande as a result of base development. In areas unaffected by development, hardwoods dominate the canopy around the stream. Such species as Magnolia virginiana (sweetbay), Illicum floridanum (star anise), and Smilax bona-nox (spiked cat brier) are dominants of seepage or steephead streams (Uolfe et al. 1988).

Biota surveys must be conducted for any wetland or stream habitat that is influenced by a site to determine which specific flora and fauna may be affected by site activities.

Birds. A literature search reveals 250 possible bird species associated with the area. Thirteen of these species are endangered, and seven are species of concern (see Appendix C). In March 1986, the Navy conducted a survey and found 23 species of birds on the NAS Pensacola facility.

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The Navy recorded moderate size rookeries of the great blue heron and found large numbers of nesting osprey in the southwestern portions of the NAS Pensacola facility. Because of the large number and diversity of habitats found around the facility and considering that the survey vas conducted during a predominantly non-mating season, it is likely that there are more species of birds using the facility and surrounding vaters as feeding and nesting sites than have been found.

Reptiles and Amphibians. During the 1986 survey conducted by the Navy, only four out of a possible 30 species of reptiles and amphibians associated vith the area vere identified on the NAS Pensacola facility, none of which are endangered. A recent check of the FNAI files confirms that the presence of the gopher tortoise (Gopherus lyphemus) can most likely be found in suitable habitats on the vestern portions of the facility (see Appendix C). Host of the reptiles and amphibians that may be found on the facility can be expected to use the surface vater bodies in some stage of their life cycle. Any contamination of surface vater bodies *can* be detrimental to existing populations of reptiles and uphibians utilizing that vater body.

512 Aquatic

Freshvater. Little is known of the flora and fauna inhabiting the streams, svamps, and bogs found on NAS Pensacola. These habitats may have been significantly altered for drainage control and base development. Some of the species associated with aquatic habitats are Semotilus atromaculatus (creek chub), Gambusia affinis (mosquitofish), and Etheostoma sp. (darters). Birds, mammals, reptiles, and amphibians that associate with aquatic habitats may also be found in and around those sites vith surface vaters (Volfe et al. 1988).

—— *tal* Wetlands. There are no reported coastal marshes or estuarine vetlands around the NAS Pensacola facility, principally along the lov energy shores of Bayou Grande. The habitat type is usually dominated by saltmarsh cordgrass (Spartina alterniflora) or black needlerush (Juncus roemarianus). A biota survey of these and other potential habitat areas will be conducted to determine the extent of estuarine flora and fauna.

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Seagrass beds are reported to be present within Big Lagoon along the southwestern portion of the NAS facility. These grassbeds are composed primarily of Thalassia testudinum, Syringodium filiforme, and Aalodule beaudettei. Seagrass beds in the area surrounding the facility have not been historically mapped, and very little is known of their composition, locality, or areal extent. Grass beds of unknown species composition extending along the north shore of Pensacola Bay in the *1950s* disappeared by *1961.* An examination of historical aerial photographs (see Section 12) may elucidate past distributions of seagrasses.

Plankton. The only existing study of the phytoplankton and zooplankton in the waters surrounding the NAS Pensacola facility was conducted by the Navy in March 1986. The phytoplankton has been characterized as low in productivity (as compared to other Gulf coast estuaries), and mainly dominated by the diatoms Navicula tripuncata, Bacteriastrum spp., Chaetocerus spp., Thalassionema nitzschoides, and Iiemiaulus spp. The zooplankton is primarily dominated by Calonoid copepods and benthic invertebrate larvae. This study is very limited by the fact that samples were collected with undefined methods and only during the early spring. This sampling protocol does not define population fluctuations that are characteristic of low population abundances commonly found in estuaries during the summer months. Examination of the zooplankton data results in the same conclusions. It should be pointed out that any contamination entering Pensacola Bay from either groundwater or surface water sources may be accumulated in the invertebrate larvae that predominate most estuarine water bodies.

Benthos. Marine soft-sediment communities are found adjacent to the northern, eastern, and southern areas of the NAS Pensacola facility in Pensacola Bay. Although no intensive benthic surveys were conducted along the perimeter of the facility, surveys at nearby sites by FDER and the Navy have described the benthic communities within Pensacola Bay as a whole. FDER collected benthic samples in most of Pensacola Bay and found that the sediments were dominated by polychaetes (Aricidea spp., Capitella spp., various spionids, and Haploscoloplos spp.) and bivalves

(Anodontia alba and Tellina spp.) during most of the year. FDER samples collected along the vastevater treatment plant outfall show a drastic drop in species abundance and diversity close to the sevage outfall (Navy 1986). This indicates that the benthic community might have been negatively influenced by the sevage outfall.

Samples collected by the Navy (1986) indicate a lov density yet moderate diversity of benthic infaunal organisms vhen compared to other estuarine systems vithin and around the turning basin. A complete comparison of the Navy's data cannot be made to other literature at this time because their data are not given in numbers per unit area. However, the Navy's data reveals that very few deep dvelling organisms reside in the areas around the turning basin, and a lack of deep dvelling benthic organisms may be an indication of a benthic community under stressed conditions (Luckenbach et at. 1988).

Fish and Shellfish. Early studies of Pensacola Bay have identified 180 bony fish species and seven cartilaginous fish species (Cooley 1978). The 13 most abundant species were spot (Leiostomus xanthurus), pinfish (Lagodon rhomboides), Atlantic croaker (Micropogonias undulatus), gulf menhaden (Brevoortia patronus), bay anchovy (Anchoa mitchilli), longspine porgy (Stenotus caprinus), silver perch (Bairdiella chrysoura), southern hake (Drophycis floridana), inshore lizardfish (Synodus foetens), gafftopsail catfish (Bagre marinus), sand seatrout (Cynoscion arenarius), and spotted hake (Urophycis regia: Eeil 1988).

Fish diversity vas highest in the more saline waters near the NAS Pensacola facility during spring and summer. In the less saline waters of East Bay, diversity vas lovest in summer and highest during the viater months. Fish population density vas the highest in the more saline waters, vith peaks throughout the summer (Cooley 1978).

Moderate densities of blue crab (Callinectes sapidus), shrimp (Penaeus duorarum, P. setiferus, and P. aztecus), and oysters (Crassostrea virginica) have been collected throughout Pensacola Bay (Eeil 1989). Shrimp are caught in greater abundances near NAS Pensacola because of

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the higher salinities. Blue crabs and oysters are more readily caught in the East Bay area. In fact, the only legal shellfishing areas recognized by the Florida Department of Natural Resources (FDNR) are in the East Bay area. Scallops (Aequipecten irradians) are collected only within grassbed areas. No information is available at this time on where scallops are collected by the general public and how many are removed. The nearest seagrass beds to the NAS facility are located in Big Lagoon along the southwest portion of the facility.

Sport and Commercial Fishing. A moderate amount of commercial fishing occurs in Escambia county, accounting for 2% of the total Florida landings for 1980 to 1985 (Navy 1986). The dominant finfish species in terms of total weight was the black mullet. The most economically important species of finfish was the red snapper. E & E examined the commercial landing data for Escambia county for 1987 and 1988 (Heil 1989) and found that the most important commercial species by weight were: black mullet (24% of county landings), brown shrimp (21%), vermillion snapper (19.5%), red snapper (7.6%), porgies (4.7%), and amberjack (4%). Other less important commercial fish caught were Spanish mackerel, sand seatrout, black grouper, spotted seatrout, blue crab, and squid. These data, as well as the Navy's data, also suggest that a significant tuna fishery may be developing in the Pensacola Bay area (0 pounds landed in 1983; 1,582 pounds in 1987).

Sport Fisheries data is not available from the State of Florida at this time due to the lack of a state saltwater fishing license (Heil 1989). A telephone survey conducted by the U.S. Fish and Wildlife Service ranks the spotted seatrout as a primary fish species sought by fisherman in 1987. Following this species were: king mackerel, red drum, Spanish mackerel, groupers, red snapper, flounders, and sand seatrout. It is likely that the sport fishing catch equals or exceeds commercial landings for species sought by both interests (Navy 1986).

The estuarine system is a very important element in the life history of most of the commercial and sport fishing species sought. Between 65 and

90% of all commercially valuable fish species are estuarine dependent during some phase of their life cycle. Shrimp, blue crab, and shellfish are known to release larvae that feed in and around estuaries until settlement. During early life history stages, the juveniles reside vithin seagrass beds or other protected habitats until maturity. Any contamination of the water or sediments around NAS Pensacola could be detrimental to fish and shellfish population structure or could be accumulated by the organisms residing near the facility.

Marine Mammals. Fev mammals have been sighted vithin the area of the NAS Pensacola facility. Most of the 13 species of mammals reported for the northeastern Gulf of Mexico stay predominantly in Gulf waters. The Atlantic bottlenose dolphin (Tursiops truncatus), however, has been sighted regularly off the NAS Pensacola facility. Manatees have been sighted irregularly, vith one recant sighting in the area recorded by FNAI in October 1988. A goosebeaked vhale (Ziphius cavirostris) vas reported stranded on Santa Rosa Island, and a pilot vhale (Globicephala macrorhynchus) vas found stranded on a beach near Pensacola (Navy 1986).

Although no surveys of marine mammals have been conducted, it can be assumed that they are quantitatively ranked as uncommon to common in abundance vithin the vaters surrounding the NAS Pensacola facility.

Threatened and Endangered Species. A number of threatened and endangered species (see Appendix C) have been identified in the vicinity of the NAS Pensacola facility. Many rare, threatened, and endangered species are associated with the wetland or bog habitats found on NAS Pensacola. A total of 57 occurrences for six plant species were recorded in an inventory conducted by FNAI (1988b) of the NAS Pensacola facility (see Appendix C). Most of these plants were found in the area around Sherman Field and habitats to the vest. Any site remediation and, more importantly, any assessment of environmental endangerment must consider the water level requirements of rare and endangered plant species, the foraging activities of birds in the vaters surrounding the NAS Pensacola facility, and nesting and feeding animals on the facility

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grounds. Complete biotic surveys may be necessary to determine the presence of threatened or endangered species and potential pathways of Contamination to these species.

5.2 Site-Specific Biological Resources

Site 36 lies underground in the southeastern corner of the NAS Pensacola facility and extends approximately 6 miles. As an industrial waste sewer line, it has no direct effect on the biological resources found at the surface. It may, however, have an indirect effect on the soils and groundwater, thereby affecting the biological resources found downgradient from the sewer line. The creek associated with Site 30 and the paved drainage ditch along the western side of Chevalier Field are both located within 100 feet of the sewer line. These aquatic habitats and associated faunal populations may be affected by contamination from Site 36. Pensacola Bay lies within 100 feet of some of the southern portions of Site 36, and the faunal populations associated with this marine habitat may be affected by contamination from the site.

If shallow soil contamination exists in the site vicinity, floral species associated with the habitats above Site 36 may be affected. A complete biotic survey along the entire sewer line must be conducted to identify the habitats and communities potentially affected by this site.

6. SURFACE WATER HYDROLOGY

6.1 General Occurrence and Significance of Surface Water

The NAS Pensacola facility is located on a coastal peninsula bounded by Bayou Grande to the north, Pensacola Bay to the south and east, and Big Lagoon to the southwest. Pensacola Bay and Big Lagoon are partially separated from the Gulf of Mexico by Santa Rosa Island and Perdido Key, both of which are barrier islands.

Surface soils consist primarily of permeable sands which allow rapid infiltration of precipitation. This direct infiltration limits stream formation and constitutes the major source of recharge to the underlying Sand-and-Gravel Aquifer.

There are no naturally occurring perennial streams on NAS Pensacola; however, there are approximately 10 naturally occurring intermittent streams and numerous artificial drainage pathways which include many stormwater outfalls. Discharge is mainly to the south into Pensacola Bay; however, some small intermittent streams discharge into Bayou Grande to the north from Sherman Field and Chevalier Field (U.S. Geological Survey [USGS] 1970a, 1970b).

The southwestern and northern portions of NAS Pensacola contain areas of freshwater wetlands. These are particularly sensitive areas formed by the intersection of the water table with the land surface. These systems are defined by and dependent upon a dynamic water-cycle, with periodic inundation and exposure corresponding to seasonal fluctuations in the water table.

The discharge of surface waters into Pensacola Bay, Bayou Grande, and the coastal wetland areas presents the potential for transport of contauinants into these systems. This could have a significant impact on seagrass and other sensitive plant communities, as well as on shell fishing, recreational fishing, and swimming in these coastal zones. Discharges, either through the surface water or groundvater, into wetland areas found on site could also have a significant impact on the biotic communities that are dependent on those habitats.

6.2 Site-Specific Surface Water Hydrology

At least three surface water bodies lie in close proximity to portions of Site 36. These are Pensacola Bay, Bayou Grande, and tbe unnamed creek and paved ditches associated with Site 30. Any contamination determined to be associated with Site 36 may ultimately impact these surface water bodies, primarily via groundwater transport. No investigation of these water bodies is planned as part of this study. However, the investigation of the unnamed creek, paved ditches, and a portion of Bayou Grande is being addressed by a separate work plan (Group E). *Also,* an investigation of nearshore sediments in Pensacola Bay is being adddressed in the work plan for Group C.

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7. PHYSIOGRAPHY AND HYDROGEOLOGY

7.1 Physiography and Regional Hydrogeology

7.1.1 Physiography

NAS Pensacola is located in the Gulf Coastal Lowlands Subdivision of the Coastal Plain Province physiographic division (Brooks 1981). The 5,800-acre facility is located on a peninsula bounded on the east and south by Pensacola Bay and Big Lagoon and on the north by Bayou Grande. The most prominent topographic feature on the peninsula is an escarpment or bluff which parallels the southern and eastern shorelines and on which Fort Barrancas was built. In the eastern portion of NAS Pensacola, the bluff runs north-south just to the west of Chevalier Field. Seaward of the escarpment is a nearly level marine terrace with surface elevations of approximately 5 feet above MSL. The central part of the peninsula, located landward of the escarpment, is a broad gently rolling upland area with surface elevations up to 40 feet MSL (USGS 1970a, 1970b). Sandy soils occur throughout the NAS Pensacola area. As a result, most of the rainfall infiltrates directly into the subsurface. Consequently, there are few streams or surface water bodies on the peninsula.

7.1.2 Regional Eydrogeology

There are three principal hydrogeologic units of importance which underlie the NAS Pensacola. These are, in descending order, the Surficial Aquifer, the Intermediate System, and the Floridan Aquifer System.

7.1.2.1 Surficial/Sand-and-Gravel Aquifer

The Surficial Aquifer occurs from land surface to a depth of approximately 300 feet at NAS Pensacola and is composed of a sequence of unconsolidated to poorly indurated clastic deposits (Wagner et al.

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1984). In this portion of Florida, the Surficial Aquifer constitutes an important source of vater supply and is called the Sand-and-Gravel Aquifer (Southeastern Geological Society [SEGS] 1986). Based on the total dissolved solids (TDS) content of groundwater from vells that tap the Sand-and-Gravel Aquifer in southern Escambia County (Clemens et al. 1989), the groundwater is classified as Class G-1 (FDER 1988b). The sediments making up this aquifer belong to all or part of the Pliocene to Eolocene Series which, in this area, consist mainly of the Citronelle Formation overlain by a thin cover of marine terrace deposits. Given that the Sand-and-Gravel Aquifer is contiguous vith land surface and recharge occurs principally by the direct infiltration of precipitation, the aquifer is particularly susceptible to contamination from surface sources. In the NAS Pensacola vicinity, the Sand-and-Gravel Aquifer is made up of three zones based on contrasting permeabilities. These zones are referred to as the surficial zone, the lov permeability zone, and the main producing zone (Wilkins et at. 1985).

Surficial Zone. The surficial zont is contiguous vitb land surface and contains groundvater under vater table or perched vater table conditions. The results of numerous borings conducted at NAS Pensacola (Geraghty and Miller, Inc. [G 6 M] 1984, 1986) indicate that the surficial zone ranges in thickness between 40 and 70 feet and consists of tan and brown, fine- to medium-grained quartz sand. Depth to the vater table vithin the surficial zone is variable depending on location and ranges from less than 1 foot near surface water bodies to more than 20 feet in areas of higher elevation. In general, the direction of groundvater flov is controlled by the topography and by discharge to surface vater bodies. Consequently, shallow groundvater in the surficial zone moves toward areas of lover elevation and/or the nearest surface vater body. Overall, the surficial zone has a high permeability. Numerous aquifer (slug) tests and laboratory permeability tests conducted on wells in or sediments from the surficial zone at NAS Pensacola yielded hydraulic conductivity values ranging from 16 to 56 ft/day (G & M 1986). Horizontal groundvater flow velocities in the surficial zone will depend on site-specific hydraulic conductivities and horizontal hydraulic gradients; however, velocities vould generally be expected to be high.

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Low Permeability Zone. Underlying the surficial zone is a zone of lower permeability sediments dominated by clay and silt-sized material. This zone is referred to as the low permeability zone. At NAS Pensacola this zone is generally composed of gray to blue, sandy, silty, slightly fossiliferous (shelly) clay and clayey sand ranging in thickness from 8 to 40 feet (G & M 1984, 1986).

The results of laboratory permeability tests conducted on samples from this zone indicate that vertical hydraulic conductivities are low, ranging from 4.2 x 10^{-5} to 9.9 x 10^{-2} ft/day. Thus, the low permeability zone probably functions as a confining or semiconfining unit inhibiting the flow of groundwater between the surficial zone and the underlying main producing zone. The low permeability zone has been encountered in at least 16 borings at widely spread locations throughout NAS Pensacola (G & M 1984, 1986). Although additional boring or geophysical techniques would be required to confirm its presence at a given location, it is likely that this unit is ubiquitous at NAS Pensacola. Few, if any, wells are open to the low permeability zone at NAS Pensacola; thus, no information is available regarding groundwater flow direction.

Main Producing Zone. The bottom portion of the Sand-and-Gravel Aquifer is called the main producing zone and consists mainly of sand and gravel interbedded with thin beds of silt and clay. The depth at which the main producing zone is encountered is somewhat variable, ranging from 60 to approximately 120 feet below land surface (BLS) at NAS Pensacola. This zone generally has the highest permeability characteristics due to thicker and more persistent sand and gravel beds, and is tapped by most of the major wells in the Pensacola area (Wilkins et al. 1985). NAS Pensacola has three supply wells which produce water from this zone; however, due to high iron content in the water, the wells are infrequently used (G & M 1986). The principal sources of water for NAS Pensacola are wells located at Corry Field, approximately 3 miles to the north. The thickness of the main producing zone can be highly variable; however, it is estimated to be up to about 100 feet at NAS Pensacola. Insufficient data exist for wells open to the main producing zone at NAS

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Pensacola to determine direction of groundwater flov vithin this zone; however, the flw direction is assumed to be generally southward under ambient conditions. Pumpage of the supply wells would locally cause groundwater in this zone to flov tovard tbe wells.

As a result of the overlying lov permeability zone, groundwater within the main producing zone occurs under confined or semiconfined conditions. At one nested well location on NAS **Pensacola** (east of Building *648)* the water level elevation in a well open to the main producing zone is approximately 7 feet lover than that in an adjacent vell open to the surficial zone (G & M 1986). This indicates that a significant downward hydraulic gradient exists between these two zones. Thus, a considerable potential exists for vertical groundwater flow from the surficial to the main producing zone at this location. It is not known to what extent this potential exists elsewhere at NAS Pensacola.

7.1.2.2 Intermediate System

The lower limit of the Sand-and-Gravel Aquifer coincides vith the top of a regionally extensive and vertically persistent hydrogeologic unit of much lower permeability. This unit is referred to as the Interaediate System. In the vicinity of NAS Pensacola, the top of the Intermediate System generally lies within the sediments termed Hiocene Coarse Clastics or corresponds to the top of the Upper Hember of the Pensacola Clay and occurs at a depth of approximately 300 feet (Vilkins et al. 1985). In general, the Intermediate System consists of fine-grained sediments and functions as an effective confining unit which retards the exchange of water betveen the overlying Sand-and-Gravel Aquifer and the underlying Floridan Aquifer System (SEGS 1986). The entire sequence is primarily poor to non-vater bearing. However, relatively thin beds of sand which may yield small quantities of water exist within the unit. In the NAS Pensacola area, the Intermediate System is approximately 1,100 feet thick and is composed of the lower portion of the Miocene Coarse Clastics, the Upper Hember of the Pensacola Clay, the Escambia Sand Member of the Pensacola Clay, and the Lover Member of the Pensacola Clay; all of Hiocene Age.

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7.1.2.3 Floridan Aquifer System

Immediately underlying the Intermediate System and occurring at a depth of approximately 1,500 feet BLS at NAS Pensacola is the Floridan Aquifer System. The Floridan Aquifer in this area is composed of the Middle to Lower Miocene Chickasawhay Limestone and undifferentiated Tampa Stage Limestone. Groundwater within the Floridan Aquifer in this area is highly mineralized and is not used for water supply (Wagner et al. 1984).

7.2 Site Hydrogeology

In the immediate vicinity of IWTP sewer areas, the surficial zone of the Sand-and Gravel Aquifer occurs from land surface to a depth of approximately 50 to 70 feet. The lithologic description of cuttings collected during the installation of monitoring wells GM54, located near Site 27, and GM61, located near Site 34 (see Figure 2-2), indicates that this zone primarily consists of tan and brown, fine- to medium-grained quartz sand. Several shallow monitoring wells open to the surficial zone exist in the immediate vicinity of Site 36. These wells indicate that the water table in most of the site areas occurs approximately 2 to 4 feet BLS. In the northwestern section, the water table is approximately 15 to 18 feet BLS.

Generally, the shallow groundwater flow direction is toward the nearest surface water body (i.e., Pensacola Bay, Bayou Grande, the unnamed creek, or paved ditches). Based on water level data collected from shallow wells in the area, the horizontal hydraulic gradient ranges, approximately, from 0.005 to 0.0005. G 6 M (1986) reported that aquifer tests have been conducted on wells GM49 and GM56, and hydraulic conductivities were found to be 34 ft/day and 57 ft/day, respectively. Assuming an effective porosity of 0.20, an average hydraulic conductivity of 46 ft/day, and an average hydraulic gradient of 0.0028, a groundwater flow velocity for the surficial zone in this area is estimated to be approximately 0.64 ft/day or 235 ft/year.

Immediately underlying the surficial zone in the vicinity of Site 36 and extending to a depth of approximately 60 to 100 feet is the low permeability zone of the Sand-and-Gravel Aquifer. Based on the cuttings from the installation of wells GM54 and GM61, this zone primarily comprises green to gray, sandy, clayey silt with SON shell fragments. No monitoring wells open to the lov permeability zone exist in the vicinity of Site 36; however, based on the lithology, this zone would be expected to function as a confining or semiconfining unit restricting the flow of groundvater between the surficial zone and the underlying main producing zone. The direction of groundvatcr flov within the low permeability zone is unknown.

The top of the main producing zone occurs at approximately 75 to 110 feet BLS in the site vicinity and mostly consists of fine- to medium-grained quartz sand. Monitoring wells GM54 and GM61 are open to the upper portion of this zone. The water level elevation in well GM61 is approximately 4 feet lower than that in well GM56 (open to the rurficial zone), and the vater level elevation in well GM54 is approximately 7 feet lover than that in well GM02 (a shallow well located 30 feet southeast of GM54). This indicates a significant dovnvard hydraulic gradient between the surficial zone and the main producing zone in this area (G & M 1984). Thus, depending on the vertical hydraulic conductivity of the low permeability zone at this site location, a significant potential for dovnvard groundwater flow from the surficial zone into the main producing zone exists.

The direction of groundvater flow within the main producing zone at these sites is unknown; however, a generally southward flov is expected under ambient conditions. An NAS Pensacola supply well (Well No. 2), located approxinately 2,000 feet west of the main section of the IWTP sewer, is screened between 105 and 160 feet BLS and thus is open to the main producing zone. This well is utilized by NAS Pensacola for backup vater supply only during periods of peak demand.

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Eovever, during these periods of pumping, the direction of flow in the main producing zone would be directly toward the supply well. Insufficient data exist for wells open to the main producing zone to allow a determination of hydraulic gradient at NAS Pensacola.

No aquifer test data exist for monitoring wells open to the main producing zone at NAS Pensacola. However, records on file with the Northwest Florida Water Management District (1985) indicate that Well No. 2 has a specific capacity of 21 gallons per minute per foot (gpm/ft) at a pumping rate of 650 gpm. This data can be used to calculate a rough approximation of the hydraulic conductivity (Lohman 1979) for the main producing zone of 150 ft/day.

8. PROJECT MANAGEMENT PLAN

The Generic Project Management Plan (GPMP) defines the technical approach and schedule as well as the qualifications of personnel who will be directing and performing this Contamination Assessment/Remedial Activities Investigation. This work plan will incorporate and reference applicable technical and schedule sections, as appropriate, and will follow E & E's project management guidelines (see Section 22).

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9. SITE MANAGEMENT PLAN

The Generic Site Management Plan (GSMP) defines the management procedures for field activities on both the site and program level. The management and implementation of all field activities conducted as part of the Contamination Assessment/Remedial Activities Investigation of Site 36 will follow the GSMP and any updated versions. Data quality objectives (DQOs) and all applicable or relevant and appropriate requirements (ARARs) have been considered in developing the initial phases of fieldwork described here and will be updated and revised for any subsequent phases of fieldwork.

10. HEALTH AND SAFETY PLAN

A comprehensive General Health and Safety Plan (GHSP) and individual site-specific safety plans (SSPs[; see Appendix A]) have been developed to provide readily available emergency information and preventative safety measures. The GRSP outlines health and safety procedures and protocols to be followed during all field investigations at each of the 39 sites on NAS Pensacola. The plan includes: standard operating procedures (e.g., site entry and decontamination); hazard communication and training (e.g., safety training, briefings, and documentation); safety equipment and instrumentation (e.g., monitoring and personnel protective equipment); hazard evaluation by contaminant class (e.g., metals and organics); and hazard evaluation for each task (e.g., drilling and sampling). The GHSP will be periodically updated, as required, during the course of this program.

In addition, the GHSP and the individual SSPs will define the toxicological properties and health hazards associated with each site. The SSP will include emergency action information pertinent to the safety of the field personnel and of the public (i.e., hospitals, ambulatory units, poison control centers, fire departments, and police/sheriff departments). The SSP will also identify first-aid and personal safety equipment and will provide recommended site security precautions. The GHSP and the SSP will comply with the Occupational Safety and Iiealth Administration (OSHA) Guidelines for Hazardous Waste Operations (29 Code of Federal Regulations [CFR] Section 1910).

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11. QUALITY ASSURANCE PROJECT PLAN

A Generic Quality Assurance Project Plan (GQAPP) has been prepared and submitted to the Navy. This comprehensive document will be referenced for all field and laboratory procedures for this program, and will be used to develop the Site-Specific Quality Assurance Plans (SQAPs[; see Appendix B]).

The SQAP will provide site-specific quality assurance/quality control (QA/QC) measures used to obtain accurate and precise data for all site investigation activities. The SQAP will address all phases of the investigation from development of the initial sampling plan through verification and reporting of the analytical results. All of the QA/QC procedures described in the GQAPP and SOAP will be in accordance with applicable professional technical standards, U.S. Environmental Protection Agency (EPA) requirements, and specific Navy goals and requirements €or this project. All samples will collected, handled, packaged, preserved, and transported in accordance with the GQAPP and SQAP and with U.S. Navy and EPA procedures.

12. AERIAL PHOTOGRAPH ANALYSIS

Prior to the initiation of fieldwork, E 6 E will examine all available aerial photographs of NAS Pensacola for past and present conditions, features, and developments which may have direct relevance to the fieldwork methodology. The aerial photograph analysis task will involve assembling and stereoscopically analyzing historical photographic imagery and topographic maps available for the site area. For the purpose of supporting the development of field investigation strategies, efforts will be made to obtain photographs of an appropriate scale that will allow for analysis of past and present surface conditions, drainage, and land use. Photographs showing the history of site activities will be analyzed to obtain information regarding the evolution of site features which might have affected hydrologic conditions. The historical perspective gained by studying aerial photographs will provide insight applicable to such tasks as field reconnaissance and monitoring well placement. In addition, the analysis of historical and current aerial photographs, performed in conjunction with geophysical investigation, will aid in the accurate determination of the extent of the formerly used area at the site.

13. UTILITIES SURVEY

Prior to conducting any augering, boring, drilling, or excavation activities, E & E will locate all underground cables, pipes, utilities, or other obstructions which may become damaged or otherwise hinder fieldwork. The appropriate authorities (e.g., NAS Pensacola Public Works and Southern Bell) will be contacted to identify the location of all underground utilities in the site area. In addition, E & E will examine available maps and documents and conduct a metal detector survey on site to determine the presence of any other potentially hazardous subsurface features. If appropriate and applicable, other surface geophysical techniques may be used to locate deeper obstructions not readily detected with a metal detector. The locations of all underground utilities or obstructions will be marked with surveyors flags, day-glow paint, or by other methods as appropriate. This task may be conducted as part of the physical survey but will be considered a separate task for cost purposes.

14. FIELDWORK METHODOLOGY

14.1 Phase I — Field Screening

The primary objective of the Phase I field screening investigation is to effectively and efficiently focus the Site Characterization (Phase 11) and subsequent Extent Delineation (phases III and IV) studies. The field screening phase will employ a variety of field investigation techniques, including the collection of samples for laboratory analysis. However, the analysis of these samples will be subject to less rigorous QA/QC requirements, which reflect the "focusing" objective--rather' than a formal contaminant quantification objective--of this phase. Each field screening task will utilize all existing information from preceding tasks, including aerial photograph analyses, to adjust the locations of the various surveys and sampling locations, thereby achieving optimum results. The objectives/advantages of the field screening methods are discussed in detail in Section 9.1 of the GQAPP.

[Data quality objectives (DQOs), which specify the quality of the data required to support decisions during remedial response activities, are contained in E & E's GQAPP and Site Management Plan (SMP). Phase I screening level data (DQO Level I & 11) will be used to focus the phase II sampling (DQO Level III & IV).]

14.1.1 Physical Survey

14.1.1.1 Overall Physical Reconnaissance

A field reconnaissance survey will be conducted along the IWTP sewer line areas. Available aerial photographs and maps will be used as guides in locating surface features. Visual inspections will be made regarding surface conditions, stressed vegetation, surface drainage patterns, overflow areas, and leachate seeps.

During the reconnaissance survey, the field team will identify areas which present the most suitable conditions for the establishment of survey baselines.

The reconnaissance survey team will utilize radiation air monitoring equipment during walkovers of Site 36, in accordance with Section 6.1.1 of the GOAPP. In the event that any readings above background are obtained, the area(s) will be flagged and identified on a site map for future reference. All findings of the physical reconnaissance will be mapped in detail and recorded in the field logbook.

14.1.1.2 HNu/OVA Surface Emissions *Survey*

An emissions survey will be conducted using HNu and/or organic vapor analyzer (OVA) air monitoring equipment. The survey will be conducted in accordance vith Section 6.1.1 of the GQAPP. Measurements will be taken continuously along the sever line where possible. Any readings above background will be recorded in the field logbook.

14.1.1.3 Radiation Survey

A radiation survey will be conducted using a micro-R-meter and gamma scintillation detector. The survey will be conducted in accordance with Section 6.3.6 of the GQAPP. Measurements will be taken continuously along the sewer line vhere possible. Any readings above background will be recorded in the field logbook.

14.1.1.4 Habitat/Biota Survey

During the physical reconnaissance, an E & E biologist/ecologist will determine the on-site terrestrial and aquatic habitats and the surrounding habitats which may be affected by off-site contaminant migrations. During the valkover survey, rare, threatened, and endangered species and their potential habitats will be identified, and an evaluation will be made of general site conditions to support'viable populations of plants and animals. [Using historical aerial photographs and the survey results, a map illustrating the identified habitats will be generated.] A habitat/biota survey will be conducted along the

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entire route of the IWTP sewer line, as well as a literature search for specific areas of NAS Pensacola.

14.1.2 Soil Gas Survey

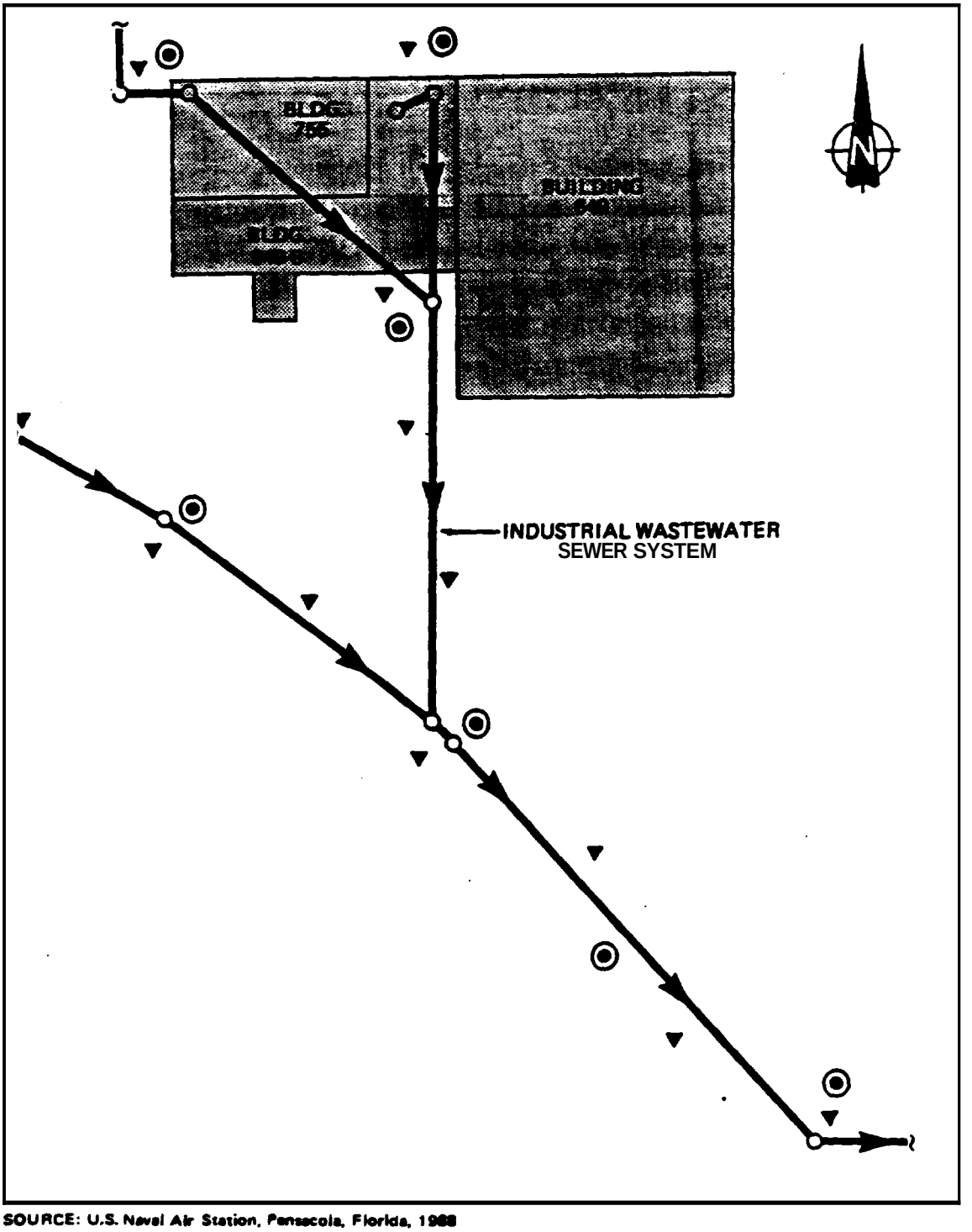
Phase I will require a soil gas survey be conducted €or Site 36 to determine the spacing of soil sampling and monitoring well locations along the length of the underground sewer system. Soil-gas probes will be installed manually into the subsurface at a frequency of every 100 feet along the sewer system. An OVA will be used in the survey mode to screen for the presence of organic vapors. In addition, a granular activated carbon probe will be utilized on the OVA to determine the presence of methane gases. After measurements are completed at each location, the probe will be extracted, and the location will be mapped. A typical soil gas measurement location scheme is shown on Figure 14-1. The soil gas survey and measurements will be conducted according to Section 6.5 of the GQAPP.

14.1.3 Analytical Screening

14.1.3.1 Laboratory Analyses

Phase I sampling activities for Site 36 will require the installation of shallow temporary monitoring wells, groundwater sampling, and the collection of soil samples. All of the samples will be analyzed in the laboratory for analytical screening parameters. The analytical screening program has been developed for the Phase I effort as a measure to efficiently and cost-effectively provide focus for subsequent phases of site characterization and contamination extent delineation. Analytical screening is addressed in detail in Section 9.1 of the GQAPP. Analytical requirements for samples collected in Phase I are shown in Table 14-1.

Soil -- Approximately 145 soil borings will be drilled along the IWTP sewer line using either a solid-stem auger extraction method or a hand-operated bucket auger. The exact depth of the industrial sewer line varies from place to place and will be determined from Navy "as-builts" prior to fieldwork. Soil samples will be collected from



SOURCE: U.S. Naval Air Station, Pensacola, Florida, 1988

SCALE

0 50 100 200 300 FEET

KEY:

- ▼ Soil Gas Survey Location
- ● Tentative Soil Boring
- ○ Tentative Temporary Monitoring Well
- ○ Manhole

Figure 14-1 TYPICAL SOIL GAS SURVEY, SOIL BORING, AND TEMPORARY MONITORING WELL LOCATIONS, SITE 36 - PHASE I

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TABLE 14-1

PHASE I SAMPLING AND ANALYTICAL REQUIREMENTS—GROUP N

SITE 36

Medium	no. of Samples	Duplicates	Total	Analytical Suite[a,b]
Soil	290	15	305	A
Groundwater	145	8	153	A
TOTAL	435	23	458	

[a]Analytical suite designations are as follows:

A = Volatile organic compounds. polynuclear aromatic hydrocarbons, phonola, pesticides and total PCBs, total recoverable hydrocarbons, and metals (total, unfiltered).

[b]Specific constituents encompassed by the various chemical groups included within analytical suite A are identified in Tables 9-1 through 9-4 of tho Generic Quality Assurance Project Plan

belov the depth of the sewer at each location. Borings will be completed to a depth below the sever or to the vater table, whichever is greater. Soil samples will be collected over 5-foot intervals (i.e., 0 to 5 feet, 5 to 10 feet, and so on to the vater table), and soil lithologies will be characterized and recorded in the field notebook. All drilling and sample collection equipment will be decontaminated at a minimum, prior to use and between each sampling interval in accordance vith the GQAPP (Section 6.10). Clean collection equipment (i.e., stainless steel bowls and travels) will be used for each sample interval. All drill cuttings, rinse waters, and contaminated clothing will be drummed and disposed of in accordance vitb Section 14.8.

Assuming a vater table depth of 10 feet at all locations, tentative total numbers of samples to be collected are listed in Table 14-1.

The selected soil sampling locations are near each manhole and at a frequency of 150 to 250 feet along the IWTP sewer line between manholes. The results of the soil gas survey will be used to aid in the appropriate placement of soil boring locations. A typical sampling scheme is shown in Figure 14-1. This sampling scheme is based on the assumption that joints in the aanholes are the areas most likely to leak. Sample numbers and locations are approximate and may be altered subject to the attainment of more detailed site-specific data from the physical survey.

All fieldwork and sampling tasks will be performed in accordance with the SQAPP, the GQAPP (sections 6.6, 6.10, and 6.11), and the Generic Health and Safety Plan.

Groundvater -- Approximately 145 temporary stainless steel monitoring wells will be installed along the IWTP sever line. Each well will have 5 feet of 0.01-inch slotted screen and will be installed to a depth at which the well screen brackets the vater table (i.e., the top of the screen extends slightly above the water level). As shown on Figure 14-1, the locations for these wells are tentative. The information gained from field reconnaissance surveys and aerial photograph

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interpretations will allow adjustments and finalization of the temporary shallow well network.

The 145 temporary wells will be purged and sampled in accordance with Section 6.8 of the GQAPP.

14.1.4 Hydrologic Assessment

The temporary wells will be surveyed to obtain top of casing (TOC) elevations referenced to USGS datum or to a suitable established benchmark located along Site 36. Static water levels will be measured in each well to determine shallow groundwater flow direction and horizontal hydraulic gradient.

In conjunction with the wellhead survey, the elevations of other nearby features such as ponds, streams, and any leachate seeps will be established.

Hydrologic data collected during Phase I will be evaluated in addition to the analytical screening data, and evidence of lateral contaminant migration in shallow groundwater will be assessed. Conclusions drawn from these evaluations will form the basis for permanent monitoring well installations during phases II and 111.

14.2 Phase II--Characterization/Extent Delineation

This section of the Contamination Assessment/Remedial Activities Investigation Work Plan--Group N (Site 36, Industrial Waste Sewer), Naval Air Station Pensacola, Pensacola, Florida, has been entirely revised to reflect the results of the Phase I activities proposed in the original work plan document (June 1990). The original version (June 1990) of Section 14.2 of this work plan is presented in Appendix D. Plate 1 shows the actual Phase I sampling locations and location designations. The results of the Phase I investigation of Site 36 are presented in E & E's Final Interim Data Report, Contamination Assessment/Remedial Activities Investigation, Industrial Waste Sewer (Site 36), Naval Air Station Pensacola, Pensacola, Florida, Volumes I through V, [November] 1992 [(E 6 E 1992a)]. [A water level elevation

map of the surficial *zone* of the Sand and Gravel Aquifer was generated for this site. This map vas included in the Phase I interim data report and is not included in the work plan.)

In general, the results of E & E's Phase I investigation of Site 36, reviewed in combination with those of the previous investigation of the site (NEESA 1983), indicated the following:

- Soil and surficial-zone groundvater contamination are present along the industrial waste sever line. Vith the exception of metals in groundvater, the videspread occurrence of which is believed to be strongly influenced by acid preservative leaching/dissolution of entrained aquifer matrix sediments, the detected contamination is either sporadically distributed across a generally limited number of highly localized sampling locations and/or predominantly concentrated along the northvest and/or southeast portions of the sewer line.

- Lead, total recoverable petroleum hydrocarbons (TRPHs), polynuclear aromatic hydrocarbons (PAHs), and phenols were the primary soil contaminants detected.

- Lead, chromium, cadmium, TRPHs, volatile organic compounds (VOCs), PAHs, and phenols vere the primary groundvater contaminants. Lead, Chromium, cadrium, and halocarbon-type VOCs (tetrachloroethene; trichloroethene; dichloroethene; and 1,1,1-trichloroethane) vere all detected in groundwater at concentrations exceeding the Florida primary drinking vater standards. TRPHs, aromatic-type VOCs (total benzene + toluene + ethylbenzene + xylenes [BTEX]), and PAHs were all detected in groundwater at concentrations exceeding the applicable or potentially applicable (PAHs) Florida Groundvater Cleanup Standard. Phenols vere detected in groundvater at concentrations exceeding the potentially applicable Florida groundvater guidance concentrations for various phenolic compounds.

- Overall, much of the detected contamination does not appear to reflect active, continuing leakage from the sever line. This determination does not mean that the sever line has never leaked and/or is not currently leaking, but rather that the Site 36 Phase I data simply do not support the unequivocable presence of active, continuing leaks at the sampling locations, especially vhen vieved in the context of the numerous other potential off-site and/or ambient sources present.

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In light of the Phase I results summarized above, the objectives of the Phase II investigation of Site 36 will be as follows:

- Identify, to the greatest extent possible, the source(s)--sewer line-related, off-site, and/or ambient--of the detected Phase I soil and groundwater contamination.
- Delineate the nature, magnitude, and, to the greatest extent possible, lateral/vertical extents of known/suspected areas of soil and groundwater contamination; and
- Initiate the Risk Assessment and Feasibility Study for the site.

In order to meet the above objectives, the Phase II investigation of Site 36 will include the following elements:

- Contaminant source survey;
- Soil sampling;
- Installation of shallow and intermediate monitoring wells:
- Collection of groundwater samples from nearby permanent existing wells GM55 and GM58 (the 16 other permanent wells in the vicinity of Site 36 will be sampled during the proposed Phase II investigations of sites 9, 12, 23, 27, 29, 31, and 34) and all newly installed wells;
- Hydrologic assessment; and
- Engineering survey.

The specific scope of work associated with each of the above elements is described in sections 14.2.1 through 14.2.4. In developing the specific scopes of work, the Phase I analytical results and previous analytical results have been evaluated regarding all requirements of the CERCLA and Superfund Amendments and Reauthorization Act (SARA), as well as all other ARARs. For Site 36, these ARARs include:

- Resource Conservation and Recovery Act (RCRA);
- Clean Water Act (CWA);
- Safe Drinking Water Act (SDWA);

- o 40 CFR Parts 264, 265, 270, and 271 (Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities; Proposed Rule);
- o Chapter 17-3, Florida Administrative Code (FAC; Water Quality Standards);
- o Chapter 17-301, PAC (Surface Waters of the State):
- o Chapter 17-302, PAC (Surface Water Quality Standards);
- o Chapter 17-550, PAC (Drinking Water Standards, Monitoring, and Reporting); and
- o Chapter 17-770, PAC (State Underground Petroleum Environmental Response).

Formal, quantitative air sampling will not be conducted during Phase II at Site 36 because no evidence that Site 36 represents a potential source of airborne volatile or particulate contaminants vas revealed by the Phase I surface emissions survey, particulate air screening, or fieldwork air monitoring activities. Biota sampling also will not be conducted during Phase II because the potential contaminants of concern have not been sufficiently characterized. However, base-wide biota sampling will be conducted in conjunction with the investigation of operable units (OUs) 15, 16, and 17 (Bayou Grande *Area,* NAS Pensacola Wet lands, and Pensacola Bay Area[, respectively]).

Based on the results of the activities identified above, during Phase II E & E will initiate the appropriate Risk Assessment and Feasibility Study activities. Risk Assessment activities will be directed toward identification of contaminants of concern as well as identification of data gaps that must be eliminated to support the eventual completion of a Baseline Risk Assessment for the site. If no data gaps are identified, the Baseline Risk Assessment will be completed during Phase II.

Feasibility Study activities, which will be required for Site 36, will be directed toward identification of data gaps that must be eliminated to support the eventual completion of a comprehensive Feasibility Study for the site. If no data gaps are identified, the Feasibility Study will be completed during Phase II.

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(Bold items enclosed in brackets denote changes to last version of document]

In addition, if warranted, E & E will evaluate the Phase II results to identify whether any interim remedial measures (IRMs) are required and, if so, to develop recommendations for implementation of these IRMs (see Section 14.2.5). IRHS will only be implemented following receipt of EPA approval.

All Phase II investigation activities and results will be discussed in an interim data report structured in the required format of a formal draft remedial investigation (RI) report. This Phase II interim data report will provide a complete data synthesis incorporating the results of E 6 E's Phase I and Phase II investigations, as well as the results of previous investigations. The interim data report will specify whether additional Phase III assessment activities are required, or whether the formal draft RI report for the site can be prepared.

All Phase I investigation activities were completed in accordance with E & E's 1990 GQAPP for Contamination Assessments and Remedial Activities at NAS Pensacola. All Phase II investigation activities will be completed in accordance with the newly revised, updated 1992 version of this document. In this section (14.2), all references apply to the 1992 version of the GQAPP.

[Bvery effort will be made to complete the investigation of this site during Phase II. To the greatest extent possible, the results of the Phase I investigation, as well as field data and/or observations generated during the Phase II investigation, will be utilized to adjust and/or redirect the Phase II efforts in order to maximize the amount of information obtained regarding the horizontal and vertical extents of possible contamination at the site. Adjustments to the Phase II scope of work may include, but may not be limited to: 1) sampling of additional media which are not already included in this work plan; 2) installation of additional and/or deeper (i.e., intermediate and/or deep) permanent monitoring wells; 3) collection and analysis of additional samples from any given medium; and 4) performance of full-scale aquifer tests or other studies to further characterize the hydraulic properties of the soil or aquifer matrix. However, sampling

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and/or analysis will not be performed on media for which the associated procedures are not described in the approved GOAPP. Furthermore, additional data from other site investigations may become available prior to or during the completion of Phase II activities at this site. This could warrant an increase or decrease in the scope of work proposed in this vork plan. In addition, temporary monitoring wells may be installed, or some other temporary groundvater sampling methodology may be employed, in place of some of the proposed permanent vells, as appropriate.

It should be noted that the NADEP Pensacola has prepared and is finalizing a hazardous vaste minimization plan (NADEPINST 5090, NADEP Pensacola Hazardous Waste Minimization Plan, August 1992). NAS Pensacola will follow this plan and take an active role in instituting a vaste minimization program.]

14.2.1 Contaminant Source Survey

A supplemental contaminant source survey will be performed at Site 36 to obtain a comprehensive understanding of potential additional contaminant source(s) in the site vicinity. At Site 36, this survey will include the following:

- Identification of current and/or past activities, at facilities proximate to the sewer line, which could represent sources of the detected contamination;
- Location of underground fuel, storm drain, and sanitary sewer lines present in the vicinity of the sewer line;
- Determination, to the greatest extent possible, of the source of backfill soils used along the sewer line excavation; and
- Deteraination of whether any normal, daily, facility-specific and/or base-wide activities, such as aircraft operations, may have created potential, low-level, ambient sources of TRPH or other contamination.

The survey will utilize existing information in NAS Pensacola files, previous investigative reports, and interviews with current and former employees of the NAS Pensacola facility. All background source survey

[Bold items enclosed in brackets denote changes to last version of document]

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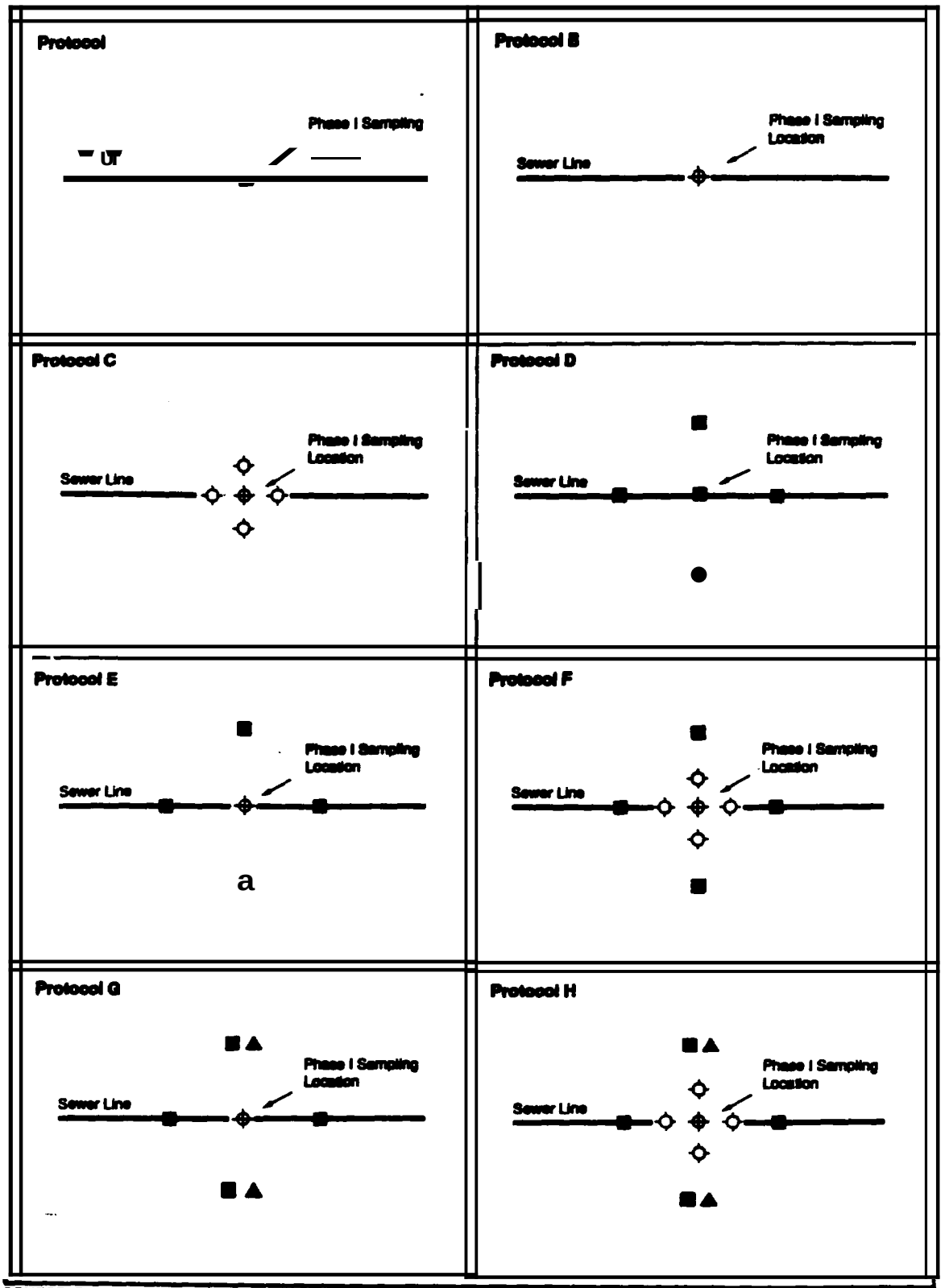
work will be conducted in close communication with the facility Installation Restoration (IR) coordinator as the survey may need to access repositories and/or individuals at several locations among the various tenant commands.

14.2.2 Sampling and Analysis

Plate 2 shows the proposed Phase II sampling locations for Site 36, and Figure 14-2 illustrates the sampling protocol referenced on Plate 2. Table 14-2 summarizes the sampling and analytical requirements, including QA/QC samples, for the Phase II investigation of Site 36. Table 14-3 provides the specific rationale for each of the eight Phase II sampling protocol developed to address contamination detected along the industrial waste sewer line during Phase I. Table 14-4 provides the sampling protocol and specific rationale for each of the proposed Phase II soil borings and monitoring wells, and for the analytical suite(s) associated with each proposed Phase II sampling location. (Groundwater samples to be collected from the two existing nearby wells and analyzed for analytical suite A [see below] are not included in Table 14-4).

The samplg location reference numbers listed in Table 14-4 correspond to the location numbers on Plate 2, and the analytical suite designations used in Table 14-4 correspond to the suite designations defined in Table 14-2.

It is proposed to sample nearby existing wells GM55 and GM58 and all newly installed wells for analytical suite A during Phase II to provide a uniform, time-synchronous perspective on Site 36 groundwater conditions. (The 16 other existing permanent monitoring wells in the vicinity of Site 36 will be sampled during the proposed Phase II investigations of sites 9, 12, 27, 29, 31, and 34.) This perspective will be critical to properly evaluate the groundwater migration pathway. In addition, during Phase II field activities at NAS Pensacola site groups A through E, soil borings, shallow monitoring wells, and intermediate monitoring wells will be completed at three background locations across the base, [clustered with the existing deep supply wells. These background soil borings and monitoring wells,] together



SOURCE: Ecology and Environment, Inc., 1992

KEY:

- Phase II Soil Boring
- Phase II Soil Boring and Shallow Monitoring Well
- Phase II Shallow Monitoring Well
- Phase II Intermediate Monitoring Well

SCALE

0 25 50 100 FEET

Figure 14-2
SAMPLING PROTOCOL - NAS PENSACOLA SITE 36 - PHASE II

3600301

Table 14-2

PHASE II SAMPLING AND ANALYTICAL REQUIREMENTS
NAS PENSACOLA SITE 36

Medium	No. of Samples[a]	Dupli-cates	Trip Blanks[b]	Preservative Blanks[b]	Field Blanks	Rinsate Blanks	Total[a]	Analytical Suite[c,d]
Soil[e]	230	23	—	NR[f]	NR	48	301	A
	560	56	—	NR	NR	—	616	B
	(1)	—	48	NR	NR	—	(1),48	D
	(230)	NR	NR	NR	NR	NR	(230)	E
Groundwater[g]	158	16	—	1	1	48	224	A
	148	15		—			163	B
	28	3	NR	—	—		31	C
	(1)	—	48	—		—	(1),48	D
	(109)	NR	NR	NR	NR	NR	(109)	F
TOTAL	1,124	113	96	1	1	96	1,431	
	(341)	NR	NR	NR	NR	NR	(341)	

14[NASP]UH8000:T0484/1446/11

Key:

[a]The number of samples shown in parentheses will bo analyzed for the additional parameters indicated.

[b]Trip blanks will be analyzed for Appendix IX volatile organic compounds (VOCs) only. Preservative blanks will be analyzed for Target Compound List (TCL) VOCs, total recoverable petroleum hydrocarbons (TRPHs), dissolved Target Analyte List (TAL)metals, and cyanide.

[c]Analytical suite designations arm as follows:

A = TCL VOCs; TCL base-neutral/acid extractable organic compounds (BNAs); TCL pesticides and polychlorinated biphenyls (PCBs); TRPHs; TAL metals (total [i.e., unfiltered] and dissolved [i.e., millipore-filtered], water only); cyanide; gross alpha, beta, and gamma radio-activity: total organic carbon: total Kjeldahl nitrogen (TKN; surface water and sediment only): grain size (sediment only): hardness (water only): and alkalinity (water only).

B = TAL metals (total and dissolved [water only]), TRPHs, TCL VOCs, and TCL BNAs.

C = TAL metals (total and dissolved).

D = Appendix IX VOCa, BNAs, dioxins, pesticides, PCBs, organophosphorus pesticides, herbicides, total metals, cyanide, and sulfide.

E = pH, alkalinity, percent roiaturm, grain size (soil only), BTU contmnt, ash contont. total organic halogens, sulfur, ignitability, and cation exchange capacity (CEC).

F = Total suspended solids, TKN (groundwater only), ammonia nitrogen, orthophosphatm phosphorus, dissolved oxygen (in field), 5-day biological oxygmn demand (BOD_5), and chemical oxygen demand (COD).

[d]Specific constituents encompassed by the various chemical groups included within the above-listed analytical suites arm identified in tables 9-6 through 9-15 of tho GQAPP.

[e]For Site 36, 19 boring locations X 2 dopth intervals = 38 samples; 132 boring locations x 3 dmpth intervals = 396 samples; 58 boring locations x 4 dmpth intervals = 232 samples; 2 boring locations x 5 dmpth intervals = 10 samples; 19 boring locations X 6 dmpth intervals = 114 samples (total samples = 790).

[f]NR = Not required.

[g]For Site 36, 2 existing wells + 332 new on-site wells (266 shallow and 66 intermediate) = 334 samples.

Source: Ecology and Environmmnt, Inc.. 1992

[Bold items enclosed in brackets denote changes to last version of document]

Table 14-3

RATIONALE FOR PROPOSED PHASE II SAMPLING PROTOCOL
NAS PENSACOLA SITE 36

Sampling Protocol Designation	Protocol Description	Rationale
A	1 shallow wll	Confirm potential presence of metals contamination in shallow groundwater. (Elevated metals present in Phase I groundvator samples, but interference from sample turbidity possible.)
B	1 soil boring and 1 shallow well	Confirm presence or absence of potential contamination, and, if present, characterise nature of dotoctod aoil and/or groundvator contamination. (Only lov levels of contamination detected in Phase I aoil and/or groundwater samples.)
C	5 soil borings and 1 shallou well	Characterise nature and delineate extent of detected soil contamination: confirm absence of significant groundwater contamination. (Only Phase I soil sample(s) exhibited elevated contaminant levels.)
D	[illegible] shallow wells	Characterise naturo and delineate latoral oxtont of detected groundwater contamination (only Phase I groundwater sample exhibited elevated metals levels)
E	1 soil boring and 5 shallow wells	confirm presence or absence of potential soil contamination, and, it present, characterise nature of detected soil contamination; characterise nature rad delineate latoral oxtont of dotoctod groundwater contamination. (Only Phase I groundwater sample exhibited elevated contaminant levels.
F	5 aoil boring. and [illegible] shallow nlla	Characterise naturo and delineate oxtont of detected aoil and groundwater (lateral oxtont only) contamination. (Elevated contaminant levels dotoctod in both Phase I soil and groundwater samples.)
G	1 soil boring, 5 shallow wlla, and 2 intermediate wells	Confirm presence or absence of potential aoil contamination, and, if present, characterise nature of dotoctod soil contamination: characterise naturo and delineate latoral and vertical extents of dotoctod groundvator contamination. (Low contaminant levels dotoctod in Phase I aoil sample(s) and elevated contamination levels with significant potential tor vertical migration dotoctod in Phase I groundvator sample.)
H	5 roil boring., 5 shallow wells, and 2 intermediate wells	Characterise naturo and oxtont of dotoctod aoil and groundwater contamination. (Elevated contaminant levels dotoctod in Phase I roil sample(s) and elevated contaminant levels uith significant potential for vortical migration dotoctod in Phase 1 groundvator sample.)

14[NASP]UH8000:T0484/1449/16

Source: ecology and Environment, Inc., 1992.

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Table 14-4

Rationale for Proposed Phase II Soil Sampling and Monitoring Well Locations and Soil and Groundwater Sample Analyses NAS Pensacola Site 36

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
001	Low xylenes and high metals and phenol concentrations detected in Phase I temporary well TW206; high TRPH concentration detected in Phase I soil boring B206.	H	S-CN (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).
002	High chromium and low xylene concentrations detected in Phase I temporary well TW208; low PAH concentrations detected in Phase I soil boring B208.	G	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite E).
			SGW-CW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).

14[NASP]UH8000:T0484/1451/10

Key at end of table.

Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical suit. (a)[c]	Analytical Rational.
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterise full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical ruito F).
003	High metals concentrations dotoctod in Pharo I temporary well TW213; hiqh PAH and phenol concentrations dotoctod in Pharo I soil boringq B213.	F	S-CB (AWT)	A,E	Characterise full spectrum of potential contaminants (analytical suite A). Support potential alto remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A	Characterise Lull spectrum or potential contaminants.
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
004	High chromium, VOCs and phenols concentrationr dotoctod in Phase I temporary well TW209; high TRPH concentrations dotoctod in Pharo I roil boring.	G	S-CB (AWT)	A,E	Characterise full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite E).
			SGW-CW	A,F	Characterise full spectrum of potential contaminants (analytical suite A). support potential site remediation planning activities (analytical ruito F).

14[NASP]UH8000:T0484/1451/10

Key at end of table.

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Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suit. (s)[c]	Analytical Rationale
			SGW-PW	B	Metals, TRPHs, VOCs and SVAs are only concern here.
			IGW	A,I	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suit. I).
005	High metals concentrations dotoctod in Phase I temporary well TW172.	G	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suit. E).
			SGW-CW	A,F	Characterize full spectrum of potontial contaminants (analytical suit. A). Support potontial site romodiation planning activities (analytical suit. F).
			SGW-PW	C	Metals are only concern here.
			IGW	A,F	Characterize full spectrum of potontial contaminants (analytical suite A). Support potential site romodiation planning activities (analytical suit. F).
006	High chromium concentration detected in Phase I temporary well TW193.	G	S-CB (AWT)	A,E	Characterize full spectrum of potontial contaminants (analytical suit. A). Support potential site remediation planning activities (analytical suite E).
			SGW-CW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site romodiation planning activities (analytical suit. F).

14[NASP]UH8000:T0484/1451/10

Key at end of table.

Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
			SOW-OW	C	Metals are only concern here.
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite I).
007	High TRPH concentration detected in Phase I roll boring 0191.	C	S-CB (AMT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite E).
			S-PB	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A	Characterize full spectrum of potential contaminants.
008	High chromium concentration detected in temporary well TW185.	D	SGW-CW	A	Characterize full spectrum of potential contaminants.
			SGW-PW	C	Metals are only concern here.
009	High chromium concentration detected in Phase I temporary well TW155.	A	SGW-CW	A	Characterize full spectrum of potential contaminants.
010	LOW 1,1-dichloroethene and high chromium concentrations detected in Phase I temporary well TW190.	G	S-CB (AMT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite E).

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Key at end of table.

Table 14-4 (Cont.)

Location Reference Number	Location Rational.	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
			SOW-CW	A,F	Characterize full spectrum of potontiat contaminants (analytical auito A). Support potontial aito remediation planning activitios (analytical auito F).
			SGW-PW	B	Metals, TRPHs, VOCa and BNAs are only concorn here.
			IGW	A,F	Characterize full spectrum of potontial contaminants (analytical suite A). Support potontial site remediation planning activities (analytical suite F).
011	High metals concentrations detected in Phase I temporary well TW145.	D	SOW-CW	A,F	Characterize full apoctrua of potontial contaminants (analytical auito A). Support potontial site remediation planning activities (analytical auito E).
			SGW-PW	C	Metals, TRPHs, VOCs, and BNAs are only concern here.
012	High chromium and VOC concentrations detected in Phase I temporary well TW226.	G	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical auito A). Support potontial aito remediation planning activities (analytical auito E).
			SGW-CW	A,F	Characterize full spectrum of potontiat contaminantr (analytical auito A). support potential aito remediation planning activitios (analytical auito F).
			SGW-PW	B	Metals, TRPHs, VOCa and BNAs are only concern here.

14[NASP]UH8000:T0484/1451/10

Key at and of table.

Table 14-4 (Cont.)

Location Reference Number	Location Rational.	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rational.
			IGW	A,F	Characterize full spectrum of potontial contaminants (analytical suite A). Support potential site remediation planning activitior (analytical ruito E).
013	High metals and voc concontrationr dotoctod in Phase I temporary well TW151.	G	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potontial site romodiation plaaninq activitior (analytical suite E).
			SGW-CW	A,F	Characterize full spectrum of potoatial contaminaatr (analytical ruito A). Support potoatial site remediation planning activities (analytical suite F).
			IO/WO/W	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize Cull spectrum or potoatial contaminants (analytical suite A). Support potontirl site romodiation plannlnq activities (analytical suite E).
014	Hiqh metals concontrationr dotoctod in Phase I temporary well TW148.	D	SGW-CW	A	Characterize full spectrum of potential contaminants.
			SGW-PW	C	Metals, TRPHs, VOCs and BNAs are only concern here.
015	Hiqh metals concentrations dotoctod in Phase I temporary well TW169.	G	S-CB (AWT)	A,E	Characterize lull spectrum of potential contaminantr (analytical suite A). Support potontirl site remediation planning activitior (analytical suite E).

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3600305

Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical suit. (s)[c]	Analytical Rational.
			SGW-CW	A,F	Characterize full spactrun of potantial contaminants (analytical auita A). Support potantial site remediation planning activitias (analytical auita F).
			SGW-PW	C	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize full spactrun of potantial contaminants (analytical auita A). Support potantial site remediation planning activitias (analytical suite F).
016	High chromium concantration detected in Phasa I temporary wall TW168.	A	SGW-CW	A	Charactarira Cull spactrun of potential contaninants.
017	High chromium concantration detected in Phasa I temporary wall TW167.	A	SGW-CW	A	Characterize full spactrun of potantial contaminants.
018	High metals and low VOC concantration datactod in Phasa I temporary wall TW164; high load and phenols concantrations datactod in Phasa I soil boring 8164.	H	S-CB (AWT)	A,E	Characterize full spectrum of potantial contaminants (analytical suite A). Support potential site remediation planning activities (analytical auita E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs and BNAs are only concarn here.
			SGW-CW	A,F	Charactarira full spectrum of potantial contaninants (anlaytical suite A). Support potantial site remediation planning activitias (analytical suite F).

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Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
			SGW-PW	B	Metals, TRPHs, VOCs and BNAs are only concern here.
			IGW	A,F	Characterize full spectrum of potential contaminantr (analytical suite A). Support potential site remediation planning activities (analytical suite F).
019	High metals concentrations detected in Phase I temporary well TW156; high TRPH and PAH concentrations detected in Phase I soil boring B156	C	S-CB	A,E	Characterize full spectrum of potential contaminant. (analytical suite A). Support potential site remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A	Characterize full spectrum of potential contaminants.
020	High load concentration detected in Phase I temporary well TW112; high load concentrations and low TRPH and PAH concentrations detected In Phase I soil boring B112.	a	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite E).
			SGW-CW	A,F	Characterize full spectrum of potential contaminantr (analytical suite A). Support potential site remediation planning activities (analytical suite F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.

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3500306

Table 14-4 (Cont.)

Location Reference Number	location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).
021	High metals concentrations detected in Phase I temporary well TW203; high lead, TRPH and PAH concentrations detected in Phase I soil boring B203.	H	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs and BNAs are only concern here.
			SGW-CW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).
022	High PAH concentration detected in Phase I temporary well TW118; high PAH and phenols concentrations detected in Phase I soil boring B118.	F	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.

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Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
			SGW-CW	A	Characterize full spectrum of potential contaminants.
			SOW-Ow	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
023	High phenols concentration dotoctod in Phase I moll boring B124.	C	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite I).
			S-PB (AWT)	I	Metals, TRPHs, VOCs and BNAs are only concern here.
			SOW-CW	A,F	Characterize full spectrum of potential contaminantr (analytical suite A). Support potential site remediation planning activities (analytical multo F).
024	High lead concentrations dotoctod in Phase I temporary well TW126.	A	SGW-CW	A	Characterize lull spectrum of potential contaminantr.
025	HIqh TRPH and PAH concentrations dotoctod in Phase I soil boring B129.	C	S-CB (AWT)	A,E	Characterize lull spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs and BNAs are only concern here.
			SGW-CW	A	Characterize lull spectrum of potential contaminants.

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2600307

Table 14-4 (Cont.)

location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
026	Lou dieldrin and low load concontrations dotoctod in Phase I temporary well TW131; high PAH and phenols concontrations dotoctod in Phase I soil boring B131.	C	S-CB (AWT)	A,E	Charactorixo full spectrum of potontial contaninants (analytical suit. A). Support potontial site remediation planning activitios (analytical suit. E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concorn here.
			SGW-CW	A,F	Charactorixo full spectrum of potontial contaminants (analytical suit. A). Support potontial site remediation planning activitios (analytical suite F).
021	High load concontration dotoctod in Phase I temporary well TW133; high TRPH concontrations dotoctod in Phase I soil boring 8133.	B	S-CB (AWT)	A,E	Charactorixo full spectrum of potontial contaminants (analytical suite A). Support potontial site rorodiation planning activitios (analytical suit. E).
			SGW-CW	A	Charactorixo full spectrum of potontial contaminants.
028	High TRPH, PAH and phenol concontrations detected in Phaso I soil boring B135.	C	S-CB (AWT)	A,E	Characterize full spectrum of potontial contaminants (analytical suit. A). Support potontial site remediation planning activitios (analytical suit. E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concorn here.
			SGW-CW	A	Characterize Cull spectrum of potontial contaminants.

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Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
029	tow chlorobenzene and high load concon-trations dotoctod in Phase I temporary well TW137; high load and TRPH concen-trations dotoctod in Phase I soil boringq 8137.	G	S-CB (AWT)	A,E	Characterise Cull spoctrum of potontial contaminants (analytical suite A). Support potoatial site remediation planning activitior (analytical suit. ■ ❯ _
			SGW-CW	A,F	Characterise full spoctrum of potoatial contaminants (analytical suite A). Support potoatial site remediation planning activities (analytical suite F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterise full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activitior (analytical suit. F).
030	High lead concontration dotoctod in Phase I temporary well TW139; high TRPH concontration detected in Phase I soil boring B139.	H	S-CB (AWT)	A,E	Characterise full spectrum of potoatial contaminants (analytical suit. A). Support potoatial site remediation planning activitior (analytical suit. ■ ❯ _
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A,F	Characterise Lull spectrum of potontial contaminants (analytical suit. A). Support potential site remediation planning activitior (analytical suit. F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.

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3600308

Table 14-4 (Coot.)

Location Reference Number	Location Rational.	Sampling Protocol[a]	Sample Types[b]	Analytical Suito(a)[c]	Analytical Rational.
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical auito A). Support potential site romodiation planning activities (analytical auito F).
031	High metals concentrations dotoctod in Phaso I temporary well TW140; high load and low PAH concontrations dotoctod in Phaso I soil boring B140.	E	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suit. A). Support potential site romodiation planning activitios (analytical suite E).
			SGW-CW	A	Characterize full spectrum of potential contaminants.
			SGW-PW	C	Metals, TRPHs, VOCS and BNAs are only concorn here.
032	High load and phenols concentrations detected in Phaso I temporary woll TW205.	A	S-CB (AWT)	A,E	Characterize full spectrum potential contaminants (analytical suit. A). Support potential site romodiation planning activitios (analytical suit. E).
			S-PB (AWT)	B	Metals, TRPHs, VOCS, and BNAs are only concern here.
			SGW-CW	A,F	Characterize full spectrum Of potential contaminants (analytical suite A). Support potential site remediation planning activitios (analytical suit. F).
033	High chromium concontration dotoctod in Phaso I temporary woll TW002.	A	SOW-CW	A	Characterize full spectrum of potential contaminants.

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Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[4]	Sample Types[b]	Analytical suito(a)[c]	Analytical Rationale
034	High metals concontrationr detected in Phase I temporary well TW00S; high PAH concontrationr dotoctod in Pharo I roil boring BOOS.	C	I-CB (AWT)	A,E	Characterize full spectrum of potontial contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, vocr, and BNAs are only concern here.
			SGW-CW	A	Characterize Cull spectrum of potontial contaminants.
035	High load concontration dotoctod in Phase I temporary well TW007; low PAH concontrationr detected in Pharo I soil boring B007.	B	S-CB (AWT)	A,E	Characterize Cull spectrum of potontial contaminants (analytical ruito A). Support potontial site remediation planning activities (analytical suite E).
			SGW-CW	A	Characterize Cull spectrum of potontial contaminants.
036	High metals and low PAH concontratioar detected in Pharo I temporary well TW009.	A	SGW-CW	A	Characterize Cull spectrum of potoatial contaminants.
037	High PAH concontration dotoctod' in Pharo I roil boring B011.	C	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potontial site remediation planning activities (analytical suite E).
			S-PB (AWT)	a	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A	Characterize full spectrum of potontial contaminants.

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360039

Table 14-4 (Cont.)

Location Reference Number	location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
038	High metals concentrations detected in Phase I temporary well TW014; high load, TRPH, and PAH concentrations detected in Phase I soil boring B014.	H	S-CE (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical ruito A). Support potential site remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern hero.
			SGW-CW	A,F	Characterize full rpoctrum, of potential contaminantr (analytical suite A). Support potential site remediation planning activities (analytical suite F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical ruito F).
039	High load and PAH concentrations detected in Phase I soil boring 8016.	H	S-CB (AWT)	A,E	Characterire full spectrum of potential contaminants (analytical ruito A). Support potential site remediation planning activities (analytical ruito E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern hero.
			SGW-CW	A,F	Characterize full spectrum of potential contaminantr (analytical ruito A). Support potential rite remediation planning activities (analytical suite F).

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Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
			SGW-FW	D	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).
040	High metals concentrations detected in Phase I temporary well TW018; low PAH concentrations detected in Phase I soil boring B018.	B	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). support potential site remediation planning activities (analytical suite E).
			SOW-CW	A	Characterize full spectrum of potential contaminants.
041	Low PAH concentration detected in Phase I temporary well TW022.	A	SGW-CW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).
042	Low PAH concentration detected in Phase I temporary well TW024.	A	SGW-CW	A,F	Characterize full spectrum of potential contaminants.
043	High chromium concentration detected in Phase I temporary well TW026.	A	SOW-CW	A	Characterize full spectrum of potential contaminants.
044	Low 1,1-dichloroethane concentration detected in Phase I temporary well TW030.	a	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). support potential site remediation planning activities (analytical suite E).

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3600310

Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rational.
			SGW-CW	A,F	Charactoriro full spectrum of potential contaminants (analytical suite A). Support potential site romodiation planning activities (analytical suite F).
			SGW-PW	E	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suit. F).
045	High load concontration dotoctod in Phase I temporary well TW106.	A	SGW-CW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site romodiation planning activities (analytical suit. F).
046	High lead concontration dotoctod in Phaso I torporary well TW105.	A	SGW-CW	A	Charactoriro full spectrum of potential contaminants.
041	High load concentrations dotoctod in Phaso I temporary well TW103.	A	SGW-CW	A	Characterize full spectrum of potential contaminants.
048	Lou 1,1,1-trichloroethane concontration dotoctod in Phaso I torpocary well TW107; low PAH and high phenol concontrationr dotoctod in Phaso I soil boring 8107.	H	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.

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Table 14-4 (Cont.)

Location Reference Number	Location Rational.	Sampling Protocol[a]	Sample Types[b]	Analytical Suit. (a)[c]	Analytical Rational.
			SGW-CW	A,F	Characterize full spectrum of potontial contaminants (analytical suite A). Support potontial site romodiation planning activities (analytical ruito F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize full spectrum of potontial contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).
049	Low PAH concontration dotoctod in Phase I temporary well TW197; high TRPH concentration dotoctod in Phase I roil boring B197.	B	S-CB (AWT)	A,E	Characterize Cull spectrum of potential contaminants (analytical suite A). Support potontial site remediation planning activitior (analytical suite I).
			SGW-CW	A	Characterize Cull spectrum of potential contaminantm.
050	High phenols concontration dotoctod in Phase I roil boring B199.	C	S-CB (AWT)	A,E	Characterize full spectrum of potontial contaminants (analytical suite A). Support potontial site remediation planning activitior (analytical ruito 8).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A,F	Characterize full spectrum of potontial contaminantm (analytical multo A). support potontial site romodiation planning activitior (analytical ruito F).

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3600311

Table 14-4 (Cont.)

Location Refbronco Number	Location Rational.	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rational.
051	Low dieldrin concentration dotoctod in Phaso I soil boring B101.	B	S-CB (AWT)	A,E	Characterize full spectrum of potontial contaminants (analytical suite A). Support potontial site romodiation planning activitios (analytical suite E).
			SGW-CW	A	Characterize full spectrum of potontial contaminants.
052	High load and low dieldrin concentrations dotoctod in Phaso I tomporary well TW100; low dieldrin concentration detected in Phaso I soil boring B100.	B	S-CB (AWT)	A,E	Characterize full spectrum of potontial contaminants (analytical suite A). Support potential site romodiation planning activitios (analytical suit. E).
			SGW-CW	A,F	Characterize full spectrum of potential contaminants (analytical suit. A). Support potontial site romodiation planning activitios (analytical suit. F).
053	High load concontration detected in Phaso I tomporary woll TW098; low TRPH concontration detected in Phaso I soil boring B098.	A	SGW-CW	A	Characterize full spectrum of potontial contaminants.
054	High lead concentrations dotoctod in Phaso I tomporary woll TW220.	A	SGW-CW	A	Characterize full spectrum of potential contaminants.
055	High chromium and low xylene concontrations detected in tomporary well TW222.	G	S-CB (AWT)	A,E	Characterize full spectrum of potontial contaminants (analytical suite A). Support potontial site remediation planning activities (analytical suit. E).

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Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
			SGW-CW	A,F	Characterize full rpoctrum *ot* potontial contaminants (analytical ruito A). Support potontial site remediation planning activities (analytical ruito F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IOU	A,F	Characterize full spectrum *ot* potontial contaminantr (analytical suite A). Support potential site remediation planning activities (analytical ruito F).
056	High metals concontrationr dotoctod in Pharo I temporary well TW093; low TRPH and phenols concontrationr dotoctod in Pharo I soil boring 0093.	A	SGW-CW	A,F	Characterize tun rpoctrum of potential contaminantr.
057	High load concontration dotoctod in Phase I temporary well TW091; hiqh TRPH and low PAH concontrationr dotoctod in Phase I soil boringq B091.	C	S-CB (AWT)	A,E	Characterize full rpoctrum of potontial contaminanto (analytical ruito A). Support potential site remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A	Characterize full spectrum of potential contaminants.
058	High metal and low PCB concentrations dotoctod in Phase I temporary well TW085; low PAH concontration dotoctod in Pharo I roil boringq 0005.		F (AWT)	S-CB	A,I Characterize full rpoctrum *ot* potential contaminants (analytical suit. A). Support potontial site remediation planning activities (analytical ruito El.

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3600312

Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
			S-PB (AWT)	A	Characterize full spectrum of potential contaminants.
			SGW-CW	A,F	characterize full spectrum of potential contaminant. (analytical suite A). Support potential site remediation planning activities (analytical suit. F).
			SGW-PW	A	Characterize full spectrum of potential contaminants.
059	High metal concentrations detected in Phase I temporary well TW078; high load and TRPH concentrations detected in Phase I soil boring 8078.	H	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suit. E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A,F	Characterize full spectrum of potential contaminant. (analytical suit. A). Support potential site remediation planning activities (analytical suit. F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical suit. a). support potential site remediation planning activities (analytical suit. F).

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Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
060	High lead concentration dotoctod in Pharo I temporary well TW079; low lead concontration dotoctod in Phase I roil boring 1079.	B	S-CB (AWT)	A, E	Characterize full rpoctrum of potontial contaminantr (analytical suite A). Support potontial site remediation planning activities (analytical suit. E).
			SGW-CW	A	Characterize full spectrum of potontial contaminants.
061	High metal concentrations dotoctod in Phase I temporary well TW081; high load concontration dotoctod in Pharo I roil boring B081.	B	S-CB (AWT)	A, E	Characterize full spectrum of potontial contaminants (analytical suite A). Support potontial site remediation planning activities (analytical suite E).
			SGW-CW	A	Characterize full spectrum of potontial contaminants.
062	High metals and trace PCI concentrations dotoctod in Pharo I temporary well TW082; high load and TRPH concentrations and low PCB concentrations dotoctod in Pharo I soil boring 1082.	H	S-CB (AWT)	A, E	Characterize full spectrum of potontial contaminants (analytical suite A). Support potontial site remediation planning activities (analytical suit. E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concorn here.
			SGW-CW	A, F	Characterize cull spectrum of potontial contaminantr (analytical suite A). Support potential site remediation planning activities (analytical suite F).
			SGW-FW	B	Metals, TRPHs, VOCs, and BNAs are only concorn here.

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3600313

Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
			IGW	A,F	Characterize full apoctrum of potential contaminants (analytical auito A). Support potential site romodiation planning activitios (analytical suite F).
063	Low load concontration dotoctod in Pharo I temporary well TW086; low load and high TRPH concentrations dotoctod in Pharo I soil boring B086.	B	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site romodiation planning activitios (analytical auito E).
			SGW-CW	A	Charactoriro full spectrum of potential contaminants.
064	High load concontration dotoctod in Phase I temporary well TW076; high load, TRPH, and PAH concentrations detected in Phase I soil boring 8076.	H	S-CB (AWT)	A,E	Charactoriro full spectrum of potential contaminants (analytical auito A). Support potential site romodiation planning activitios (analytical auito E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concorn here.
			SGW-CW	A,F	charactoriro full spectrum of potential contaminants (analytical auito A). Support potential site romodiation planning activitios (analytical auito F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concorn here.
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site comodiation planning activities (analytical suite F).

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Table 14-4 (Cont.)

Location Rotorence Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
065	tow load concentrations dotoctod in Pharo I temporary well TW074; high load, TRPH, PAH and phenol concontrationr dotoctod in Phase I soil boringq B074.	F	S-CB (AWT)	A,E	Characterise full spectrum of potential contaminants (analytical rulto A). Support potontlal site remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A	Characterise full spectrum of potential contaminants.
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
066	High metals concontrationr detected in Phase I temporary well TW072; Low lead and hiqh TRPH concentrations dotoctod in Pharo I roil boringq B072.	F	S-CB (AWT)	A,E	Characterise lull spectrum of potontial contaminants (analytical suite A). Support potontial site remediation planning activities (analytical rulto E).
			I-PI (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SOW-Cy	A	Characterise full spectrum of potontial contaminants.
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
067	High load concontrationr dotoctod in Pharo I temporary well TW070; high load concentration detected in Pharo I roll boringq 8070.	H	S-CB (AWT)	A,E	Characterise lull spectrum of potential contaminants (analytical suite A). support potontial site remediation planning activities (analytical suite E) -
			S-PB (AWT)	I	Metals, TRPHs, VOCs, and BNAs are only concern here.

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Table 14-4 (Cont.)

Location Reference Number	Location Rational.	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
			SGW-CW	A,F	Characterize full spectrum of potential contaminants (analytical suit. A). Support potential site remediation planning activities (analytical suite F).
			SGW-PW	C	Metals are only concern here.
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical suit. A). Support potential site remediation planning activities (analytical suit. F).
068	High load concentration detected in Phase I temporary well TW068; high load concentration detected in Phase I soil boring 8068.	C	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suit. A). Support potential site remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs arm only concern here.
			SGW-CW	A	Characterize full spectrum of potential contaminants.
069	High TRPH, xylene, PAH and phenol concentrations detected in Phase I temporary well TW063; high load, TRPH, VOC, PAH and phenol concentrations detected in Phase I soil boring 8063.	H	S-CB (AWT)	A,D (5 feet to water table), E	Characterize full spectrum of potential contaminants (analytical suit. A). Meet RCRA requirements (analytical suit. D). Support potential site remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.

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Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rational.
			SGW-CW	A,F	Characterize Lull spectrum of potontial contaminantr (analytical suite A). Support potontial site remediation planning activities (analytical suit. F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize full spectrum of potontial contaminantr (analytical ruito A). Support potontial site remediation planning activities (analytical suite F).
070	Low load concontration dotoctod in Phase I temporary well TW060; high PAH concontration dotoctod in Phase I soil boring B060.	C	S-CB (AMT)	A,E	Characterize Lull spectrum of potontial contaminants (analytical ruito A). Support potontial site remediation planning activities (analytical ruito E).
			S-PB (AMT)	E	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A	Characterize full spectrum of potontial contaminantr.
071	High metals and phenols concontrationa dotoctod in Phase I temporary well TW057; high load and low PAH concentrations dotoctod in Phase I soil boring B057.	F	S-CB (AMT)	A,E	Characterize full spectrum of potontial contaminantr (analytical suite A). Support potontial site remediation planning activities (analytical suit. E).
			S-PB (AMT)	E	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A	Characterize full spectrum of potontial contaminants.

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Table 14-4 (Coot.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical suite(s)[c]	Analytical Rational.
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concorn here.
072	High load, PAH and phenol and low TRPH and 1,1 dichloroothano concentrations dotoctod in Phaso I temporary well TW058; high load, TRPH, PAH, and phenol concentrations dotoctod in Phaso I soil boring B058.	H	S-CB (AWT)	A,E	Characterize full spoctrum of potontial contaminants (analytical suit. A). Support potontial site romodiation planning activitios (analytical suit. E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern horo.
			SGW-CW	A,D,F	Charactoriso full spoctrum of potontial contaminants (analytical suite A). Hoot RCRA requirements (analytical suite D). Support potontial site romodiation planning activitios (analytical suit. F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concorn horo.
			IGW	A,F	Charactoriso full spectrum of potontial contaminant. (analytical suite a). support potontial site romodiation planning activities (analytical suit. F).
073	High TRPH and PAH concentrations detoctod in Phase I soil boring B055.	C	S-CB (AWT)	A,E	Characterize full spoctrum of potontial contaminants (analytical suit. A). Support potontial site romodiation planning activities (analytical suit. E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concorn horo.

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Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[b]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
			GW-CW	A	Characterize full spectrum of potential contaminants.
74	High lead and low tetrachloroethene concentrations detected in Phase I temporary well TW053; high lead, TRPH, PAH and phenol concentrations detected in Phase I soil boring B053.	III	SCB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite E).
			S-RB (AWT)	B	Metals, TRPHs, VOCs and BNAs are only concern here.
			GW-CW	A	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).
075	High metals and tetrachloroethene concentrations detected in Phase I temporary well TW049; high lead, TRPH and PAH concentrations detected in Phase I soil boring B049.	III	SCB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite E).
			S-RB (AWT)	B	Metals, TRPHs, VOCs and BNAs are only concern here.

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Table 14-4 (Cont.)

Location Reference Number	Location Rational.	Sampling Protocol[1]	Sample Types[b]	Analytical suit. (s)[c]	Analytical Rationale
			SOW-CW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).
			SOW-Ow	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).
076	High metals and low VOC concentrations detected in Phase I temporary well TW046; high lead and TRPH and low PAH concentrations detected in Phase I soil boring B046.	H	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminant. (analytical suite A). Support potential site remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SOW-CW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suite F).

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Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
077	High metals concentrations dotoctod in Phase I temporary well TW048; high load, TRPH, and phenol concontrationr dotoctod in Phase I roil boringq B048.	F	S-CB (AWT)	A,E	Characterize full rpoctrum of potential contaminants (analytical ruito A). Support potontial site remediation planning activities (analytical ruito E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A,F	Characterize full spectrum of potoatial contaminants (analytical suite A). Support potential site remediation planning activities (analytical ruito F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
078	High PAH concontrationr detected in Phase I roil boringq B045.	C	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical ruito E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A	Characterize Cull rpoctrum o l potontial contaminants.
079	High TRPH and low PAH concentrations dotoctod in Phase I moil boringq 0044.	B	S-CB (AWT)	A,E	Characterize lull rpoctrum of potontial contaminants (analytical suite A). Support potontial site remediation planning activities (analytical ruito E).

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Table 14-4 (Cont.)

Location Reference Number	Location Rational.	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rational.
			SGW-CW	A	Characterize full spectrum of potential contaminants.
080	High load concentration detected in Phase I temporary well TW216; high load and PAH and low TRPH concentrations detected in Phase I soil boring 6216.	H	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suit. E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A,F	Characterize full spectrum of potential contaminants (analytical suit. A). Support potential site remediation planning activities (analytical suit. F).
			SGW-PW	6	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize full spectrum of potential contaminants (analytical suite A). Support potential site remediation planning activities (analytical suit. F).
081	Low lead and phenols concentrations detected in Phase I temporary well TW042; high PAH and phenols concentrations detected in Phase I soil boring B042.	C	S-CB (AWT)	A,E	Characterize full spectrum of potential contaminants (analytical suit. A). Support potential site remediation planning activities (analytical suit. E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.

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Key at end of table.

Table 14-4 (Cont.)

Location Reference Number	Location national.	Sampling Protocol[a]	Sample Types[b]	Analytical Suite(s)[c]	Analytical Rationale
			SGW-CW	A	Characterise Cull rpoctrum of potontlal contaminants.
082	High had and phenols, and low chlorobenzene and PAH concontrationr dotoctod in Phase I temporary well TW040; high load and low TRPH concontrationr dotoctod in Phase I roll borlnq B040.	G	S-CB (AWT)	A,E	Characterise full spectrum of potontlal contamlnantr (analytical suite A). Support potential site romodiation planning activities (analytical rulto E).
			SGW-CW	A,F	Characterise full spectrum of potontlal contaminants (analytical suite A). Support potontlal site remediation planning activities (analytical multo F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterise Cull rpoctrum of potential contaminants (analytical suite A). Support potontlal site remediation planning activities (analytical suite F).
083	High metals, VOC, PAH, and low phenols concentrations detected in Phase I temporary well TW034; high phenols and low load and PAH concentrations dotoctod in Phase I roll boring B034.	H	S-CB (AWT)	A,E	Characterise Cull rpoctrum of potontlal contaminants (analytical rulto A). Support potontlal site remediation planning activities (analytical rulto E).
			r-• (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A,F	Characterise full spectrum of potential contamlnantr (analytical rulto a). support potontlal site remediation planning activities (analytical rulto F).

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Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical suito(s)[c]	Analytical Rational.
			SOW-PW	a	Metals, TRPHs, VOCS. and BNAs are only concorn here.
			IGW	A,F	Characterize full spectrum of potontial contaminants (analytical suit. A). support potontial site romodiation planning activitios (analytical suit. F).
084	High load and low VOC and phenols concentrations dotoctod in Phaso I temporary well TW036; low load and TRPH concentrations dotoctod in Phaso I soil boring B036.	G	S-CB (AWT)	A,E	Characterize full spectrum of potontial contaminants (analytical suit. A). Support potontial site remediation planning activitios (analytical suite E).
			SGW-CW	A,F	Characterize full spectrum of potontial contaminants (analytical suit. A). support potontial site romodiation planning activitios (analytical suit. F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterize full spectrum of potontial contaminants (analytical suite A). Support potential site remediation planning activitios (analytical suit. F).
085	High load and PAH, and low phenols concontrations dotoctod in Phaso I temporary well TW038; low load concontration dotoctod in Phaso I soil boring 8038.	D	SGW-CW	A	Characterize full spectrum of potontial contaminants.
			SGW-PW	B	Metals, TRPHs, VOCS, and BNAs are only concorn here.

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Table 14-4 (Cont.)

Location Reference Number	Location Rationale	Sampling Protocol[a]	Sample Types[b]	Analytical suite(s)[c]	Analytical Rationale
086	High metals and PAHs, and low TRPH concontrationm detected in Phase I temporary well TW039; high load TRPHs and PAH concontrationr detected in Phase I soil boring B039.	H	I-CB (AWT)	A,E	Characterise full spectrum of potential contaminantm (analytical suite A). Support potontial rito remediation planning activities (analytical suite E).
			S-PB (AWT)	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			SGW-CW	A,F	Characterise full spectrum of potontial contaminantm (analytical suite A). Support potontial rito remediation planning activities (analytical suite F).
			SGW-PW	B	Metals, TRPHs, VOCs, and BNAs are only concern here.
			IGW	A,F	Characterise full spectrum of potential contaminants (analytical suite A). Support potontial rito remediation planning activities (analytical ruito f).

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Key:

[a]The rationales for each sampling protocol are presented in Tabla 14-3.
[b]Two existing wells in tho rito vicinity (GM55 and GM58) will also bo sampled during Phase XI for analytical suite A (see Table 14-21.
[c]Specific parameters included within each analytical suite are presented in Table 14-2.

S-CB = Soil samples from central soil boring located at Phase I sampling location.
S-PB = Soil samples from peripheral moil borings encircling Phase I rampling location.
AWT = Soil samples collected above tho water table at tho following intervals (BLS): 0 to 1.0, 1.0] to 2.1, 2.1 to 1, 5 to 10, 10 to 15, and 15 to 20 toot.
SGW-CW = Oroundwator sample from central shallow monitorinq well located at Phase I sampling ocrtion.
SGW-PW = Oroundwator sample from peripheral shallow monitoring well encircling Phase I sampling location.
IGW = Groundwater sample from intermediate monitorinq well.
TRPHS = Total recoverable petroleum hydrocarbons.
VOCS = Volatile organic compounds.
BNAS = Base/neutral and acid extractable organic compounds.
PAHS = Polynuclear aromatic hydrocarbons.
RCRA = Resource Conservation and Recovery Act.

Source: Ecology and Environment, Inc., 1992.

with the three existing on-base deep supply wells [will be] sampled for analytical suite A [(see E & E 1992b)]. (Soil samples collected below the water table will be analyzed for Target Analyte List (TAL] metals). These background locations will help provide a perspective on the on-site occurrences of potential contaminants as well as aid in evaluating the impact of potential, base-wide ambient contaminant sources. The collection of these background soil and groundwater samples is discussed in the work plan for Group A--Site 1 (Sanitary Landfill; (see E & E 1992b]).

Table 14-2 indicates that one sample from each medium will be additionally analyzed for analytical suite D (Appendix IX parameters). It should be noted that for these samples, suite A analyses will only be performed for parameters not encompassed by Appendix IX (e.g., gross alpha, beta, and gamma radioactivity). Furthermore, it should be noted that trip blanks will not be analyzed for the full Appendix IX suite of parameters, but only for the Appendix IX VOCs, and that the number of required trip blanks shown on Table 14-2 reflects the total number of trip blanks required for all the samples.

As noted above, tables 14-3 and 14-4 provide specific rationale for prpposed Phase II sampling protocol and Phase II sampling locations and analyses, respectively. In selecting the Phase II sampling locations, only Phase I locations at which evidence of soil and/or groundwater contamination had been detected were considered. However, at many of these Phase I locations, only low levels of contamination had been detected; furthermore, even clearly elevated contaminant levels could not be attributed unequivocably to leakage from the sewer line. Given the above and the extensive length of the sewer line, the proposed Phase II sampling program €or Site 36 is designed to achieve two objectives:

- Confirmation of the absence of significant levels of contamination at Phase I sampling locations where only low levels of contamination were detected; and

- Determination, to the greatest extent possible, of the source(s) and extent of contamination at Phase I sampling locations where elevated levels of contamination were detected.

To satisfy the above objectives, the eight Phase If sampling protocol illustrated on Figure 14-2 and described in Table 14-3 vere developed based on:

- o The presence, nature, and magnitude of detected Phase I contamination; and
- o The contaminated medium/media (i.e., soil, groundwater, or both).

For example, if:

- o Only potential groundvater metals contamination vas detected at a Phase I location--only one Phase II shallov vell groundvater sample is proposed (protocol A; see Figure 14-2 and Table 14-3).
- o Only lov levels of a potentially broader group of contaminants vere detected in soils and/or groundvater at a Phase I location--Phase II soil boring and shallov vell samples are proposed (protocol B; see Figure 14-2 and Table 14-3).
- o Very elevated soil and groundvater contaminant concentrations vere detected at a Phase I location--a Phase II cluster of five soil borings, five shallov vells, and tvo intermediate vells is proposed to identify the source(s) and extent of contamination (protocol H; see Figure 14-2 and Table 14-3).

The above-described sampling protocol address completion of a Baseline Risk Assessment and Feasibility Study for the site. Furthermore, completion of the Baseline Risk Assessment and Feasibility Study also require that, at most sampling locations, soil samples from at least one soil boring and one groundvater sample be analyzed'for the full suite of parameters in analytical suite A to identify the full spectrum of potential contaminants. Not all of the Site 36 Phase II samples (particularly the peripheral soil boring and/or shallov vell samples associated vith protocol C through H) will be analyzed for analytical suite A--pesticides and polychlorinated biphenyls vere almost completely absent in the Phase I saaples, and a number of groundvater samples will be collected only to confirm aquifer matrix contributions to the high metals concentrations detected in the Phase I temporary vell groundvater samples. All analytical suite designations are defined in Table 14-2.

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Finally, to support potential remediation planning activities for this site, selected samples from each medium also must be analyzed for those parameters which directly control the viability of various remedial alternatives (see analytical suites E and F, Table 14-2).

14.2.2.1 soil Sampling

During the Phase II soil boring and monitoring well installation (Section 14.2.2.2), soil samples will be collected at 230 locations across Site 36 (see Plate 2 and Figure 14-2). At soil boring locations where a monitoring well will not be installed, soil borings will be completed using hollow-stem auger methods, and soil samples will be collected using split-spoon samplers in accordance with Section 6.6.2 of the GQAPP.

At each location, except as noted below, composite samples will be collected from each of the following depth intervals: 0 to [1.0] foot BLS, [1.0] foot to 2.5 feet BLS, 2.5 to 5 feet BLS, and then every 5-foot interval to the depth of the water table. For the purpose of estimating sample numbers, the depth to the water table is assumed to vary between 2.5 feet BLS and 20 feet BLS across the site (see Table 14-2, footnote "e").

The number and types of soil field QA/QC samples to be collected during Phase II were determined in accordance with Section 11.1 of the GQAPP.

All soil sampling, compositing, and lithologic logging activities will be performed in accordance with Section 6.6 of the GQAPP. Equipment decontamination will be performed in accordance with Section 6.10 of the GQAPP.

The 790 soil samples will be analyzed for the parameters indicated on Table 14-2 (see also tables 14-3 and 14-4).

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14.2.2.2 Soil Boring Completion a d On-Site Permanent Monitoring Well Installation and Development

A total of 332 permanent monitoring wells will be installed at Site 36. These wells will be located and designed to supplement the Phase I investigation results regarding the lateral and vertical extents of groundwater contamination. The number and target completion depths of these wells are as follows:

- Two hundred and sixty-six shallov wells which will vary in depth between 11 and 25 feet; and
- Sixty-six intermediate wells, each of vhich will be approximately 40 feet deep.

Plate 2 shows the proposed Phase II sampling locations and associated protocol designations for Site 36 (see also Figure 14-2).

To detect the presence of any floating product at Sitt 36, the 266 shallow wells will be completed into the upper portion of the surficial zone of the Sand-and-Gravel Aquifer so that the well screen brackets the water table. These wells are expected to vary in depth between 11 and 25 feet. The intermediate wells will be installed to investigate the vertical extent of possible groundwater contaminants, particularly any dense nonaqueous phase liquids (DNAPLs) at Site 36. The 66 intermediate wells will be completed into the lover portion of the surficial zone immediately above the first confining/semi-confining unit. These intermediate vells are expected to be approximately 40 feet deep. Each of the intermediate vells will be clustered with one shallow well to assist in delineating the vertical extent of any contamination at that location as well as determine the vertical hydraulic gradients betveen the tvo monitored zones (see Plate 2 and Figure 14-2).

The shallow wells will be installed using hollow-stem auger methods and constructed of 4-inch-diameter, flush-threaded, polyvinyl chloride (PVC) casing terminating in 10 feet of 0.015-inch, factory-slotted screen.

To prevent the potential downward migration of any shallow contaminants during drilling, the intermediate wells will be installed using either

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hollow-stem auger or hydraulic rotary methods, through 8-inch-diameter PVC surface casings. The surface casings will be grouted in place and allowed to set 24 hours prior to drilling the well borehole to the target depth, in accordance with Section 6.7.4 of the GQAPP. The intermediate well surface casing will be set at approximately 30 feet BLS. The 66 intermediate wells installed through the surface casings will be constructed in the same manner as the shallov wells. All drilling and finished monitoring well construction will be conducted in accordance with sections 6.7.2 and 6.7.3 of the GQAPP. In addition, all Site 36 newly installed wells will be protected above surface grade with a steel surface casing and locking wellhead cover.

In conjunction with the drilling of the well boreholes, continuous spit-spoon samples will be collected to the target completion depth of each well in accordance with Section 6.7.2.3 of the GQAPP. Where wells are constructed in clusters, split-spoon samples will only be collected during drilling of the deeper well borehole.

After installation, each of the new monitoring wells will be developed using a submersible pump and/or bailer in accordance with Section 6.7.5 of the GQAPP. Development waste will be contained in 55-gallon drums, labeled, and moved to a storage area on NAS Pensacola, as directed by the Navy (see also Section 14.6.2).

All drilling equipment will be decontaminated prior to use and between the installation of each well in accordance with Section 6.10 of the GQAPP. All borehole cuttings and drilling fluids will be stored in 55-gallon drums, labeled, and moved to a storage area on NAS Pensacola, as directed by the Navy (see also Section 14.6.2).

14.2.2.3 Groundvater Sampling

During Phase II at Site 36, groundwater samples will be collected from nearby existing monitoring wells GM55 and GM58 and the 332 newly installed on-site monitoring wells (see Plate 2 and Figure 14-2). Purging and sampling of each well will be conducted in accordance with sections 6.8.2 and 6.8.3 of the GQAPP, respectively. Equipment

decontamination activities will be conducted in accordance with Section 6.10 of the GQAPP. The number and types of groundwater field QA/QC samples to be collected during Phase II vere determined in accordance vith Section 11.1 of the GQAPP.

The 334 groundwater samples will be analyzed for the parameters indicated on Table 14-2 (see also tables 14-3 and 14-4).

All shallow monitoring wells will be checked for floating and/or sinking immiscible hydrocarbons vith an oil/water interface probe. All intermediate monitoring wells will be checked for sinking immiscible hydrocarbons with an oil/water interface probe.

14.2.3 Hydrologic Assessment

The main objective of the Phase II hydrologic assessment is to further delineate the hydrogeologic character of the underlying aquifer at Site 36. Slug and short-term specific capacity tests, rather than a long-term pump test, have been proposed for Phase II because the location and distribution of contaminants in the various zones of the underlying aquifer have not yet been precisely determined. The hydrologic assessment at Site 36 will include a vellhead elevation survey of all the newly installed permanent monitoring wells; static vater level measurements in all the on-site wells, nearby existing wells, and nearby surface water bodies; short-term specific capacity and/or slug tests on one newly installed shallow permanent well and one newly installed intermediate permanent well, if present, in each proposed Phase II monitoring well cluster (total of 42 shallow wells and 33 intermediate wells); and measurement of tidal currents, wind, and/or stream.flow at appropriate nearby surface water locations.

All of the newly installed monitoring wells will be surveyed during the engineering survey (Section 14.2.4), and referenced to a USGS benchmark, in accordance with Section 6.7.6 of the GQAPP. In addition, staff gauges will be placed in all nearby surface water bodies and will be surveyed relative to the same datum as the wells.

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At Site 36, static water levels will be measured in the nearby existing wells and all newly installed on-site wells, and in the nearby surface vater bodies, on at least four occasions: once during the sampling of the newly installed wells; once approximately two to four weeks after sampling to obtain an estimate of the short-term temporal variability in water levels; once during a low tidal phase; and once during a high tidal phase. The measurements taken during opposing tidal phases will be collected on the same day to accurately evaluate tidal influences on water level elevations at Site 36.

Limited aquifer testing will be conducted at Site 36 on selected newly installed monitoring wells (see above). This testing will consist primarily of performing short-term specific capacity tests on selected wells that are capable of sustaining a measurable yield. The specific capacity testing at Site 36 will be conducted (folloving] the development of the selected newly installed wells(, after the water level in the vells has stabilized]. The procedure for specific capacity testing involves measuring the initial static water level in the well and then withdrawing groundwater from the well at a constant rate for a designated period. The sustained water level during pumping is then noted, and the pump is turned off. The water level recovery in the well is then recorded continuously over time until the water level equilibrates to the initial static level. In addition to measuring drawdown in the develop[ed] well during the specific capacity testing, water levels will be measured in adjacent shallow, intermediate, and/or deep monitoring wells to determine the extent to which the respective, monitored zones may be hydraulically connected.

Injection or withdrawal-type slug tests will be performed on selected newly installed wells that are not capable of sustaining a measurable yield. The procedure for slug testing involves measuring the initial static water level in the well and then injecting or withdrawing a known volume from the well, using a solid stainless steel cylinder, to create an instantaneous change in water level. The water level is then recorded continuously over time until the water level equilibrates to the initial static level.

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The purposes of the specific capacity and slug testing are to obtain site-specific, first estimate values for hydraulic conductivity (K), transmissivity (T), and groundwater flov velocity (V) for both of the monitored depth zones. During each of these tests, a calibrated tape and/or electronic data logger will be used to monitor and record the water levels in the well(s) being tested or observed.

For all inland surface vater bodies in the vicinity of Site 36 in vhich a flov is noted, velocity, discharge, and stream elevation data will be recorded at the same time that water levels *are* measured in the on-site and nearby monitoring vells. A rain *gauge* will be installed at or near the site and monitored regularly over the course of the fieldvork.

14.2.4 Engineering Survey

A comprehensive engineering survey will be conducted to accurately identify all site sampling locations and cultural and topographic features. All sampling and monitoring well locations will be identified both horizontally and vertically. In addition, any utilities, aboveground structures, and improvements (such as pavement) will be located. Any pertinent information found during the contaminant source survey (Section 14.2.1) will be incorporated into this survey. The survey also will delineate topographic variability using contour intervals of 2 feet.

All engineering survey information will be integrated with any existing computer-aided design (CAD) base naps so that all updated, site-related information can be precisely and efficiently added to the base map. The development of a CAD base map will include the addition of previous data point locations (i.e., coordinates of latitude and longitude). The survey draving will be produced in mylar and blueline copies; the CAD file for the draving will be kept on diskette.

14.2.5 Interim Remedial Measures

During the field investigation, circumstances on site may require IRMs. IRMs will be initiated on a case-by-case basis and only folloving receipt of EPA approval. Rapid response will be emphasized. *An* IRM

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could involve the installation of security fences and warning signs; construction of berms, caps, and/or recovery and treatment systems; and removal of soil, sediment, and/or drums. If an IRM is conducted, a detailed, explanatory report of the IRM will be developed by E & E and provided to the Navy and EPA.

14.2.6 Report

Refer to Section 20 of this work plan (revised April 1992) for a description of the Phase II report.

14.3 Phase 111 — Extent Delineation

Phase III tasks will be conducted based on the results of phases I and II, if deemed necessary. Although the earlier phases are intended to identify and characterize areas and contaminants of primary concern as they extend laterally from the site source(s), Phase III activities will be geared toward further delineating the horizontal and vertical extents of contamination.

14.3.1 Biota Sampling

If deemed appropriate on the findings of phases I and 11, biota sampling may be conducted during Phase 111. If required, a separate biological sampling plan will be prepared. However, base-wide biota sampling will be conducted as part of the investigation of OUs 15, 16, and 17.

14.3.2 Soil Sampling

Soil sampling will be conducted in conjunction with any new shallow, intermediate or deep well installations.

14.3.3 Shallow Monitoring Well Installation and Development

Additional shallow monitoring wells may be required to determine the horizontal extents of shallow groundwater contamination.

14.3.4 Intermediate and Deep Monitoring Well Installation and Development

The installation of additional monitoring wells into deeper zones of the aquifer may be required in order to assess horizontal and vertical

hydraulic gradients, aquifer physical characteristics, and vertical extent of contamination. The number of vells and their locations and depths are dependent upon the findings of phases I and 11.

14.3.5 Groundvater Sampling

All vells installed in Phase III will be sampled, and analytical requirements for the samples will be developed based on the results of previous phases. Monitoring vells installed prior to Phase III will be sampled as required.

14.3.6 Hydrologic Assessment

All vells installed during Phase III will require a vellhead survey to obtain TOC elevations. Water level measurements will be made for all site monitoring vells. Horizontal and vertical gradients will be determined. Aquifer testing will be performed to ascertain aquifer physical characteristics. On sites vhcre contamination is found in the surficial zone during phases I and/or II, the lov permeability zone will be further characterized during Phase III and any subsequent phases. It is intended that soil sample results, lithologic logs, isopach maps, permeability testing, and aquifer testing will be utilized as required to determine the lateral extent and/or continuity of the lov permeability zone, as well as the degree to which hydraulic connection exists betveen the surficial zone and underlying main producing zone at the site.

14.3.7 Engineering Survey

A comprehensive engineering survey will be conducted to accurately identify all new site sampling locations. All sampling and monitoring well locations will be identified both horizontally and vertically. In addition, any improvements (such as pavement) will be located. All engineering survey information will be integrated vith the existing Phase II CAD base maps so that all updated, site-related information can be precisely and efficiently added to the base map. The survey draving will be produced in mylar and blueline copies; the CAD file for the draving will be kept on diskette.

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14.3.8 Air Sampling

The need for formal air sampling and the techniques to be employed are dependent upon the findings of Phase I, and any sampling performed in Phase 11.

14.4 Phase IV--Extent Delineation

The following tasks, if required, will be performed as a continuation of the effort to delineate the extent of contamination:

- Soil sampling;
- Shallow monitoring well installation and development;
- Intermediate and deep monitoring well installations and development;
- Groundwater sampling;
- Hydrologic assessment; and
- Engineering survey.

14.5 Field Quality Assurance/Quality Control

14.5.1 Documentation

Field activities and sample management will entail certain strict documentation requirements as described in Section 7 of the GQAPP.

14.5.2 Field Quality Assurance/Quality Control Samples

Samples collected for laboratory analysis (both screening and non-screening) during all phases of fieldwork will require the preparation of field QA/QC samples as described in Section 11.1 of the QAPP. The estimated numbers of required field QA/QC samples for phases I and II are shown in tables 14-1 and 14-2.

14.6 Decontamination and Waste Management Procedures

14.6.1 Decontamination Procedures

All equipment decontamination procedures for Site 36 will be performed in accordance with Section 6.10 of the GQAPP.

14.6.2 Waste Management Procedures

All investigation-derived waste handling will be performed in accordance with Section 6.11 of the GQAPP and EPA's guidance for investigation-derived waste. All water generated during monitoring well purging and development activities on Site 36 will be discharged onto the ground surface away from the well or will be contained, labeled, and moved to a storage area on NAS Pensacola, as directed by the Navy.

Any excess soil auger cuttings generated by soil boring or monitoring well installation activities will be disposed of on site or will be containerized, labeled, and moved to a storage area on NAS Pensacola, as directed by the Navy.

Other investigation-derived wastes, such as potentially contaminated protective clothing and other disposable materials, will be containerized, labeled, and moved to a storage area on NAS Pensacola.

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15. LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

Laboratory QA/QC procedures are designed to ensure the accuracy, precision, completeness, representativeness, and comparability of all analytical data. Laboratory QA/QC has been addressed both in the GQAPP and GSMP. All phases of fieldwork will incorporate a different level of data quality and requisite laboratory QA/QC. These levels are discussed in detail in the GQAPP and GSHP.

16. GROUNDWATER MODELING

E & E will use the data generated in the previous field investigation phases to conduct limited computer modeling when applicable and appropriate. The following scenarios will be considered to assess the potential for off-site contamination:

- Estimated future plume movement without any remedial action effects (i.e., no action); and
- Estimated total time periods required, for a total contaminant mass at variable pumping rates, to extract contaminants from the aquifer in order to meet previously established standards for drinking water (ARARs).

E & E will use the two-dimensional analytical RANDOMWALK model (Prickett et at. 1981) to arrive at these estimates. E 6 E will calculate flow velocity field input data €or the solute transport simulation from a simplified model based on Darcy's Law. E & E will utilize parameters including transmissivity, storativity, and hydraulic conductivity from the previous phases of fieldwork described above.

To obtain a prediction of plume extent without remediation, E & E will illustrate organic and inorganic simulations for the current time and for one, five, and ten years into the future. Additional simulations will include different remedial pumping scenarios for both organic and inorganic contamination. E & E then will use information generated by these computer simulations for remedial alternative development. Other computer models that can be utilized to assess on-site groundwater conditions include: PLASH, a two-dimensional, finite-difference groundwater flow model; GWTRANS, a two-dimensional, finite-difference solute transport model; FEHWATER, a finite-element groundwater model; and FEMWASTE, a finite-element solute transport model.

[A three-dimensional transport model (MODFLOW and PLASM), which allows vertical discretization of hydraulic properties, as well as horizontal and vertical boundary effects, will be utilized if test data indicated that contamination in the surficial *tone is* migrating into deeper zones of the sand and gravel aquifer.

At sites where radionuclide contamination exists, more appropriate models for transport mechanism (i.e., RESRAD-- from DOE-Argonne National Lab; and GENII-- from DOE-Pacific Northwest Lab) will be utilized.]

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17. TREATABILITY STUDY

As indicated in Table 14-2, a number of the analyses to be performed on the samples collected during phases II through IV are required in support of the treatability study. Characterization of samples in terms of parameters listed in Table 14-2, together with treatability tests, will provide the basic data required for the evaluation of physical, chemical, and biological remedial technologies. Some of the treatability tests that may be examined are incineration tests, solubility tests, soil leaching tests, and coagulation-flocculation jar tests.

18. BASELINE RISK ASSESSMENT

As part of the Remedial Activities Investigation, a baseline risk assessment will be conducted to determine the level of effort required in the FS for remedial actions. The baseline risk assessment will provide an evaluation of the potential threat to human health and the environment in the absence of any remedial action by providing the basis for determining whether or not remedial action is necessary and the justification for performing any remedial actions. [The risk assessment will be performed in accordance with EPA's 1989 document, Risk Assessment Guidance for Superfund: Volumes I and II.]

The baseline risk assessment identifies and characterizes the toxicity and levels of hazardous substances present in the media of concern (e.g., air, groundwater, soil, surface water, sediment, or biota), the environmental fate and transport mechanisms within the media of concern (e.g., physical, chemical, biological degradation processes, and hydrogeological conditions), the potential human and environmental receptors, the potential exposure routes and the extent of actual or expected exposure, the extent of impact or threat (i.e., risk characterization), and the level or levels of uncertainty associated with all of the above. The complexity of the site will determine the level of effort required to conduct the baseline risk assessment. The conclusions of the baseline risk assessment will determine the level of effort required in the risk assessment to be conducted in the FS.

The baseline risk assessment can be divided into four tasks: contaminant identification, exposure assessment, toxicity assessment, and risk characterization.

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18.1 Contaminant Identification

The main purpose of this step is to screen available information on the hazardous wastes present at the site and to identify contaminants of concern to focus on in subsequent efforts in the risk assessment process. [The ideotification of contaminants of concern will be conducted in accordance vith tbe previously referenced risk assessment guidance documents (BPA 1989a, 1989b).]

18.2 Exposure Assessment

In this subtask, actual or potential pathvays are identified, populations potentially exposed are characterized, and the extent of exposure is determined. Identification of potential exposure pathvays helps to conceptualize the migration of contaminants from an existing source to an existing or potential point of contact. *An* exposure pathway may be vieved as identifying four elements:

1) A source mechanism of chemical release into the environment;
2) *An* environmental transport medium (e.g., air, groundwater, or biota);
3) A point of potential contact vith the medium of concern; and
4) *An* exposure route to the population from the contact point.

The purpose of this analysis is to provide decision makers with an understanding of both the current and potential future risks if no action is taken. Therefore, as part of this evaluation a reasonable maximum exposure scenario should be developed to reflect the type(s) and extent(s) of exposures that could occur based on the expected future use of the site.

The final step in the exposure assessment is to integrate the information and develop a qualitative and/or quantitative estimate of tbe expected exposure levels resulting from the actual or potential release of contaminants from the site.

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18.3 Toxicity Assessment

This step considers: (1) the types of adverse human or environmental effects associated with contaminant exposure; (2) the relationship between the magnitude of exposure(s) and the adverse effects; and (3) related uncertainties such as the evidence for a chemical's potential carcinogenicity in humans. Typically, this process relies heavily on existing toxicity information and rarely involves the development of new data on toxicity or dose-response relationships. [The Integrated Risk Information System (IRIS) will be utilized during the toxicity assessment.)

18.4 Risk Characterization

In the final stages of the baseline risk assessment, a characterization of the potentially adverse effects to human health or environment of each scenario derived is developed and summarized. By integrating information developed during the exposure and toxicity assessments, estimates of risk can be developed to include carcinogenic risks, noncarcinogenic risks, and environmental risks. To characterize environmental risks, the potential exposures to the surrounding ecological receptors must be identified, and the potential effects associated with such exposure(s) must be determined. Important factors to examine include disruptive effects to populations (plant and animal) and the extent of perturbations to the ecological community.

The following data will be obtained for each site as part of the baseline risk assessment:

- Distance to the closest residence (on or off NAS Pensacola);
- Type of barrier, if any, to prevent access;
- Approximate population within 0.25 mile of the site (including NAS Pensacola);
- Sensitive land uses in the vicinity of the site (e.g., schools, hospitals, and retirement homes);
- Activities (recreational and/or occupational) which take place near the sites and the estimated number of people involved;

- Records of any environmental and/or health complaints regarding the sites; and
- Log of any actions taken by a health unit regarding health issues, complaints, and concerns.

The results of the baseline risk assessment may indicate that the site poses little or no threat to human health or the environment. In such cases, the FS should be appropriately scaled dovn or eliminated. The results of the Remedial Activities Investigation and baseline risk assessment will serve as the primary basis of documenting a no further action decision.

It should be emphasized that all the tasks conducted as part of the baseline risk assessment will be performed on an interactive basis between the various disciplines required (e.g., hydrogeologists, Chemists, and risk assessors), the Navy, and the reviewing regulatory agencies (i.e., FDER and EPA) and that the goal of these tasks is *to* produce appropriate, sufficient, and high quality data to complete the baseline risk assessment.

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19. FEASIBILITY STUDY

Further details on the specific tasks to be performed as part of the FS will be described in detail during the update of this work plan after the initial phases of the fieldwork have been completed. However, it is anticipated that if contamination of some degree is identified on site, the general approach described below will be followed.

As part of the initial scoping activities of the FS, E & E will prepare a summary of field data collected during the RI to compare and evaluate the concentration of the contaminants of concern against the cleanup criteria developed. E & E will prepare a qualitative and quantitative summary of contamination for the scenarios identified during risk assessment evaluation. Results of this evaluation will serve as a basis for the screening of applicable remedial technologies for the development and evaluation of remedial action technologies. [All PS tasks will be performed in accordance with EPA's current document, Guidanc for Conducting Remedial Investigation and Feasibility s Under CERCLA (EPA 1988b). If any of the procedures described in this section are in conflict vith the current EPA guidance documents, the methods described in the EPA guidance document will be followed.]

19.1 Screening of Applicable Remedial Technologies

E & E will screen and develop applicable technologies for the remediation of any on-site contamination. In the process of screening applicable technologies, E & E will consider all ARARs, identify problems, and determine pathways of contamination using a receptor-oriented approach based on the threat to the public health, welfare, and the environment. In this summary, pathways will be outlined for each medium of concern. E & E then will identify

applicable remedial technologies for each general response action such as contaminant removal, treatment, disposal, and so on. The identification of technologies will be based on technical selection criteria and E & E's engineering judgment.

19.2 Assessment of Applicable Remedial Technologies

During the assessment process, E & E will consider the relative applicability of each technology. In addition, criteria such as environmental, institutional, and public health impacts, and technical feasibility will be applied. A discussion of the applicable technologies will be provided for each general response action. The summary will include comments as appropriate concerning the reliability and implementability of the technology.

19.3 Risk Assessment

Based on the results of the baseline risk assessment conducted during the Remedial Activities Investigation, E & E will perform a detailed risk analysis to determine the acceptable levels of risk. This will allow the Navy to balance the increase in costs associated vith each alternative against gains in safety. The risk analysis will include consideration of site contaminant toxicity, transport mechanisms, persistence in the environment, and impacts on human health and the environment.

19.4 Development and Evaluation of Remedial Action Alternatives

During the preceding task, remedial technologies will be assessed independently vithout considering potential advantages or disadvantages of technologies applied in combination. In this task, individual technologies will be assembled into remedial action alternatives for the site. During the assembly and evaluation of the action alternatives, criteria including technical feasibility, environmental and public health, institutional impacts, and comparative costs will be considered.

19.5 Selection of Recommended Remedial Action Alternatives

During this task, E & E will select a single remedial action alternative for the remediation of the site. The alternatives assembled during the

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preceding task will be compared using technical, environmental, and economic criteria. E 6 E will consider present worth of total costs, environmental effects, technical aspects, the extent to which alternatives comply with ARARs, community effects, and other factors. E & E will apply these evaluation criteria uniformly to each alternative along vith any additional criteria that may result from the Navy project coordination. E 6 E will discuss the selection of the chosen alternative by means of a statement of the relative advantages of the alternative over the other alternatives considered.

19.6 Feasibility Study Report

A draft and a final FS report will be provided to the Navy for review and comments.

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20. REPORT

Folloving the Phase I investigation, E & E will prepare a Phase I Interim Data Report for each site. The purpose of this report will be to summarize briefly the findings of Phase I and provide recommendations for the Phase II investigation; the Phase I interim report will not be a formal report. (In general, during the proposed multi-phase investigation process, formal reports will be generated only when little or no additional assessment work appears to be required.) Following the Phase I interim report, the work plans for the Phase II work will be updated accordingly. If the results of Phase II indicate that no further action is warranted, a formal RI report will be produced. Eowever, if the Phase II results indicate that additional investigation is required, the Phase II report will be produced as the Phase II Interim Data Report and will only briefly summarize the Phase II results and provide recommendations for the Phase III investigation. Thus, the Phase II interim report will not be a formal document. Following production of the Phase II interim report, the work plans for the Phase III work will be updated. Once the Phase III work is complete, all results will be synthesized and presented in an RI report.

In addition, following any treatability studies and FS work, formal reports will be produced for these efforts. These reports will include detailed narratives associated with the respective tasks.

For all reports, E & E will prepare a 100% draft report for the Navy and Technical Review Committee (TRC) review. The TRC review comments will be incorporated into draft final reports which will be resubmitted to the TRC for final approval. The draft final report will then become final if no further comments are received from the TRC.

Each report will be written as an independent document, complete in its own right, and fully supportive of the conclusions that it contains. Where appropriate, public participation issues will be summarized, as will interim remedial measures necessary to protect against continued degradation of conditions at the site(s). Information used in analyses, but supplemental to the analytical results, will be provided in a series of appendices.

Monthly progress reports during all field activities will be submitted to keep the Navy apprised of fieldwork status and site conditions. Current and planned activities as well as cost tracking will be provided.

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21. DOCUMENT REVISION

Periodic updating of all administrative documents (GOAPP, GSMP, GHSP, GPMP, and work plans) will be necessary due to changes in site conditions and/or program conditions or requirements. The schedules shown in the GPMP and GSMP indicate document revisions approximately every two months for the GOAPP, GSMP, GHSP, and GPMP. Work plans will be revised after each phase of fieldwork, with phases III and IV, if required, fully developed after Phase II with separate cost estimations. Revised documents will undergo the same review process (e.g., Navy and TRC) as the original documents.

22. PROJECT MANAGEMENT

Project management will be an ongoing process throughout this investigation. This process includes preparation of biweekly project status reports, coordination of schedules? mobilizations, and other project incidentals with the Navy, management of project staff, coordination with the E 6 E support groups (e.g., publications and laboratory), and ongoing project review by E & E technical managers and directors. These project management steps are described in detail in the GPMP submitted to the Navy.

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23. PROJECT SCHEDULE

Figures 23-1, 23-2, 23-3, and 23-4 show the project schedules €or phases I, II, III, and IV, respectively. Given that the scopes of work for Phase II and beyond are dependent on the results of the preceding phases, the project schedules for phases II, 111, and IV are tentative. In addition, the length of time between phases is subject to the schedule in the Federal Facilities Agreement Site Management Plan (FFA SMP). The schedule in the FFA SMP will be updated yearly.

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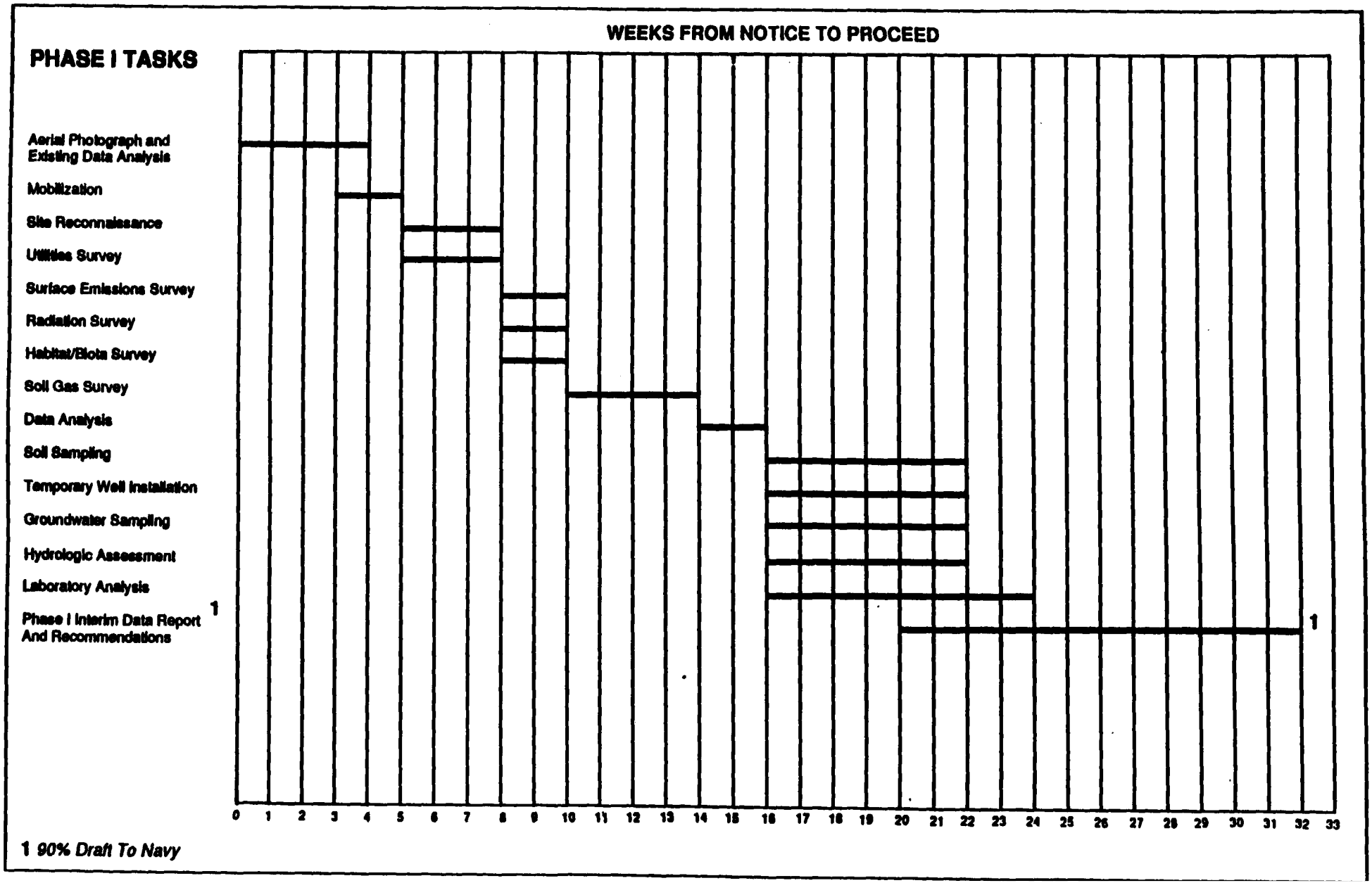

Figure 23-1 PHASE I PROJECT SCHEDULE -- GROUP N (SITE 36)

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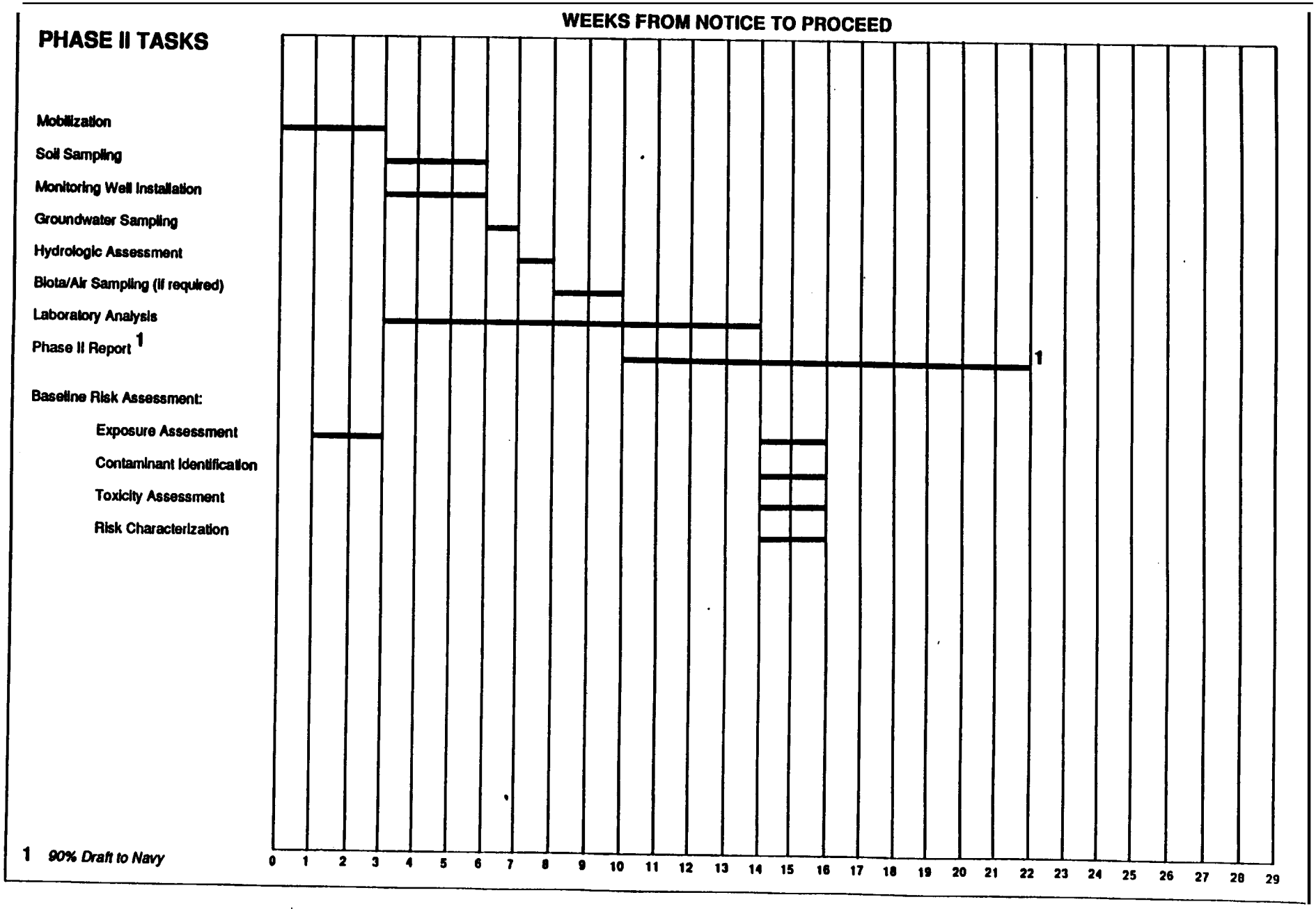

Figure 23-2 PHASE II PROJECT SCHEDULE -- GROUP N (SITE 36)

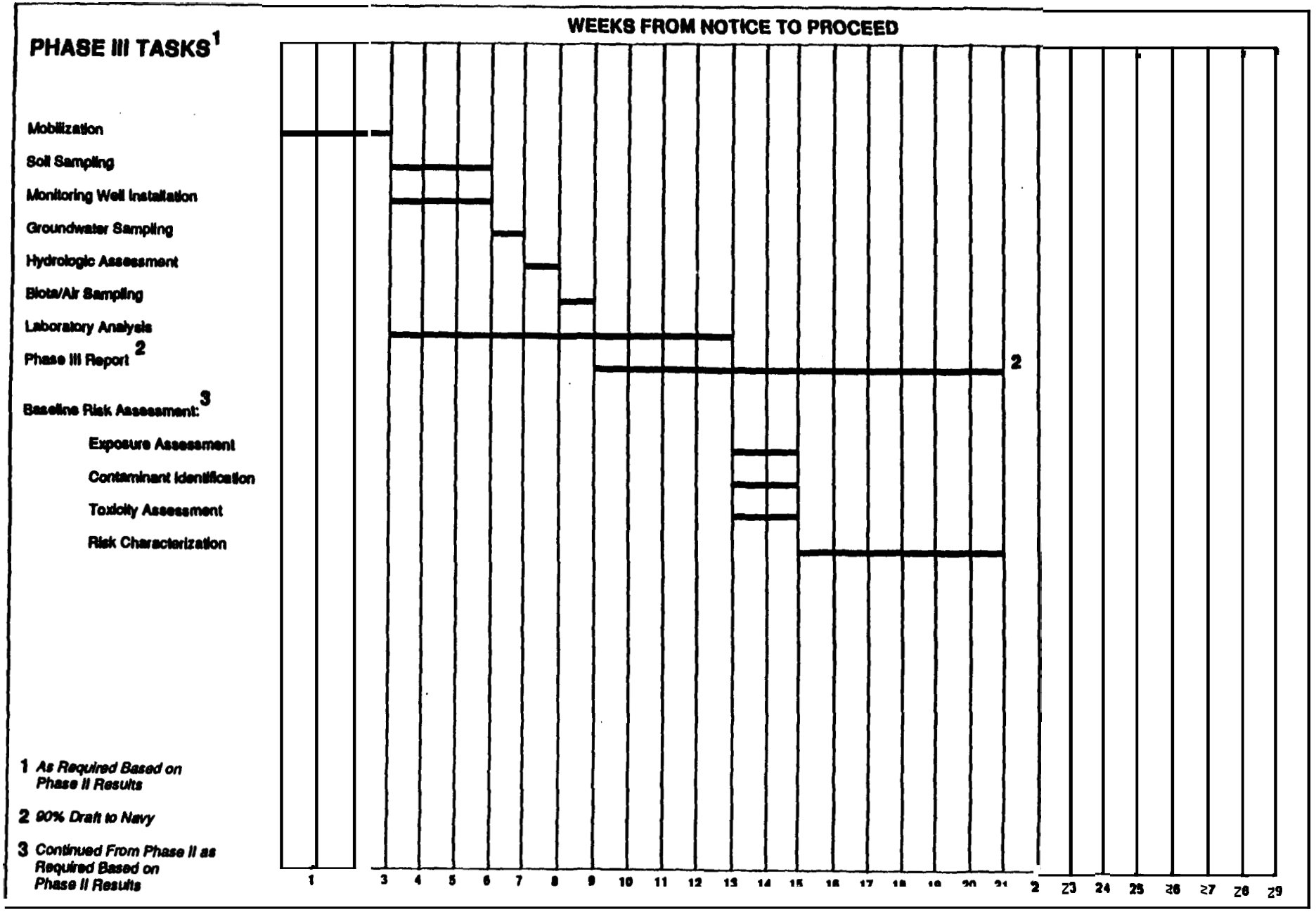

Figure 23-3 PHASE III PROJECT SCHEDULE -- GROUP N (SITE 36)

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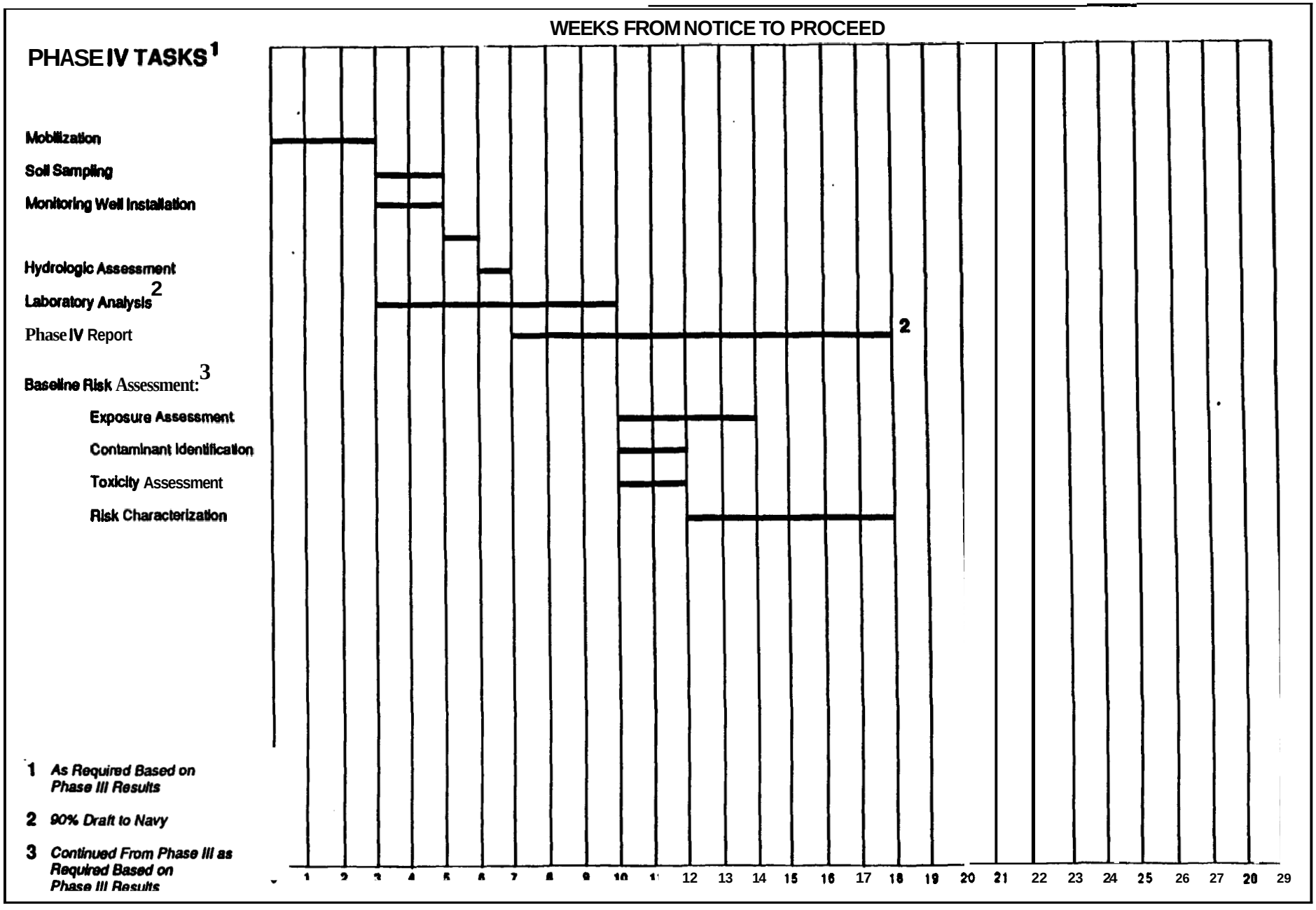

Figure 23-4 PHASE IV PROJECT SCHEDULE -- GROUP N (SITE 36)

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25. FLORIDA PROFESSIONAL GEOLOGIST SEAL

I hereby affix my seal to the Contamination Assessment/Remedial Activities Investigation Work Plan, Group N, Naval Air Station, Pensacola, Escambia County, Florida, in accordance with Chapter 492 of the Florida Statutes and applicable rules and regulations developed pursuant thereto:

Name:	John D. Barksdale
License Number:	P.G. No. 1150
State:	Florida
Expiration Date:	July 31, 1994

John D. Barksdale

John D. Barksdale

Date

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APPENDIX A

SITE-SPECIFIC SAFETY PIAN

[Bold items enclosed in brackets denote *changes* to last version of document]

ecology and environment, inc.

SITE SAFETY PLAN

Version 988

A. GENERAL INFORMATION

Project Title: Site 36 - Industrial Waste Sewer

Project No.: UH8000

TDD/Pan No.:

Project Manager: John Barksdale

Project Dir.: Gerry Gallagher

Location(s):

Prepared by: Dan Foss

Dato Proparod: 3/23/92

Approval by: Sybil Newchurch

Dato Approved:

Site Safety Officer Review:

Dato Reviewed:

Scope/Objective of Work: Field activities will include soil sampling, permanent monitoring well installation, groundwater sampling, physical surveys, and hydrologic assessment.

Proposed Dato of Field Activities: December 1992

Background Into: Complete: [X] Preliminary (No analytical data available) [ ]

Documentation/Summary:

Overall Chemical Hazard:	Serious [ ]	Low [X]	Moderate [ ]	Unknown [ ]
Overall Physical Hazard	Serious [ ]	Low [ ]	Moderate [X]	Unknown [ ]

B. SITE/WASTE CHARACTERISTICS

Waste Type(s):

Liquid [X] Solid [ ] Sludge [X] Gas/Vapor [X]

Characteristic(s):

Flammable/ Ignitable	[X]	Volatile	[X]	Corrosive	[X]	Acutely Toxic	[X]
Explosive	[X]	Reactive	[X]	Carcinogen	[X]	Radioactive*	[ ]

Other: All industrial wastes generated on NAS Pensacola are disposed of into this sewer line.

Physical Hazards:

Overhead	[X]	Confined* Space	[ ]	Below Grade	[ ]	Trip/Fall	[X]
Puncture	[ ]	burn	[X]	cut	[ ]	Splash	[X]
Noise	[X]	Other:	Sampling along Industrial Waste Sewer Line. Heat/cold stress.				

*Requires completion of additional form and special approval fror tho Corporato Health/Safety group. Contact RSC or HQ.

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Site History/Description and Unusual Features (see Sampling Plan for detailed description): From 1973 to present all industrial wastes generated on NAS Pensacola have been disposed of into 15-inch diameter 5.5-mile long industrial sewer line and transported to the Industrial Waste Water Treatment Plant. Phase I soil and groundwater samples exhibited elevated levels of one or more of the contaminant groups: metals (primarily As, Cd, Cr, and Pb), TRPHs, VOCs, PAHs, and phenols.

Locations of Chemicals/Wastes: Subsurface

Estimated Volume of Chemicals/Wastes: Unknown

Site Currently in Operation Yes: [X] No: [ ]

Compound	PEL/TWA	Route of Exposure	Acute Symptoms	Odor Threshold	Odor Description
Hydrochloric Acid	5 ppm	Inh, Ing, Con.	Corrosive	Unknown	Acrid
Nitric Acid	2 ppm	Inh, Ing, Con.	Corrosive	0.3 - 1 ppm	Acrid
Sulfuric Acid	1 mg/m^3	Inh, Ing, Con.	Corrosive		Odorless
Sodium Hydroxide	2 mg/m^3	Inh, Ing, con.	Corrosive	N/A	Odorless
Isopropyl Alcohol	400 ppm	Inh, Ing, Con.	Drowsiness, Head	7.5 - 200 ppm	Rubbing Alcohol
Methylene Chloride	500 ppm	Inh, Cong.	Dizzy, naus, vomit)	214 ppm	Sweet odor
1,1,1-trichloroethane	350 ppm	Inh, Ing, Con.	Dizzy, naus, vomit	20-100 ppm	Chloroform-11ke
Trichloroethylene	50 ppm	Inh, Ing, Con.	Dizzy, MUS, vomit	50 ppm	Chloroform-like
Tetrachloroethylene	25 ppm	Inh, Ing, Con.	Dizzy, naus	None	Ether-like
Chlorobenzene	75 ppm	Inh, Ing, Con.	Drowsy, Vomit	61 ppm	Sweet odor
1,1-Dichloroethene	1 ppm	Inh, Ing, Con.	Dizzy, naus	None	Chloroform-like
1,1-Dichloroethane	100 ppm	Inh, Ing, Con.	CNS depression	300 ppm	Sweet
Ethylbenzene	100 ppm	Inh,Ing,Con,Abs.	Head, vomit, burn	0.1 ppm	Aromatic
Toluene	200 ppm	Inh,Ing,Con,Abs.	Fatigue, head	0.2 ppm	Aromatic
Xylene	100 ppm	Inh,Ing,Con,Abs.	Head, naus, cough	0.5 ppm	Sweet
1,2-Dichlorobenzene	50 mg/kg	Inh, Ing, Con.	Head, vomit, naus	2-30 ppm	Camphor/mothballs
1,2-Dichloroethane	50 ppm	Inh, Ing. Con.	Naus, head, vomit	6 ppm	Sweetish
Arsenic	0.5 mg/m^3	Inh,Ing,Con,Abs.	Naus,vomit,diarr	N/A	N/A
Chromium	0.5 mg/m^3	Inh, Ing, Con.	Cough,wheeze,head.	N/A	N/A
Cadmium	0.2 mg/m^3	Inh, Ing, Con.	Head, cough, vomit	N/A	N/A
Lead	0.05 mg/m^3	Inh, Ing, Con.	Vomit, diarrhea	N/A	N/A

Note: Complete and attach a Hazard Evaluation Sheet for major known contaminant.

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D. SITE SAFETY WORK PLAN

Site Control: Attach up, use back of this page, or sketch of site showing bot zone, contamination reduction, zone, etc.

Perimeter identified? [Yes] Site secured? [No]

Work Areas Designated? [Yes] Zone(s) of contamination Identified? [No]

Personnel Protection (TLD badges required for all field personnel):

Anticipated Level of Protection (Cross-reference task numbers to Section C):

	A	B	C	D
Task 1				X
Task 2				X
Task 3				X
Task 4				X
Task 5				X
Task 6				X

(Expand if necessary)

Modifications: Modified level D with tyvek, neoprene gloves and boots, safety glasses, APR available when upgrade to level C is necessary based on OVA readings.

Action Levels for Evacuation of Work Zone Pending Reassessment of Conditions:

- Level D: O_2 <19.5% or >25%, explosive atmosphere >10% LEL, organic vapors above background levels, particulates >_____ mg/m3, other _____
- Level C: O_2 <19.5% or >25%, explosive atmosphere >25% LEL (California-20%), unknown organic vapor (in breathing zone) >1 ppm, particulates >_____ mg/m^3, other _____
- Level B: O_2 <19.5% or >25%, explosive atmosphoro >25% LEL (California-20%), unknown organic vapors (in breathing zone) >5 ppm, particulates >_____ mg/m^3, other _____
- Level A: O_2 <19.5% or >25%, explosive atmosphere >25% LEL (California-20%), unknown organic vapors >500 ppm, particulates >_____ mg/m^3, other _____

Air Monitoring (daily calibration unless otherwise noted):

Contaminant of Interest	Type of Sample (area, personal)	Monitoring Equipment	Frequency of Sampling
Volatile Organics	Area	OVA	Continuous
Radiation	Area	Mini-rad	Continuous
Explosive Gases	Area	O_2/Explosimeter	Continuous

(Expand if necessary)

Decontamination solutions and Procedures for Equipment, Sampling Gear, etc.:

Alconox + tap water wash, tap watmr rinse, two isopropanol rinses, organic-frme watmr rinse, and air dry.

Teflon implements used for the collection of samples for metals analyses will have a 10% nitric acid solution rinse after tho tap watmr rinse followed by another tap watmr rinse, two isopropanol rinses, and air dry.

Personnel Decon Protocol: Boot and glove wash - Alconox + tap water wash with clean water rinse. Expendables will bo double-bagged and drummed for disposal. Field personnel rill take a hygienic shower off site, following completion of each day's fieldwork.

Decon Solution Monitoring Procedures, if Applicable: Decontamination activities will *bo* performed in a well-ventilated area upwind of the sampling zone.

Special Site Equipment, Facilities, or Procedures (Sanitary Facilities and Lighting Must Meet 29 CFR 1910.120):

Site Entry Procedures and Special Considerations: E & E's "buddy system" will *bo* employed at a11 times during fieldwork activities. Personnel will exercise caution in the vicinity of nearby roadways. If above background radiation levels are encountered, team members will evacuate tho sampling area and contact tho corporate health physics group to reassess tho site.

Work Limitations (time of day, weather conditions, etc.) and Heat/Cold Stress Requirements: All fieldwork activities will be performed during daylight hours. Team members will break as needed to prevent heat stress and replace fluids. cooling vests may be used to prevent heat stress.

General Spill Control, if applicable: N/A

Investigation-Derived Material Disposal (i.e., expendables, decon waste, cuttings): All fieldwork waste materials rill *bo* double bagged, drummed, labeled, and transported to designated location for final disposal by the Navy.

Sample Handling Procedures Including Protective Wear: During all handling of samples, a11 field team members will wear surgical gloves. Goggles will be worn during sample preservation with acids.

Team Member*	Responsibility
To bo determined.	Team Leader
	Site Safety Officer/Sampler
	Geologist/Sampler
	Sampler

*All entries into exclusion zone require Buddy System use. All E & E field staff participate in medical monitoring program and have completed applicable training per 29 CFR 1910.120. Respiratory protection program meets requirements of 29 CFR 1910.134, and ANSI Z88.2 (1980).

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E. EMERGENCY INFORMATION

(Use supplemental sheets, if necessary)

LOCAL RESOURCES

(Obtain a local telephone book from your hotel, if possible)

Ambulance: On base: (904) 452-4138; Off base: 911

Hospital Emergency Room: NAS Dispensary - Building 3600: (904) 452-2733; Baptist Hospital: (904) 434-4811 (Life Flight)

Poison Control Center:

Police (include local, county sheriff, state): 911

Fire Department: 911

Airport:

U.S. Coast Guard: Emergency: (904) 453-8178; General Intorration: (904) 453-8282

Laboratory: E & E ASC: (716) 631-0360

Fed. Express: (800) 238-5355

Client Contact: U.S. Navy Southern Division, Enginoor-In-Chargo, Susanna D. Sanborn: (803) 743-0574

Site Contact: WAS Pensacola Environmental Coordinator, Ron Joyner: (904) 452-4515

SITE RESOURCES

Site Emergency Evacuation Alarm Method: N/A

Water Supply Source: On site

Tolophone Location, Number: To bo dotorminod on site

Cellular Phone, if available: To bo dotorminod on site

Radio:

Other: On-site warehouse number to bo dotorminod

EMERGENCY COOR —

1. Dr. Raymond Harbison (Univ. of Florida) ..... (501) 221-0465 or (904) 462-3277, 3281
   Alachua, Florida (501) 370-8263 (24 hours)

2. Ecology and Environment, Inc., Safety Director
   Paul Jonmaire ..... (716) 684-8060 (office
   (716) 655-1260 (home)

3. Regional Safety coordinator - Sybil Nowchurch..... ..... (904) 877-1978 (offico
   (904) 878-2336 (home)

4. Regional Office Manager - Rick Rudy ..... (904) 877-1978 (office
   (904) 893-7245 (homo)

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1. Twenty-four hour answering service: (501) 370-8263

What to report:

- State: "this is an emergency."
- Your name, region, and site.
- Telephone number to reach you.
- Your location.
- Name of person injured or exposed.
- Nature of emergency.
- Action taken.

2. A toxicologist, (Drs. Raymond Harbison or associate) will contact you. Repeat the information given to the answering service.

3. If a toxicologist doom not return your call within 15 minutes, call the following persons in order until contact is made:

a. 24 hour hotline - (716) 684-8940
b. Corporate Safety Director - Paul Jonmaire - home # (716) 655-1260
c. Assistant Corp. Safety Officer - Steven Sherman - home # (716) 688-0084

EMERGENCY ROUTES

(NOTE: Field Team must Know Route(s) Prior to Start of Work)

Directions to hospital (include map) from Site 36

NAS Dispensary - See figures A-1 and A-2. The NAS Dispensary is located on Turner Street in Building 3600.

Baptist Hospital - Take Duncan Road (Navy Blvd.) north to exit the base. Navy Blvd. becomes HWY 91 and curves to the east. Follow Navy Blvd./Hwy. 90 east approx. 3 mi to Pace Blvd. Turn left (north) on Pace Blvd. and proceed approx. 1 mi to Cervantes St. (Hwy. 90). Turn right on Cervantes/Hwy. 90 and follow this road for about 8 blocks and turn left (north) onto I street. The hospital is about 6 blocks north on the left.

Emergency Egress Routes to Get Off-Site Emergency egress routes will be located if emergency exit routes become blocked by construction. etc.

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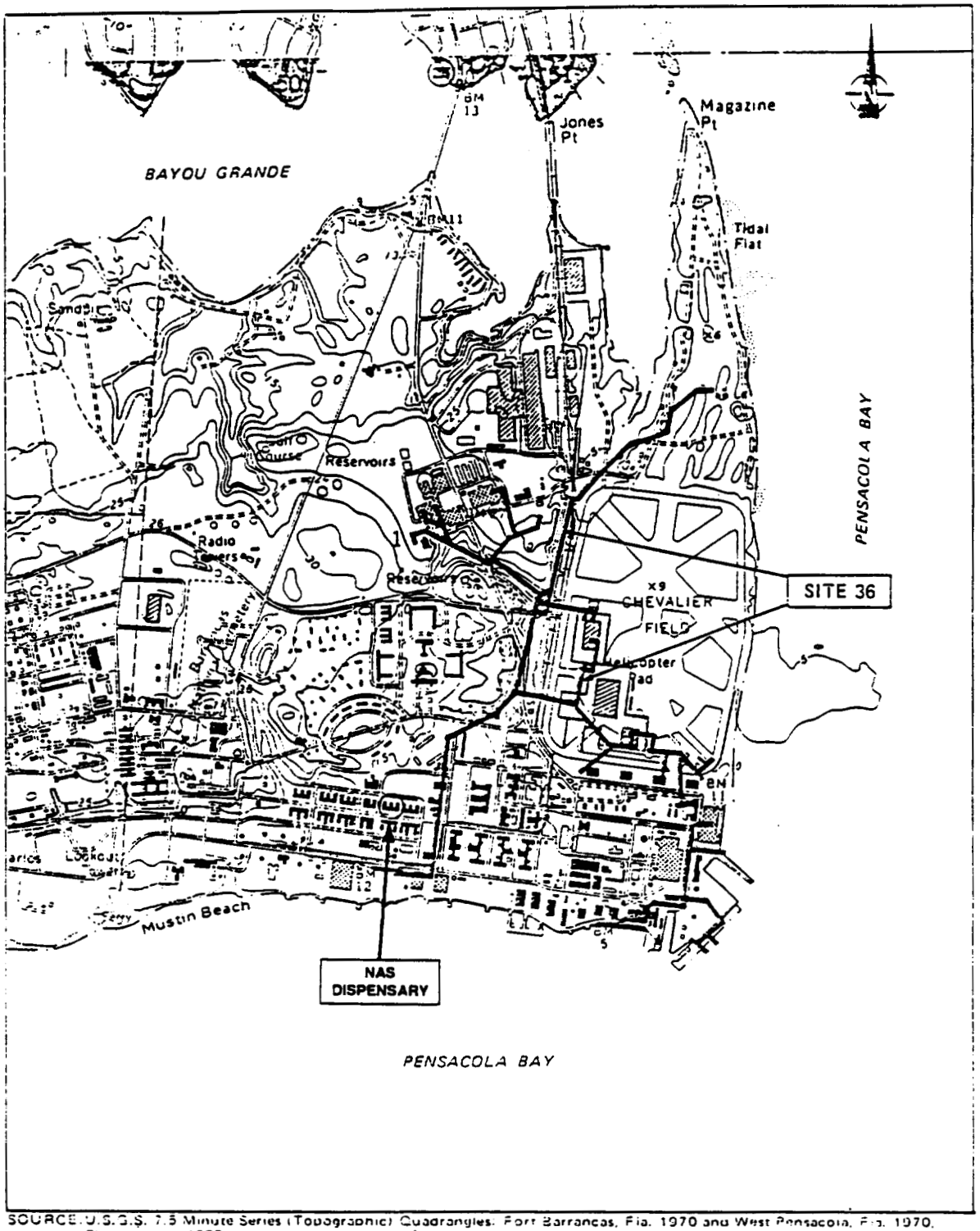

SOURCE: U.S.G.S. 7.5 Minute Series (Topographic) Quadrangles: Fort Barrancas, Fla. 1970 and West Pensacola, Fla. 1970, Photorevised 1987

SCALE

0 ½ 1 MILE

0 .5 1 KILOMETER

Figure A-1 LOCATION OF NAS DISPENSARY

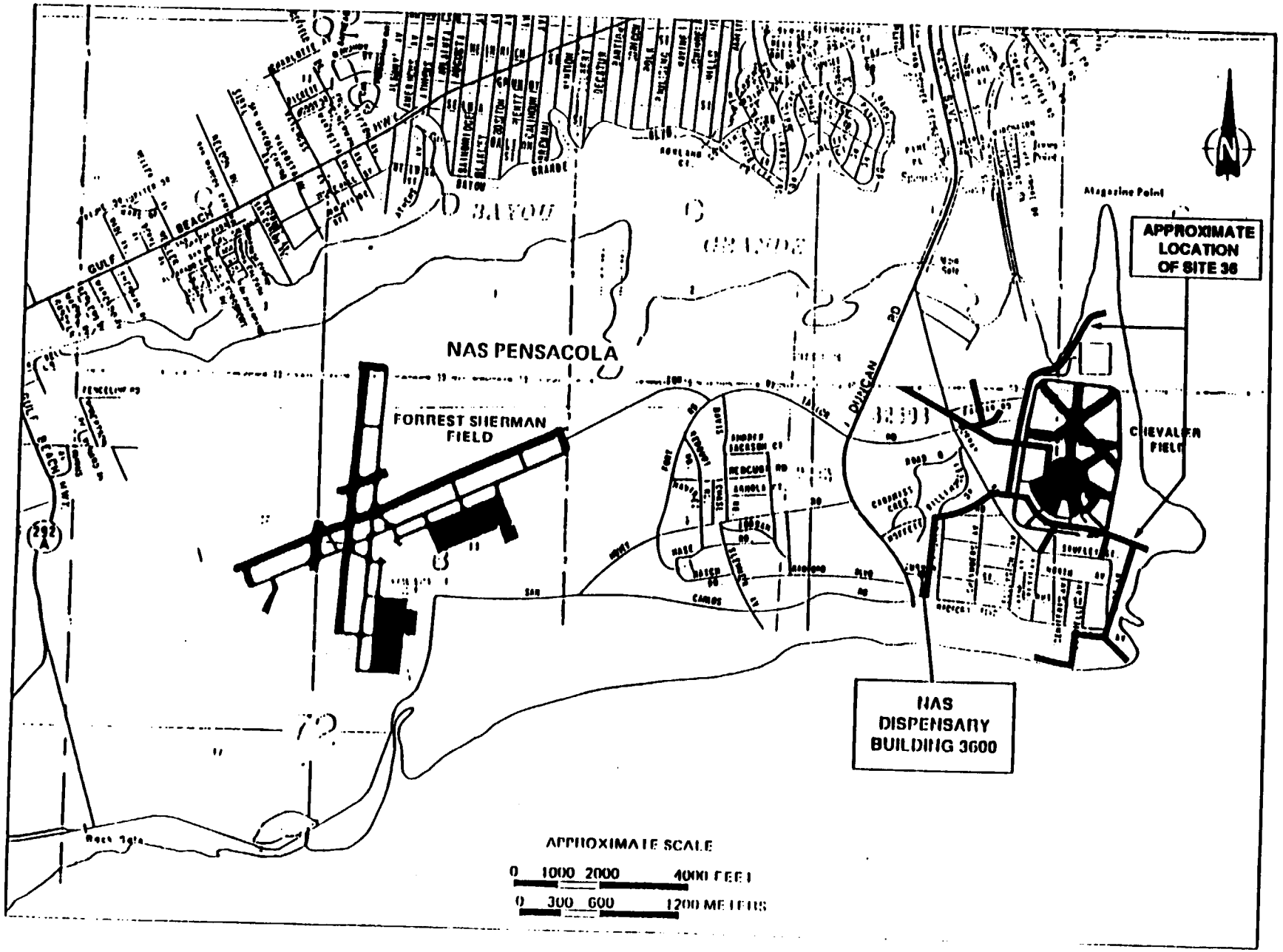

Figure A-2 LOCATION OF NAS DISPENSARY

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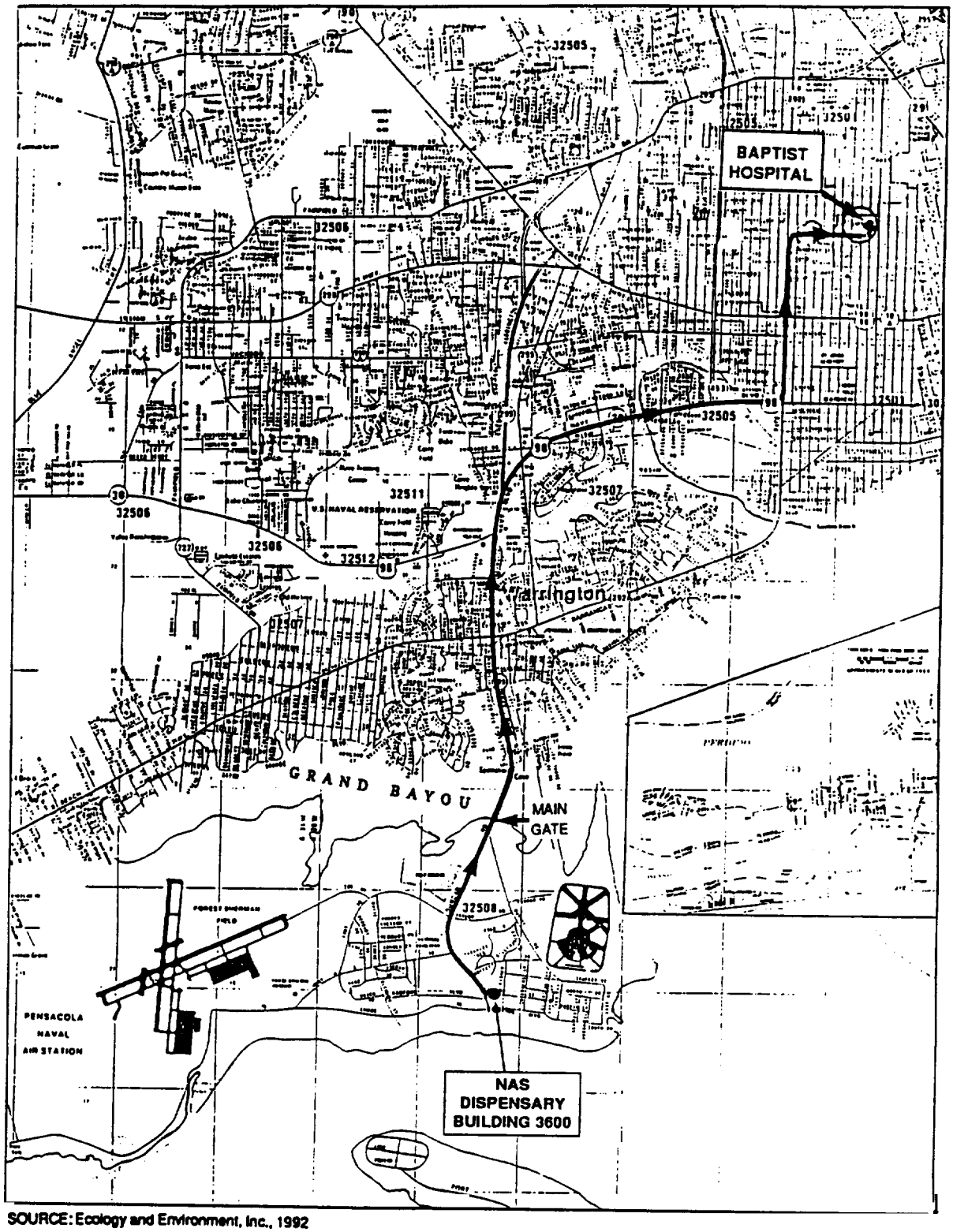

SOURCE: Ecology and Environment, Inc., 1992

APPROXIMATE SCALE IN FEET

0 2000 4000 6000 8000

Figure A-3 LOCATION OF BAPTIST HOSPITAL

F. EQUIPMENT CHECKLIST

PROTECTIVE GEAR

Level A	No.	Level B	No.
SCBA		SCBA	
SPARE AIR TANKS		SPARE AIR TANKS	
ENCAPSULATING SUIT (Type _____)		PROTECTIVE COVERALL (Type _____)	
SURGICAL GLOVES		RAIN SUIT	
NEOPRENE SAFETY BOOTS		BUTYL APRON	
BOOTIES		SURGICAL GLOVES	
GLOVES (Type _____)		GLOVES (Type _____)	
OUTER WORK GLOVES		OUTER WORK GLOVES	
HARD HAT		NEOPRENE SAFETY BOOTS	
CASCADE SYSTEM		BOOTIES	
5-MINUTE ESCAPE COOLING VEST		HARD HAT WITH FACE SHIELD	
		CASCADE SYSTEM	
		MANIFOLD SYSTEM	
Level C		**Level D**	
ULTRA-TWIN RESPIRATOR		ULTRA-TWIN RESPIRATOR (Available)	X
POWER AIR PURIFYING RESPIRATOR		CARTRIDGES (Type GMC-H _____)	
CARTRIDGES (Type _____)		5-MINUTE ESCAPE MASK (Available)	
5-MINUTE ESCAPE MASK		PROTECTIVE COVERALL (Type Tyvek _____)	X
PROTECTIVE COVERALL (Type _____)		RAIN SUIT	
RAIN SUIT		NEOPRENE SAFETY BONDS	
BUTYL APRON		BOOTIES	X
SURGICAL GLOVES		WORK GLOVES	
GLOVES (Type _____)		HARD HAT WITH FACE SHIELD	X
OUTER WORK GLOVES		SAFETY GLASSES	X
NEOPRENE SAFETY BOOTS			
HARD HAT WITH FACE SHIELD			
BOOTICS			
HARDHAT			

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INSTRUMENTATION	No.	DECON EQUIPMENT	NO.
OVA		WASH TUBS	X
THERMAL DESORBER		BUCKETS	X
O2/EXPLOSIMETER W/CAL. KIT	X	SCRUB BRUSHES	X
PHOTOVAC TIP		PRESSURIZED SPRAYER	X
HNu (Probe 10.2 eV)	X	DETERGENT (Type)	
MAGNETOMETER		SOLVENT (Type)	
PIPE LOCATOR		P W T I C SHEETING	X
WEATHER STATION		TARPS M.D POLES	
DRAEGER PUMP, TUBES		TRASH BAGS	X
BRUNTON COMPASS		TRASH CANS	
MONITOX CYANIDE		MASKING TAPE	X
HEAT STRESS MONITOR		DUCT TAPE	X
NOISE EQUIPMENT		PAPER TOWELS	X
PERSONAL SAMPLING PUMPS		FACE MASK	
		FACE MASK SANITIZER	
		FOLDING CHAIRS	
		STEP LADDERS	
RADIATION EQUIPMENT		DISTILLED WATER	X
DOCUMENTATION FORMS			
PORTABLE RATEMETER			
SCALER/RATEMETER		SAMPLING EQUIPMENT	
ZnS Probe		HALF-GALLON BOTTLES	X
GM Pancake Probe		VOA BOTTLES	X
GM Side Window Probe		BAILER CORD	X
MICRO R METER		HAND BAILERS	X
ION CHAMBER		THIEVING RODS WITH BULBS	
ALERT DOSIMETER		SPOONS	X
POCKET DOSIMETER		KNIVES	
MINI RAD	X	FILTER PAPER	
FIRST AID EQUIPMENT		PERSONAL SAMPLING PUMP SUPPLIES	
FIRST AID KIT	X		
OXYGEN ADMINISTRATOR			
STRETCHER			
PORTABLE EYE WASH	X		
BLOOD PRESSURE MONITOR			
FIRE EXTINGUISHER	X		

VAN EQUIPMENT	No.	MISCELLANEOUS (Cont.)	No.
TOOL KIT	X		
HYDRAULIC JACK			
LUG WRENCH			
TOW CHAIN			
VAN CHECK OUT			
Gas			
Oil			
Antifreeze			
Battery			
Windshield Wash			
Tire Pressure			
		SHIPPING EQUIPMENT	
MISCELLANEOUS		COOLERS	X
PITCHER PUMP		PAINT CANS WITH LIDS, 7 CLIPS EACH	
SURVEYOR'S TAPE		VERMICULITE	X
100 FIBERGLASS TAPE		SHIPPING LABELS	X
300 NYLON ROPE		DOT LABELS: "DANGER"	
NYLON STRING		"UP"	
SURVEYING FLAGS		"INSIDE CONTAINER COMPLIES ..."	
FILM		"HAZARD GROUP"	
WHEEL BARROW		STRAPPING TAPE	X
BUNG WRENCH		BOTTLE LABELS	X
SOIL AUGER		BAGGIES	X
PICK		CUSTODY SEALS	X
SHOVEL		CHAIN-OF-CUSTODY FORMS	X
CATALYTIC HEATER		FEDERAL EXPRESS FORMS	X
PROPANE GAS		CLEAR PACKING TAPE	X
BANNER TAPE			
SURVEYING METER STICK			
CHAINING PINS & RING			
TABLES			
WEATHER RADIO			
BINOCULARS			
MAGAPHONE			

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ON-SITE SAFETY MEETING

Project _____ TDD/Pan _____

Date _____ Time _____ Job No. _____

Address _____

Specific Location _____

Typo of Work _____

SAFETY TOPICS PRESENTED

Protective Clothing/Equipment _____

Chemical Hazards _____

Radiation Hazards _____

Physical Hazards _____

Emergency Procedures _____

Hospital/Clinic _____ Telephone _____

Hospital Address _____

Special Equipment _____

Other _____

Checklist

1. Emergency information reviewed? _____ and made familiar to all team members? _____
2. Route to nearest hospital driven? _____ and its location known to 011 team members? _____
3. Site safety plan readily available and ita location known to all team members? _____

Meeting shall be attended by all personnel who will be working vithin the exclusion area. Daily informal update meetings will be hmld when site tasks and/or conditions change.

ATTENDEES

(Expand on back of shoot if necessary)

Name Printed	Signature

Meeting Conducted by: _____ (Print) _____ (Signature)

_____ (Site Safety Coordinator) _____ (Team Leader)

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STANDARD OPERATING PROCEDURES FOR HEALTH AND SAFETY ON DRILLING RIG OPERATIONS

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1 INTRODUCTION

This document is meant to be used in conjunction vith E & E SOPs for field operations and hazardous waste site operations, and incorporates by reference all the safety precautions required therein. It specifically addresses the functions and responsibilities of personnel vorking on or around drilling operations.

E & E personnel are frequently required to vork in the field vith drill rigs, taking soil and rock samples, installing piezometers, and monitoring wells. Two general situations discussed separately are the supervision of Subcontract Drillers by E & E, and the direct operation of E & Es ovn drill rig by our personnel.

2 OPERATION OF DRILLING EQUIPMENT BY E & E

2.1 RESPONSIBILITIES AND AUTHORITY OF SITE SAFETY OFFICER

The duties of the Site Safety Officer (SSO) on drilling sites are the same as in other types of operations vith the exception of the increased emphasis on the hazards unique to drilling vork. 'This section details specific drilling concerns of an SSO.

E & E personnel are restricted from the borehole area during active drilling. When E & E personnel are doing drilling; they will be restricted from the borehole area by means of a "super exclusion zone" delineated by placing a 4- by 8-foot sheet of plywood over the borehole.

2.2 RESPONSIBILITIES AND AUTHORITY OF E & E DRILLER

At the beginning of each vork day, the E & E driller must inspect the rig to ensure the folloving components have been properly inspected, maintained, or replaced, or procedures have been performed:

- Kill svitches tripped and operation verified;
- Chain guards in place;
- Belt guards in place;
- Belts set to proper tension (visual);
- Loose belts;
- Presence of *any* fluid leaks:
- Any damaged hoses, cables, ropes, chains;
- Control panel is clean:
- Control lever functions labeled;
- Pressure relief valves function;
- Cathead free of rust and grease:
- Cathead grooves less than 1/8 inch in depth;
- All tools in proper vorking order;
- Rig leveled and stabilized;
- Check for veld cracks in mast; and
- Safety hooks operational.

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The Driller will report items needing attention to the sso; however, it is the Driller's responsibility to make sure that these items ate corrected prior to drilling.

During the drilling operations, the following safety practices will be in effect:

- All wheels will be blocked.
- Rig will be leveled using jacks or stabilizers.
- Rig engine will be in neutral when not actively turning augers.
- Plywood (or suitable substitute material) "super exclusion zone" pad will be in place over borehole.
- Rig engine key will be properly labeled.
- Rig equipment will be kept in an orderly manner within drilling work zone.
- All equipment will be properly lubricated.
- Tools will be wed only for their intended purpose.
- Safety glasses, hearing protection will be worn when hammers are operated.
- Jaws of all wrenches will be clean and free of mud to prevent slippage.
- All lift hooks will have jaw clasps.
- Fire extinguisher will be staged at tear of rig.
- Rig will not be moved when mast is in raised position.
- Cables and topes will be tied back or secured on stabilizer posts.
- All unattended drill holes will be covered.
- Check for overhead obstructions when raising rig mast, boom will not be raised within 25 feet of overhead utilities.
- No refueling will be permitted while equipment is running.

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The Driller has authority to direct personnel vithin the area while drilling operations are in progress. Access to the hazardous area around the auger and borehole is restricted by the "super exclusion zone" delineated by the 4- by 8-foot sheet of plywood centered over the borehole before drilling. A large hole cut in the plywood allovs penetration of the augers. No personnel are alloved in this zone pad at any time while drilling is actively underway.

Housekeeping around the rig is the responsibility of the Driller, but all team members must participate in this effort as well.

23 RESPONSIBILITY AND AUTHORITY OF OTHER E & E PERSONNEL

E 6 E personnel working at a drilling site must act as support to the Drilling Team by providing any necessary support functions; however, it is important that personnel are careful not to interfere vith the drilling process. Personnel are restricted from approaching the "super exclusion zone" while drilling is underway. If an E & E crew member recognizes an unsafe condition in the vork area or on the rig, he should bring it to the attention of the SSO and Team Leader, if it is not resolved in a timely manner. If conditions are still deemed to be hazardous, team members have the option to contact their Regional Safety Coordinator (RSC) or Corporate Health and Safety in Buffalo.

It is the responsibility of all E 6 E personnel to carry their issued nondisposable gear, including hard hat, face shield, respirator, steel-toed boots, eyepiece inserts, safety glasses, and appropriate outervear for the expected climate.

All personnel should be aware of emergency facilities, egress routes, and special medical conditions of their team members. As vith all E & E field work, the buddy system is to be enforced.

3 TRAINING REQUIREMENTS FOR SITE PERSONNEL

3.1 E 6 E SITE SAFETY OFFICER

In addition to Basic Health and Safety Training and other OSHA mandated training, first aid, CPR, and necessary training in field monitoring of personnel, an SSO should have previously vorked as a team member on field drilling projects in order to have a vorking knowledge of the drill rig and its inherently hazardous nature. Where monitoring instrumentation is to be used, the SSO must be properly trained prior to field work. The SSO must have an understamding of the hazards of heat and cold stress, their associated symptoms, and proper vork modifications to protect field staff from potential injury.

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3.2 E & E DRILLER AND HELPER

The E & E driller and helper shall have taken and passed the basic 40-hour Health and Safety Training as prescribed by E & E and mandated by OSHA. They shall also meet the other minimum requirements for field work including medical approvals and respirator fit test. Based on previous experience and training, the Driller will be critiqued by the E & E Drilling Team upon employment with E & E, by performing various types of drilling. This review will be the basis for determining whether additional training or apprenticeship will be required before allowing this employee to act as Driller. An existing E & E employee shall have a minimum of 1 year experience as a Driller's Helper on an assortment of field projects before he or she can be reviewed for advancement to the position of Driller. If a Driller is uninvolved in drilling efforts for 1 year or more, he or she will be required to act as a Driller's Helper on a project, as well as receive rig-specific training on the equipment, before being permitted to act as a Driller again. The Driller's Helper position requires prior attendance at a drilling training school program. Following successful completion of such a course, the Driller's Helper will be observed on sites for a period of approximately 6 months, during which time he or she will work on several drilling projects performing assorted types of drilling. The E & E Drilling Team will determine, based on these field observations, whether additional training is required for this individual.

3.3 OTHER E & E DRILLING PERSONNEL

All E & E personnel shall have taken the basic 40-hour Health and Safety Training course. Field personnel must meet medical and respiratory fit test requirements established by E & E and OSHA, as well.

3.4 SUBCONTRACT DRILLER AND OTHER SUBCONTRACT DRILLING PERSONNEL

Subcontract Drillers and their support personnel must, at a minimum, have passed basic 40-hour Health and Safety Training as prescribed by OSHA 29 cpB1910.120. They shall be medically approved and trained to use the level(s) of respiratory protection required onsite. Certification of training by the Subcontractor shall be required as a deliverable included in E & E's contractual documentation. This training shall be verbally verified and logged onsite by the SSO or Team Leader before starting work.

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4 SUPERVISION OF SUBCONTRACT DRILLERS

4.1 RESPONSIBILITIES AND AUTHORITY OF SITE SAFETY OFFICER

The responsibilities of the SSO at a drilling site vhere subcontracted drillers are used include the folloving: rig inspections, personnel aonitoting, and personnel protection.

A rig inspection starts vith, but is not limited to, verifying each item on the folloving checklist:

- The mast must be located at least 25 feet from any overhead or underground utility lines.
- The location and operation of operational and unencumbered kill switches must be reiterated to all site personnel.
- Outriggers, stabilizers, or jacks are in place, and the rig is level.
- A geophysical survey (electromagnetic or ground-penetrating radar) or a reliable site history must be obtained to verify absence of buried obstacles, tanks, or drums.
- A first aid kit and filled eyewash *must* be readily available.
- A fire extinguisher should be charged to the proper pressure and staged at rear of rig during drilling.
- The condition of ropes, chains, and cables must be checked.
- A lifeline or safety belt must be available if mast climbing is necessary.
- The Site Safety Plan (SSP) must be posted with emergency phone list and map of hospital route.
- A "super exclusion zone" must be established around the borehole, using a 4- by 8-foot sheet of plyvood. This defined area will be entered during active drilling only by the Driller, except in emergency situations.

If any of these items need replacement or repair, the SSO must make necessary arrangements and later verify that repair or replacement is sufficient before actual drilling begins. Working together, the SSO and the driller should verify that the rig has been checked against the Operator's checklist.

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The SSO's monitoring duties include calibration urd setup of the appropriate monitoring devices, as specified in the SSP. At a minimum, this generally includes m O_2/explosimeter and realtime organic vapor monitoring capabilities (e.g., HNU, OVA). Noise monitoring, like heat stress monitoring, is employed where appropriate. If the SSO believes additional monitoring devices beyond the directive of the SSP should be employed (e.g., Rad Mini, Mini Ram), it is his or her responsibility to obtain this equipment vith the cooperation of the RSC or the Corporate Health and Safety Group, from the nearest E & E office.

It is the responsibility of the SSO to ensure that all safety equipment is in good working order. Day-to-day operations, as well as calibration data, must be recorded in the equipment fog or SSO log. Adequate supplies such as breathing air, drinking liquids, and calibration gas must be maintained.

E & E personnel are forbidden from entering the "super exclusion zone" around the borehole while the rig is actively drilling. The SSO must not attempt to take air readings in or around the auger vhilc in we, nor are cutting samples taken vhile the auger is in motion. An O_2/explosimeter should be set up if possible for unmanned (alarmed) operations at the rig using an extension hose to continuously drav samples from the borehole area during drilling operations.

The SSO has the ultimate authority over the Subcontractor vith regard to whether vork practices meet the requirements of the SSP. Shutdown of vork or restriction of personnel are options available to the SSO. The SSO should hold informal site safety briefings at the start of both field vork and daily vork shifts throughout the course of the project. Although E & E contractually requires Subcontractors to provide properly trained and outfitted staff, the SSO should verify verbally at the start-up meeting that the field staff has necessary respiratory approval and OSHA-mandated training, especially on hazardous vaste sites. Site safety briefing topics, as well as attendees, will be recorded in the site safety log.

If the SSO has reason to believe either E & E or Subcontractor personnel are under the influence of alcohol or drugs, or are othervise ill before or during vork onsite, he or she should consider restricting those team members from site vork. Personnel arriving for vork requiring level C protection vho 8re not cleanly shaved may also'bc restricted at the discretion of the SSO.

The following is a list of basic topics to be covered at site safety meetings:

- o Personnel responsibilities;
- o Planned investigation and presumed potential hazards;
- o Levels of protection, monitoring plan, and equipment;
- o Emergency scenario plans, including kill switch use;

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- o Location and operation of kill svitches, fire extinguisher, and first aid kit:
- o Heat and cold stress hazards:
- o "Super exclusion zone" around borehole; and
- o Varnings to Subcontractors about hazards of climbing the mast vithout safety belt and other equipment.

Because heat stress is a constant threat during varm veather, the SSO is responsible for determining whether conditions are unsuitable for work. Where vorkers cannot vork vith the assistance of vork nodifications, cooling vests, and other cooling means, the SSO may decide that work should not continue. The need for worker monitoring through blood pressure and oral temperature checks will be determined by the SSO with assistance from the RSC and Buffalo Health and Safety staff, if necessary.

The SSO will be responsible for shutdown of the drilling operation if electrical storms are in the site area.

No refueling operations will be performed until rig engines are shut down. Motor fuels should be stored and dispensed from spring-loaded, OSHA/FM-approved gas cans constructed of metal or polyethylene.

The SSO should ensure and document that no boreholes are left open or unfilled after drilling equipment is moved. fn'instances where a hole must be left open and unattended, suitable barricades, or the equivalent, will be staged around the hole to prevent personnel and equipment from falling in.

4.2 RESPONSIBILITIES AND AUTHORITY OF OTHER E & E PERSONNEL

All E & E personnel on site are required to follow the terms of the SSP and the direction of the SSO. Because the SSO cannot be in all places at all times, the crev should observe the subcontractors and condition of their equipment at all times, and report immediately to the Team Leader and SSO any safety-related issues that are unresolved. Included are such details as dressout, site functions, and decontamination. It is important that the SSO be involved so that proper log entries can be made.

E & E, as policy, does not provide safety equipment or monitoring instrumentation to subcontractors. Sone projects, hovever, may be set up so that E & E personnel and subcontractors share the same expendable supplies.

B 6 E personnel are forbidden from approaching augers during drilling. Activities at the borehole, such as sampling, require that equipment be stopped.

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5 GENERAL DRILLING SITE SAFETY CHECKLISTS

5.1 SAFETY CHECKLISTS FOR SPECIFIC TYPES OF DRILLING ACTIVITIES

5.1.1 General Drill Site Safety Checklist

- All E & E drilling personnel will have read and understood the terms of the E & B drilling SOP.
- Obvious or questionable safety conditions that arise during daily inspection of the rig and its components will be cause for work interruption.
- Only approved Drillers will remain in proximity to the borehole during drilling, and an approximate 4- by 8-foot "super exclusion area" will be established around the moving auger at all times. No personnel, except the Driller and the Driller's Helper, will enter this zone during drilling. The SSO will issue varnings to those personnel who breach this zone.
- Continuous O_2/explosimeter monitoring at borehole using remote sampling hose will exist at all times.
- All field team members will be briefed on planned drilling operations and possible problems before work begins on day 1. All will be *shown* the location and operation of "kill switches," which will be operationally checked each morning.
- Fire extinguisher(s) will be staged next to the rig before drilling and refueling operations.
- Welding and cutting activities will only be performed avay from ignition sources at a distance approved by the SSO or Team Leader.
- Appropriate personnel protective equipment (based on hazards associated vith assumed well contaminants) will be vorn as directed by the SSO and the SSP. At a minimum, steel-toed boots, hard hats, a d face shields will be vorn during *any* active drilling.
- Outrigger stabilizers must be in place before drilling commences, and the rig must also be leveled.
- The drill rig mast must be horizontal during movement of rig and should not be erected vithin 25 feet of overhead lines.

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- Electrical storms vithin hearing range of the job site will signal vork termination until the SSO and Team Leader notify personnel othervise.

- The local utilities should be contacted prior to drilling so that their lines can be located and flagged. Situations of close proximity may involve isolating utility lines (i.e., shutdown and inerting of gas lines).

- When buried drums or other material are suspected, a full survey of the drilling zone is required using appropriate instrumentation prior to ground breaking.

- Only trained, experienced staff who have studied proper drilling methods and served as a Helper under an experienced Driller will operate the cathead.

- Only properly licensed staff will drive the drill rig. A daily safety check of the vehicle, folloving E & E protocol, will be carried out by the driver.

- Climbing on the vertical mast is not permitted by E & E staff. Because the boom is not equipped vith a ladder, it should be lowered for repairs.

5.1.2 Rotary and Core Drilling

The folloving precautionary measures should be taken during rotary and core drilling:

- Rotary drilling tools should be safety checked prior to drilling:

  - Rods and bit should be open and clear.

  - Water svivels and hoisting plugs should be lubricated and checked for "frozen" bearings before use.

  - Drill rod chuck jaws should be checked periodically and replaced when necessary.

  - The capacities of hoists and sheaves should be checked against the anticipated weight of the drill rod string, in addition to other expected hoisting loads.

  - All hoses to and from the pump should be checked for properly installed couplings; couplings should be secured vith locking devices on "quick connect" fittings or vire on "Chicago-Style" couplings.

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- Hoses should be inspected daily for deterioration and leakage, and replaced if needed.

o Special precautions that should be taken for safe rotary or core drilling involve chucking, joint break, hoisting, and lowering of drill rods:

- Only the Operator of the drfll rig should brake or set a manual chuck so that rotation (of the chuck) will not occur before removing the wrench from the chuck.

- Drill rods should not be braked while being lowered into the hole with chuck jaws.

- Drill rods should aot be held or lowered into the hole with pipe wrenches.

- If a string of drill rods 8re accidentally or inadvertently released into the hole, do not attempt to grab the falling rods with hands or 8 wrench.

- In the event of a plugged bit or other circulation blockage, the high pressure in the piping and hose between the pump and the obstruction should be relieved or bled down before breaking the first tool joint.

- When drill rods are hoisted from the hole, they should be cleaned for safe handling with rubber or other suitable rod viper. Do not use your hands to clean drilling fluids from drill rods.

- If work must progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough-surfaced, fitted, cover panels strong enough to hold drill rig personnel.

- Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage, or lay the rods down. As previously stated, hardhats, steel-toed boots, safety glasses, and work gloves are to be worn during such work, with impervious gear and respiratory protection added as required by the SSP.

5.1.3 Cathead Usage

o Keep the cathead clean and free of rust, oil, and grease. If it becomes rusty, clean with a wire brush.

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- Check the cathead periodically, vhen the engine is not running, for rope wear grooves. If a rope groove forms to a depth greater than 1/8 inch (3 mm), the cathead should be replaced.

- Always use a clean, dry, sound rope. A vet or oily rope may "grab" the cathead and cause drill tools or other items to be rapidly hoisted to the top of the mast.

- Should the rope "grab" the cathead or othervise become tangled in the drum, release the rope and sound an appropriate alarm for all personnel, including the Operator, to rapidly back away and stay clear. If the rope "grabs" the cathead and tools are hoisted to the sheaves at the top of the mast, the rope will often break, releasing the tools. If the rope does not break, stay clear of the drill rig until the Operator can turn off the drill rig engine and initiate other appropriate actions to release the tools. The Operator should carefully vatch the suspended tools, quickly backing away after turning off the engine.

- Chemicals can cause deterioration of the rope that may not be visibly detectable, thus the rope should alvays be protected from any chemical contact.

- Never wrap the rope from the cathead (or any other rope, wire rope, or cable on the drill rig) around a hand, vrist, arm, foot, ankle, leg, or any other part of the body.

- Always maintain a minimum of 18 inches of clearance betveen the operating hand and the cathead drum vhen driving samplers, casing, or other tools vith the cathead and rope method. Be aware that the rope advances tovard the cathead with each hammer blov as the sampler or other drilling tool advances into the ground.

- Do not use more rope wraps than are required to hoist a load.

- Do not leave a cathead unattended vith the rope vrapped on the drum.

- Position all other hoist lines to prevent contact vith the operating cathead rope.

- When using the cathead and rope for driving or back-driving, make sure that all threaded connections are tight, vhile staying as far avay as possible from the hammer impact point.

- The cathead Operator must be able to operate the cathead standing on a level surface vith sound, firm-footing conditions, without distraction or disturbance.

5.1.4 Continuous-Flight or Hollow-Stem Augers

- Prepare to start an auger boring with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear, and the engine running at low RPM.
- Apply an adequate amount of down pressure before rotation to seat the auger head below the ground surface.
- Check auger flights for nicks or burrs that could catch clothing during rotation, and file them down.
- Watch the auger head while slowly engaging the clutch or rotation control, and start rotation. Stay clear of the auger.
- Slowly rotate the auger and auger head while continuing to apply down pressure. Keep one hand on the clutch or the rotation control at all times until the auger has penetrated about 1 foot or more below ground surface.
- If the auger head slides out of alignment, disengage the clutch or hydraulic rotation control, and repeat the starting process.
- An auger guide should be considered to facilitate the starting of a straight hole through hard ground or pavement.
- The Operator and tool handler should establish a system of responsibility for the various activities required for auger drilling, such as connecting and disconnecting auger sections and inserting and removing the auger fork. The Operator must ensure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation.
- Only use the manufacturer's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger vith your hands, a wrench, or any other tool during rotation.
- Whenever possible, we tool hoists to handle auger sections.
- Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.

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- When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger.

- Use a long-handled shovel to move auger cuttings avay from the auger. Never use your hands or feet to move cuttings avay from the auger.

- Do not use hands to clean rotating augers when removing augers from the ground.

- The use of vire line hoists, vire rope, and hoisting hardvare should conform to stipulations developed by the American Iron and Steel Institute Wire Rope Users Hanual.

5.1.5 Use of Wire Line Hoists, Vire Rope, and Hoisting Equipment

- All vire ropes and fittings should be visually inspected during use and thoroughly inspected at least once a veek for abrasion, broken vires, vear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper veaving, jamming, crushing, bird caging, kinking, core protrusion, and damage to lifting hardvare. All related equipment must conform to standards as established by the American Iron and Steel Institute Wire Rope Users Hanual. Vire ropes should be replaced vhen inspection indicates excessive damage according to the Wire Rope Users Hanual. All vire ropes which have not been used for a period of 1 month or more should be thoroughly inspected before being returned to service.

- End fittings and connections consist of spliced eyes and various manufactured devices. All manufactured end fittings and connections should be installed according to the manufacturer's instructions and loaded according to the manufacturer's specifications.

- If a ball-bearing type hoisting swivel is used to hoist drill rods, swivel bearings should be inspected and lubricated daily to ensure that the svivel freely rotates under load.

- If a rod slipping device is used to hoist drill rods, do not drill through or rotate drill rods through the slipping device, and do not hoist the drill rod column higher than one-half the mast height above the top of the mast (derrick). Do not hoist a rod column vith loose tool joints and do not make up, tighten, or loosen tool joints vhile the rod column is being supported by a rod slipping device. If drill rods should slip back into the borehole, do not attempt to brake the fall of the rods vith hands or by tensioning the slipping device.

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- Most sheaves on exploration drill rigs are stationary with a single part line. The number of parts of line should never be increased without first consulting with the manufacturer of the drill rig.

- Wire ropes must be properly matched with each sheave—if the rope is too large, the sheave will pinch the wire rope—if the rope is too small, it will groove the sheave. Once the sheave is grooved, it will severely pinch and damage larger wire ropes.

- Use tool handling hoists only for vertical lifting of tools (except when angle hole drilling). Do not use tool handling hoists to pull objects away from the drill rig: however, drills may be moved using the main hoist if the wire rope is spooled through proper sheaves according to the manufacturer's recommendations.

- When stuck tools or similar loads cannot be raised with a hoist, disconnect the hoist line and counect the stuck tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull to the hoist line or the feed mechanism of the drill.

- When attempting to free a mired vehicle or drill carrier, use only a winch on the front or rear of the vehicle, and stay as far as possible amy from the wire rope. Do not attempt to use tool hoists to pull out a mired vehicle or drill rig carrier.

- Minimize shock loading on a wire rope—apply loads smoothly and steadily.

- Avoid sudden loading in cold weather.

- Never use frozen ropes.

- Protect wire rope from sharp corners or edges.

- Do not operate the rig with damaged or faulty guides, rollers, sheave bearings, or latches on safety hooks.

- Clutches and brakes on hoists should be periodically tested.

- Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles, and other lifting aids.

- Always wear gloves when handling wire rope.

- Following the installation of a new wire rope, first lift a light load to allw the wire rope to adjust.

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- Never carry out hoisting operations when veather conditions are such that hazards to personnel, the public, or property are created.
- Never leave a load suspended in the air when the hoist is unattended.
- Never hoist a load over the head, body, or feet of personnel.
- Never use a hoist line to "ride" up the mast (derrick) of a drill rig.
- Replacement of wire ropes should conform to the drill rig manufacturer's specifications.

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6 REFERENCES

Health and safety sections of the folloving operation manuals are incorporated by reference in this SOP:

Diedrich D-50 Safety Manual.

Drilling Safety Guide, Diamond Core Drill Manufacturers Association and National Drilling Contractors Association.

Wire Rope Users Manual, American Iron and Steel Institute.

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STANDARD OPERATING PROCEDURE
FOR
EMERGENCIES DUE TO HEAT AND HEAT STRESS MONITORING

REVISED JANUARY *1990*

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1 INTRODUCTION

Field operations present a variety of hazards to the employee. During hot days or when wearing protective clothing, heat stress can be experienced and, if not remedied, *can* threaten the health or life of field personnel. Therefore, it is important that all employees are able to recognize the symptoms of hut stress as well as perform first aid vithout delay.

2 SCOPE

This standard operating procedure (SOP) describes the symptoms and treatment for the three classical types of hut stress presented here in ascending order of severity: hut cramps, beat exhaustion, and heat stroke. Field personnel should take immediate action to prevent a less severe form of hut stress from escalating into one requiring hospital treatment.

In addition, this SOP recommends ways to avoid hut stress, such as frequent rest periods, carefully timed excursions in protective clothing, and monitoring heartrate and body temperature. The Site Safety Officer (SSO) has overall responsibility for seeing that these guidelines are followed in the field. However, each individual must be cautious when working in conditions where hut stress is possible.

3 OBJECTIVES

The prevention of heat stress is of paramount importance for field personnel, particularly when they must wear heavy or confining protective clothing. The SSO must ensure that all personnel monitor themselves for possible heat stress, and know what *to* do in a heat emergency. For example, a person who recognizes the symptoms of heat stroke can provide lifesaving first-aid to another, while medical assistance io summoned.

4 EFFECTS OF HEAT

Normal oxidation processes within the body produce a predictable amount of hut. If the hut is liberated as it is formed, there is no change in body temperature. If tho heat is liberated slightly more rapidly, the body cools to a point 8t which the production of hut is accelerated and the excess is available to bring the body temperature back to normal.

Interference vith the elimination of heat leads to Its accumulation and thus to the elevation of body temperature. As a result, the person is said to have a fever. Such a condition produces a cycle in which certain body processes speed up and generate additional heat. Then the body must eliminate not only the normal but also the additional quantities of hut.

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Heat produced within the body is brought to the surface largely by the bloodstream and escapes to the cooler surroundings by conduction and radiation. If air movement such as a breeze strikes the body, additional heat is lost by convection. However, when the temperature of the surrounding air becomes equal to or rises above that of the body, all of the heat must be lost by vaporization of the moisture (sweat) from the skin surface. As the air becomes more humid (contains more moisture), vaporization from the skin slovs down. Thus, on a day vhen the temperature is 95°F to 100°F, with high humidity and little or no breeze, heat is retained within the body. It is on such a day or, more commonly, after a succession of such days (a heat wave) that medical emergencies due to heat are likely to occur. Such emergencies are classified in three categories: heat cramps, heat exhaustion, and heat stroke.

4.1 HEAT CRAMPS

Heat cramps usually affect people vho vork in hot environmenrs and perspire a great deal. Loss of salt from the body causes painful cramps of the leg, arm, or abdominal muscles. Heat cramps also may result from drinking iced vater or other drinks either too quickly or in too large a quantity. Heat cramps generally occur during vork, but may appear hours later in some cases.

4.1.1 Symptoms

The symptoms of heat cramps include the folloving:

- Muscle cramps in legs, arms, or abdomen;
- Pain accompanying the cramps;
- Profuse perspiration; and
- Faintness.

4.1.2 Emergency Care

Place the victim in a cool location, observing safety and decontamination considerations (see Section 6) if the victim is coming from the hot zone. Give the person sips of vater or an electrolyte liquid such as Gatorade or its equivalent. Apply manual pressure to the cramped muscle. The victim should not require medical treatment but be alert for any indication of a more serious problem.

4.2 HEAT EXHAUSTION

Heat exhaustion occurs in individuals vorking in hot environments and may be associated with beat cramps. Beat exhaustion is caused by the pooling of blood in the vessels of the skin. The heat is

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transported from the interior of the body *to* the surface by blood. The blood vessels in the skin become dilated and a large amount of blood is pooled in the skin. This condition, plus the blood pooled in the lover extremities when an individual is in an upright position, may lead to an inadequate return of blood *to* the heart and eventually to physical collapse.

4.2.1 Symptoms

The symptoms of hut exhaustion are as follows:

- o Pale clammy skin,
- o Profuse perspiration,
- o Generalized weakness,
- o Dizziness,
- o Weak pulse,
- o Rapid and usually shallow breathing,
- o Unconsciousness, aad
- o Appearance of having fainted (the patient will respond to the same treatment that is administered in cases of fainting).

4.2.2 Emergency Care

Place the victim in a cool location and remove as much clothing as possible while observing proper decontamination procedures. Administer *cool* water, Cltor.de, or its equivalent. If possible, fan the patient continually to remove hut by convection, but do not allov chilling or overcooling. Trut for shock, and take the victim to a medical facility if there is any Indication of a more serious problem.

4.3 EBAT STROKE

Heat stroke is a profound disturbance of the heat-regulating mechanism, associated vlth high fever and collapse. Sometimes this condition results in convulsions, unconsciousness, and even death. Direct exposure to sun, poor air circulation, poor physical condition, and advanced age (over 40) bear directly on the tendency to hut stroke. It is o serious threat to life and carries a 20-percent mortality rate. Alcoholics are extremely susceptible.

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4.3.1 Symptoms

Polloving are the symptoms of heat stroke (note the absence of perspiration):

- o Dry, hot, and flushed skin:
- o Sudden onset:
- o Full and fast pulse;
- o Dilated pupils;
- o Early loss of consciousness:
- o Body (core) temperature's exceeding 105°F;
- o Muscle tvitching, growing into convulsions; and
- o Breathing deeply at first, later shallovly or even almost absent.

4.3.2 Emergency Care

Remember that this is a true emergency, therefore, transportation to a medical facility should not be delayed. In the meantime, place the victim in a cool environment and remove as much clothing as possible. Ensure an open airvay. Reduce body temperature promptly, preferably by vrapping the victim in a vet sheet or dousing the body vith vater. If cold packs are available, place them under the arms, around the neck, on the ankles, or any place vhere blood vessels located close to the skin can be cooled. Protect the victim from injury during convulsions, especially tongue biting.

5 PREVENTION OF HEAT STRESS

Please note that in the case of heat cramps or heat exhaustion, Gatorade or its equivalent is suggested as part of the treatment regime. The reason for this type of liquid refreshment is that such beverages will return much-needed electrolytes to the body's system. Vithout these electrolytes, body systems cannot function properly, and the represented health hazard will be increased. Therefore, vhen personnel are working in situations vhere the ambient temperatures and humidity are high, and especially in situations vhere levels A, B, and C of protective apparel are required, the SSO must follov the procedures listed below:

- o Ensure that all employees have sufficient quantities of fluids (Gatorade or its equivalent). Personnel should prepare ahead of time for field work in heat stress environments by consuming extra fluids;

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- Ensure that frequent breaks are scheduled so that overheating is less likely to occur:
- Revise work schedules, when necessary, to take advantage of the cooler parts of the day (i.e., 5:00 a.m. to 1:00 p.m., and 6:00 p.m. to nightfall); md
- Cooling vests should be worn if available.
- NOTE: Taking salt tablets is NOT currently recommended.

5.1 GUIDELINES FOR USE OF PROTECTIVE CLOTHING

If protective clothing must be worn, especially levels A and B, the suggested guidelines for ambient temperature and maximum wearing time per excursion are as follovs:

Ambient Temperature (°F)	Maximum Wearing Time per Excursion (min)
Above 90	15
85 to 90	30
80 to 85	60
70 to 80	90
60 to 70	120
50 to 60	180

5.2 HEARTRATE MONITORING

One method of measuring the effectiveness of an employee's rest-recovery regime is by monitoring the heartrate. The "Brouha guideline" is one such method:

- During a 3-minute period, count the pulse rate for the last 30 seconds of tbe first minute, the last 30 seconds of the second minute, and the last 30 seconds of the third minute.
- Double the count.

If the recovery pulse rate during the last 30 seconds of the first minute is at 110 beats/minute or less and the deceleration between the first, second, and third minutes is at least 10 beats/minute, the work-recovery regime is acceptable. If the employee's rate is above that specified, a longer rest period is required, accompanied by an increased intake of fluids.

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5.3 HONITORING PERSONNEL BODY TEMPERATURE AND BLOOD PRESSURE

When personnel are in respiratory protective gear for extended periods, or vhen air temperatures are very high, the monitoring of body temperature and blood pressure is another vay of checking for symptoms of heat stress. Careful adherence to existing medical guidelines could Identify an individual vho nay not have fully stabilized and therefore, is not ready to continue vorking in the hot zone.

5.4 MONITORING THE WORK AREA FOR HEAT STRESS CONDITIONS

Air temperature ana relative humidity are the two most important measurements for determining tha likelihood that a heat stress situation will occur. The reading can be achieved using both a dry and vet bulb thermometer.

6 DECONTAMINATION

As in other medical emergencies, decontamination should proceed as normally as possible vithout contributing unduly to the victim's stress or injury. At a minimum, the protective clothing should be removed as he or she is taken from the hazardous zone. The "buddy system" is always in effect and backup personnel should be available at the decontamination station to either suit up and assist in extraction or to help decontaminate and undress the victim. If other serious injuries or more life-threatening conditions exist, and the victim cannot be disrobed or decontaminated completely, the victim (or contaminated portions) should be wrapped in plastic (or other protective material) for his or her own safety as well as the safety of ambulance and hospital personnel. Carefully avoid action that vould result in the victim's being further overheated.

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Material Safety Data Sheet

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Emergency Telephone Number: 314-982-5000

3600364

HYDROCHLORIC ACID, 37%

PRODUCT IDENTIFICATION:

Synonyms: Muriatic acid

Formula CAS No.: 7647-01-0

Molecular Weight: 36.46 (HCl)

Chemical Formula: HCl

Hazardous Ingredients: Hydrogen chloride

PRECAUTIONARY MEASURES

DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG DAMAGE.

Do not get in eyes, on skin, or on clothing.
Avoid breathing mist.
Use only with adequate ventilation.
Wash thoroughly after handling.
Store in a tightly closed container.
Remove and wash contaminated clothing promptly.
This substance is classified as a POISON under the Federal Caustic Poison Act.

EMERGENCY/ RSTAID

In caw of contact, immediately flush skin or eyes with plenty of water lor at least 15 minutes. If swallowed, DO NOT INDUCE VOMITING!
Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Corrosive Material

SECTION 1 Physical Data

Appearance: Clear, colorless fuming liquid.

Odor: Pungent odor of hydrogen chloride.

Solubility: Infinite in water with slight evolution of heat.

Boiling Point: 53°C (127°F); Azeotrope (20.2%) boils at 109°C (228°F)

Melting Point: -74°C (-101°F)

Specific Gravity: 1.18

Vapor Density (Air=1): No information found.

Vapor Pressure (mm Hg): 190 @ 25°C (77°F)

Evaporation Rate: No information found.

SECTION 2 Fire and Explosion Information

Fire:
Can react with metals to release flammable hydrogen gas.

Explosion:
Not considered to be an explosion hazard.

Fire Extinguishing Media:
If involved in a fire, use water spray.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage. Containers may burst when heated.

Hazardous Decomposition Products:
When heated to decomposition, emits toxic hydrogen chloride fum and will react with water or steam to produce heat and toxic and corrosive fumes.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
A strong mineral acid, concentrated hydrochloric acid is highly reactive with strong bases, metals, metal oxides, hydroxides, amines, carbonates and other alkaline materials. Incompatible with materials such as cyanides, sulfides, sulfites, and formaldehyde.

SECTION 4 Leak/Spill Disposal Information

Clean-up personnel should wear protective clothing and respiratory equipment suitable for toxic or corrosive fluids or vapors. Isolate or enclose the area of the leak or spill.
Small Spills: Flush with water and neutralize with alkaline material (soda ash, lime, etc.). Sewer neutralized material with excess water. Larger spills and lot sizes: Neutralize with alkaline material, pick up with absorbent material (sand, earth, vermiculite). Provide forced ventilation to dissipate fumes. Dispose in a RCRA-approved waste facility or sewer the neutralized slurry with excess water if local ordinances allow.

Reportable Quantity (RQ)(CWA/CERCLA) : 5000 lbs.

Ensure compliance with local, state and federal regulations.

AD

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 0

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Corrosive! Inhalation of vapors **can** cause coughing, choking, **inflamation of the nose, throat, and upper respiratory tract.** Inhalation **of** higher concentrations may cause lung damage.

Ingestion:
Corrosive! Swallowing hydrochloric **acid** can cause immediate pin and burns **of** the mouth, **throat, esophagus and gastrointestinal** tract. **May** cause nausea, vomiting, and diarrhea.

Skin Contact:
Corrosive! Can cause redness, pin, **and** severe skin burns. Concentrated **solutions cause deep** ulcers and **discolor** skin.

Eye **Contact:**
Corrosive! Vapors are irritating and may cause damage to the **eyes. Splashes may cause** severe burns and permanent **eye** damage.

Chronic Exposure:
Long-term **exposure** to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive **properties of the acid.**

Aggrevation of **Pre-existing Conditions:**
Persons with pre-existing skin disorders or eye disease may be more **susceptible** to the effects **of** this substance.

B. FIRST AID

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing **is difficult, give** oxygen. **Call** a physician.

Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk **if available.** Never **give** anything by mouth to an **unconscious** person. Get medical attention immediately.

Skin Exposure:
In case of contact, immediately flush skin with plenty of **water for** at **least 15 minutes while removing** contaminated clothing **and** shoes. Wash **clothing before reuse.** Thoroughly **clean** shoes before reuse. Get medical attention immediately.

Eye **Exposure:**
Wash eyes with plenty **of water for at least** 15 minutes, lifting **lower** and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY DATA (RTECS, 1986)

Oral rat LD50: 900 **mg/kg** (Hydrochloric acid concentrated) Mutation references cited.

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
-OSHA Permissible **Exposure** Limit (PEL):
5 ppm Ceiling
-ACGIH Threshold Limit Value (TLV):
5 ppm Ceiling

Ventilation System:
A **system of local and/or general exhaust is recommended to keep** employee exposures below the Airborne **Exposure Limits. Local** exhaust **ventilation is generally preferred because** it **can** control the emissions **of the** contaminant at **its source, preventing** dispersion of it into **the** general **work area. Please refer to the** ACGIH document, "Industrial Ventilation, A Manual of **Recomm Practices",** m a t **recent** edition, **for** details.

Personal Respirators: (NIOSH Approved)
If the TLV is exceeded full facepiece chemical cartridge **respirator may be worn, In general,** up to 100 times the TLV **at** th maximum **use concentration specified** by **the** respirator supplier, whichever is less. Alternatively, a supplied air **full facepiece** respirator or airlined hood may be worn.

Skin Protection:
Rubber or neoprene **gloves** and additional protection including **impervious boots, apron,** or **coveralls, as** needed in areas **of** unusual **exposure** to **prevent** skin **contact.**

Eye Protection:
Use chemical safety goggles and/or a **full** face **shield where** splashing **is possible. Contact lenses should not be worn when working with this material.** Maintain **eye** wash fountain and quick-drench facilities in work **area.**

SECTION 7 Storage and Special Information

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect from physical damage and direct sunlight. Isolate from incompatible substances. Protect from moisture.

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RECYCLED PAPER

3600303

ISOPROPYL ALCOHOL

PRODUCT IDENTIFICATION:

Synonyms: 2-propanol; sec-propyl alcohol; isopropanol

Formula CAS No.: 67-63-0

Molecular Weight: 60.10

Chemical Formula: $(CH_3)_2CHOH$

Hazardous Ingredients: Not applicable.

PRECAUTIONARY MEASURES

WARNING! FLAMMABLE LIQUID. HARMFUL IF SWALLOWED OR INHALED. AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES IRRITATION.

Keep away from heat, sparks and flame.
Keep container closed.
Use with adequate ventilation.
Avoid breathing vapor.
Wash thoroughly after handling.
Avoid contact with eyes, skin and clothing.

EMERGENCY/FIRST AID

If swallowed, give water to drink. Induce vomiting if medical help is not immediately available. Never **give anything** by mouth to an unconscious person. If inhaled, remove to fresh air. If **not breathing,** give artificial respiration. If breathing is difficult, **give** oxygen. In case of contact, immediately flush skin **or** eyes with plenty of water for at least **15** minutes. In all cases call a physician.

See **SECTION 5.**

DOT Hazard Class: Flammable Liquid

SECTION 1 Physical Data

Appearance: Clear, colorless liquid.

Odor: Rubbing alcohol.

Solubility: Infinite in water.

Boiling Point: 82°C (180°F).

Melting Point: -89°C (-128°F).

Specific **gravity:** 0.79

Vapor Density (Air-1) 2.1

Vapor **Pressure (mm Hg):** 33 @ 20°C (68°F)

Evaporation **Rate:** (n-BUAC = 1) 2.83

SECTION 2 Fire and Explosion Information

Fire:
Flammable Liquid
Flashpoint: 12°C (53°F). (closed **cup**).
Autoignition temperature: 399°C (750°F).
Flammable limits in air, % by volume:
lel: 2.0; uel: 12.0.

Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted **above. Contact with strong oxidizers may cause fire or explosion.**

Fire Extinguishing Media:
Water **spray,** dry chemical, alcohol foam, or carbon dioxide. Water spray may **be** used to keep fire exposed containers cool.

Special Information:
In the event of a fire, **wear** full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures. Vapors can **flow** along surface to distant ignition source and flash back.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage. Heat and sunlight can contribute to instability.

Hazardous **Decomposition** Products:
Toxic gases and **vapors such as carbon monoxide** may be **released** a fire involving isopropyl alcohol.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Heat, flame, strong oxidizers, acetaldehyde, chlorine, ethylene oxide, hydrogen-palladium combination, hydrogen peroxide-sulfuric acid combination, potassium tert-butoxide, hypochlorous acid, isocyanates, nitroform, phosgene, oleum and perchloric acid.

SECTION 4 Leak/Spill Disposal Information

Remove all sources of ignition. Ventilate area of leak or **spill. Clean-up personnel require** protective clothing and **respiratory protection from vapors. Small spills may be absorbed** on paper towels and evaporated in a fume hood. **Allow enough time** for **fumes** to **clear hood, then ignite paper in a suitable location away from combustible materials. Contain** and **recover liquid for reclamation when possible. Larger spills** and **lot sizes** can **be collected as** hazardous waste and atomized in a **suitable RCRA** approved combustion chamber, or **absorbed with vermiculite,** dry **sand, earth or similar material** for disposal as hazardous **waste** in a RCRA approved facility.

Ensure compliance with local, state and **federal regulations.**

NFPA Ratings: Health: [illegible] Flammability: 3 Reactivity: 0

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ISOPROPYL ALCOHOL

PRODUCT IDENTIFICATION:

Synonyms: 2-propand; sec-propyl alcohol; isopropanol

Formula CAS No.: 67-63-0

Molecular Weight: 60.10

Chemical Formula: $(CH_3)_2CHOH$

Hazardous Ingredients: **Not** applicable.

PRECAUTIONARY MEASURES

WARNING! FLAMMABLE LIQUID. HARMFUL IF SWALLOWED OR INHALED. AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES IRRITATION.

Keep away from heat, sparks and flame.
Keep container closed.
Use with adequate ventilation.
Avoid breathing vapor.
Wash thoroughly after handling.
Avoid contact with eyes, **skin** and clothing.

EMERGENCY/FIRST AID

If swallowed, give water to drink. Induce vomiting if medical help **is not** immediately available. Never give **anything** by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, **give** artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Flammable Liquid

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SECTION 1 Physical Data

Appearance: Clear, colorless liquid.

Odor: Rubbing alcohol.

Solubility. Infinite in water.

Boiling Point: 82°C (180°F).

Melting Point: -89°C (-128°F).

Specific gravity: 0.79

Vapor Density (Air = 1): 2.1

Vapor Pressure (mm Hg): 33 @ 20°C (68°F)

Evaporation Rate: (n-DUAC = 1) 2.83

SECTION 2 Fire and Explosion Information

Fire:
Flammable Liquid
Flashpoint: 12°C (53°F). (closed cup).
Autoignition temperature: 399°C (750°F).
Flammable limits in air, % by volume:
lel: 2.6, uel: 12.0.

Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire or explosion.

Fire Extinguishing Media:
Water spray, dry chemical, alcohol form. or carbon dioxide. Water spray may be used to keep fire exposed containers cool.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures. Vapors can flow along surfaces to distant ignition source and flash back.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage. Heat and sunlight can contribute to instability.

Hazardous Decomposition Products:
Toxic gases and **vapors** such as carbon monoxide may be released in a **fire involving isopropyl alcohol.**

Hazardous Polymerization:
Will not **occur.**

Incompatibilities:
Heat, flame, strong oxidizers, acetadehyde, chlorine, ethylene oxide, hydrogen-palladium combination, hydrogen peroxide-sulfuric acid combination, potassium tert-butoxide, hypochlorous **acid,** isocyanates, nitroform, phosgene, oleum and perchloric arid.

SECTION 4 Leak/Spill Disposal Information

Remove all **sources** of ignition. Ventilate area of leak or spill. Clean-up personnel require protective clothing and respiratory protection from vapors. Small spills may **be absorbed on** paper towels and evaporated in a **fume** hood. Allow **enough** time for fumes to **clear hood,** then ignite paper in a suitable **location** away from combustible materials. Contain and **recover** liquid for reclamation when possible. Larger spills and lot sizes can be collected as hazardous waste and atomized in a suitable RCRA approved combustion chamber. or absorbed with vermiculite, dry sand, earth or similar material for disposal as hazardous waste in RCRA approved facility.

Ensure compliance with local. state and federal regulations.

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0

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NITRIC ACID, 70%

PRODUCT IDENTIFICATION:

Synonyms: Aqua Fortis; Azotic Acid; Nitric Acid 70%

Formula CAS No.: 7697-37-2

Molecular Weight: 63.00

Chemical Formula: HNO_3

Hazardous Ingredients: Not Applicable

PRECAUTIONARY MEASURES

DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG DAMAGE.

Do not get in eyes, on skin, or on clothing.
Avoid breathing mist.
Use only with adequate ventilation.
Wash thoroughly after handling.
Keep from contact with clothing and other combustible materials.
Do not store near combustible materials.
Store in a tightly closed container.
Remove and wash contaminated clothing promptly.
This substance is classified as a POISON under the Federal Caustic Poison Act.

EMERGENCY/FIRST AID

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. If swallowed, DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Oxidizer

SECTION 1 Physical Data

Appearance: Clear, colorless to slightly yellow liquid.

Odor: Suffocating acrid.

Solubility: Infinite in water.

Boiling Point: 122°C (252°F)

Melting Point: -34°C (-29°F)

Specific Gravity: 1.41

Vapor Density (Air = 1): 2-3 approximately

Vapor Pressure (mm Hg): 62 @ 20°C (68°F)

Evaporation Rate: No information found.

SECTION 2 Fire and Explosion Information

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Can react with metals to release flammable hydrogen gas.

Explosion:
Reacts explosively with combustible organic or readily oxidizable materials such as: alcohols, turpentine, charcoal, organic refuse, metal powder, hydrogen sulfide, etc.

Fire Extinguishing Media:
If involved in a fire, use water spray.

Special Information:
Increases the flammability of combustible, organic and readily oxidizable materials. In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage. Containers may burst when heated.

Hazardous Decomposition Products:
When heated to decomposition, emits toxic nitrogen oxides fumes and hydrogen nitrate. Will react with water or steam to produce heat and toxic and corrosive fumes.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
A dangerously powerful oxidizing agent, concentrated nitric acid is incompatible with most substances, especially strong bases, metallic powders, carbides, hydrogen sulfide, turpentine, and combustible organics.

SECTION 4 Leak/Spill Disposal Information

Isolate or enclose the area of the leak or spill. Clean-up personnel should wear protective clothing and respiratory equipment suitable for toxic or corrosive fluids or vapors.
Small Spills: Flush with water and neutralize with alkaline material (soda ash, lime, etc.). Sewer with excess water.
Larger spills and lot sizes: Neutralize with alkaline material, pick up with absorbent material (sand, earth, vermiculite) and dispose in a RCRA-approved waste facility or sewer the neutralized slurry with excess water if local ordinances allow. Provide forced ventilation to dissipate fumes.

Reportable Quantity (RQ)(CWA/CERCLA) : 1000 lbs.

Ensure compliance with local, state and federal regulations.

AD

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 0 Other: Oxidizer

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Corrosive! Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract.

Ingestion:
Corrosive! Swallowing nitric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract.

Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color.

Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Splashes may cause severe burns and permanent eye damage.

Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.

Aggrevation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

B. FIRST AID

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Exposure:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Eye Exposure:
Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY DATA (RTECS, 1982)

Inhalation (Rat) LC50: 244 ppm
(NO_2)/30M

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
2 ppm (TWA)
-ACGIH Threshold Limit Value (TLV):
2 ppm (TWA); 4ppm (STEL)

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators: (NIOSH Approved)
If the TLV is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or self-contained breathing apparatus. Nitric acid is an oxidizer and should not come in contact with cartridges and cannisters that contain oxidizable materials, such as activated charcoal.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 7 Storage and Special Information

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect from physical damage and direct sunlight. Isolate from incompatible substances. Protect from moisture.

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Material Safety Data

Emergency Phone Number: 314-982-5000

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Mallinckrodt, Inc., Science Products Division, P.O. Box M, Paris, KY 40361.

SODIUM HYDROXIDE

PRODUCT IDENTIFICATION:

Synonyms: Caustic soda; lye; sodium hydroxide solid; sodium hydrate

Formula CAS No.: 1310-73-2

Molecular Weight: 40.00

Chemical Formula: NaOH

Hazardous Ingredients: None.

PRECAUTIONARY MEASURES

DANGER! MAY BE FATAL IF SWALLOWED. CAUSES SEVERE BURNS.

Do not get in eyes, on skin, or on clothing.
Avoid breathing dust.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.
This substance is classified as a POISON under the Federal Caustic Poison Act.

EMERGENCY/FIRST AID

If swallowed, do NOT induce vomiting. Give large quantities of water. Never give anything by mouth to an unconscious person. Call a physician immediately. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Corrosive Material

SECTION 1 Physical Data

Appearance: White, deliquescent pellets.

Odor: Odorless.

Solubility: 111 g/100 g of water.

Boiling Point: 1390°C (2534°F)

Melting Point: 318°C (604°F)

Specific Gravity (water=1): 2.13

Vapor Density (Air=1): No information found.

Vapor Pressure (mm Hg): Negligible.

Evaporation Rate: No information found.

SECTION 2 Fire and Explosion Information

Fire:
Not considered to be a fire hazard. Hot or molten material can react violently with water.
Can react with certain metals, such as aluminium, to generate flammable hydrogen gas.

Explosion:
Not considered to be an explosion hazard.

Fire Extinguishing Media:
Use any means suitable for extinguishing surrounding fire.
Adding water to caustic solution generates large amounts of heat.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage. Very hygroscopic. Can slowly pick up moisture from air and react wit carbon dioxide from air to form sodium carbonate.

Hazardous Decomposition Products:
Sodium oxide.

Hazardous Polymerization:
This substance does not polymerize.

Incompatibilities:
Contact with water, acids, flammable liquids, and organic halog compounds, especially trichloroethylene, may cause fire or explosion. Contact with nitromethane and other similar nitro compounds causes formation of shock-sensitive salts. Contact with metals such as aluminum, tin, and zinc causes formation of flammable hydrogen gas.

SECTION 4 Leak/Spill Disposal Information

This is a test line. 1000°C. Clean-up personnel require protective clothing and respiratory protection from dust. Sweep, scoop or pick up spilled material. Avoid dusting. Collected waste may be transferred to a closed, preferably metal, container and sent to a RCRA-approved waste disposal facility. Do not flush to the sewer. Caution! Floor and other surfaces may be slippery. Do not contact with water. Neutralize traces with dilute acid.

Ensure compliance with local, state and federal regulations.

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 1

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SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH E m

Inhalation:
Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of exposure. Severe pneumonitis may occur.

Ingestion:
Corrosive! Swallowing may cause severe burns of mouth, throat, and stomach. Severe scarring of tissue and death may result.

Skin Contact:
Corrosive! Contact of skin can cause irritation or severe burns and scarring with greater exposures.

Eye Contact:
Corrosive! May cause irritation of eyes, and with greater exposures, severe burns with possibly blindness resulting.

Chronic Exposure:
Prolonged contact with dilute solutions or dust has a destructive effect upon tissue.

Aggrevation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

B. FIRST AID

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Exposure:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Call a physician immediately.

Eye Exposure:
Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY DATA (RTECS, 1982)

No LD50/LC50 information found relating to normal routes of occupational exposure. Irritation data: Skin, rabbit: 50 mg/24H Severe Eye, rabbit: 50 mg/24H Severe

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
2 mg/m^3 (TWA)
-ACGIH Threshold Limit Value (TLV):
2 mg/m^3 (Ceiling)

Ventilation System:
A system of local and/or general exhaust is recommended to k employee exposures below the Airborne Exposure Limits. Lo exhaust ventilation IC generally preferred because it can contro the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators: (NIOSH Approved)
If the TLV is exceeded, a dust/mist respirator with chemical goggles may be worn, In general, upd ten times the TLV. Co respirator supplier for limitations. Alternatively, a supplie al full facepiece respirator or airlined hood may be worn.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, l coat, apron or coveralls to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 7 Storage and Special Information

Keep in a tightly closed container. Protect from physical damage. Store in a cool, dry, ventilated area away l— sources of heat, moisture and incompatibilities. Always add th caustic to water while stirring; never the reverse.

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Emergency Phone Number: 314-982-5000

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Mallinckrodt, Inc., Science Products Division, P.O. Box M, Paris, KY 40361.

SULFURIC ACID *96%*

PRODUCT IDENTIFICATION:

Synonyms: Oil of Vitriol

Formula CAS No.: 7664-93-9

Molecular Weight: 98.07

Chemical Formula: H_2SO_4

Hazardous Ingredients: Not applicable.

PRECAUTIONARY MEASURES

DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY CAUSE LUNG DAMAGE.

Do not get in eyes, on skin, or on clothing.
Do not breathe mist.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
This substance is classified as a POISON under the Federal Caustic Poison Act.

EMERGENCY/FIRST AID

In all cases call a physician. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. If swallowed, DO NOT INDUCE VOMITING! Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
SEE SECTION 5.

DOT Hazard Class: Corrosive Material

SECTION 1 Physical Data

Appearance: Colorless, oily liquid.

Odor: Odorless.

Solubility: Infinite @ 20°C.

Boiling Point: ca. 310°C (590°F)

Melting Point: ca. -14°C (6°F).

Specific Gravity: 1.84

Vapor Density (Air = 1): < 0.3 @ 25°C (77°F)

Vapor Pressure (mm Hg): 1 @ 146°C (250°F).

Evaporation Rate: No information found.

SECTION 2 Fire and Explosion Information

Fire:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Reacts with most metals releasing flammable, potentially explosive hydrogen gas.

Explosion:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition.

Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:
Toxic fumes of oxides of sulfur. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas, and with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Water, bases, organic material, halogens, metal acetylides, oxides and hydrides, strong oxidizing and reducing agents and many other reactive substances.

SECTION 4 Leak/Spill Disposal Information

Dike and cover leaking or spilled liquid with dirt, vermiculite, kitty-litter or other inert absorbent. Cover spill with sodium bicarbonate or soda ash and mix. Clean-up personnel require protective clothing and respiratory protection from vapors and mists. Neutralized waste may be containerized and disposed in a RCRA approved waste disposal facility. Flush area of spill with dilute soda ash solution and discard to sewer.

Reportable Quantity (RQ)(CWA/CERCLA) : 1000 lbs.

Ensure compliance with local, state and federal regulations.

NFPA Ratings: Health: 3 [illegible]ability: 0 Reactivity: 2 Other: Water reactive

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SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. May cause lung edema. Symptoms may include irritation of the nose and throat, and labored breathing.

Ingestion:
Corrosive. Swallowing can cause severe burns of the mouth, throat, and stomach, leading to death. Can cause sore throat, vomiting, diarrhea.

Skin Contact:
Corrosive. Symptoms of redness, pain, and severe burn can occur.

Eye Contact:
Corrosive. Splashes can cruse blurred vision, redness, pain and severe tissue burns.

Chronic Exposure:
Long-term exposure to mist or vapors may cause damage to teeth.

Aggrevation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

B. FIRST AID

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:
If swallowed, DO NOT induce vomiting. Give large quantities of water or milk if available. Call a physician immediately. Never give anything by mouth to an unconscious person.

Skin Exposure:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician.

Eye Exposure:
Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY DATA (RTECS, 1982)

Oral rat LD50: 2140 mg/kg. Inhalation Guinea Pig LC50: 18 mg/m^3.

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
1 mg/m^3 (TWA).
-ACGIH Threshold Limit Value (TLV):
1 mg/m^3 (TWA).

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators: (NIOSH Approved)
If the TLV is exceeded a full facepiece chemical cartridge respirator may be worn, in general, up to 100 times the TLV or the maximum use concentration specified by the respirator supplier, whichever is less. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 7 Storage and Special Information

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, always add the acid to water; never add water to the acid.

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Arsenic

Date 3/26/92

DOT Name/U.N. No. 1558

Job No. UN8000

CAS Number 7784-42-1

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Arsenic)

Chemical Formula As Molecular Weight 74.9

Physical State Solid Solubility (H2O) Insoluble Boiling Point Sublimes

Flash Point N/A Vapor Pressure/Density 0 r Freezing Point N/A

Specific Gravity 5.73 Odor Characteristic N/A Flammable Limits Non

Incompatabilities STRONG OXIDIZERS, BROMINE AZIDE, HYDROGEN GAS

Biological Properties:

TLV-TWA 0.002 mg/m^3 PEL 0.010 mg/m^3 Odor/Odor Threshold Odorless

IDLH 100 mg/m^3 Human Aquatic Rat/Mouse

Route of Exposure Inh, Abs, Ing, Con

Carcinogen Yes Teratogen Mutagen

Handling Recommendations: (Personal protective measures)

Tyvek and safety glasses with full-face respirator available for upgrade.

Monitoring Recommendations:

Continuous Mini-Ram

Disposal/Waste Treatment:

Health Hazards and First Aid:

Eye: wash immediately; skin: wash immediately; Swallow: immediate medical attention - irritation from exposure requires immediate medical attention.

Symptoms: Acute: Headache, dizziness, nausea, vomiting, convulsions

Chronic: Coma

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Cadmium Date 3/23/92

DOT Name/U.N. NO. 2570 Job lo. UH8000

CAS Number 7440-43-9

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual **ACGIH** **Other:**

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms:)

Chemical Formula Cd Molecular Weight 112.4

Physical State solid solubility (H2O) Insoluble boiling Point 1409° F

Flash Point N/A Vapor Pressure/Density 0 mm Freezing Point 610° F

Specific Gravity 1.65 Odor Characteristic — Flammable Limits

Incompatabilities Strong oxidizers

Biological Properties:

TLV-TWA — PEL 0.2 mg/m^3 Odor/Odor Threshold Odorless

IDLH 50 mg/m^3 Human — Aquatic — Rat/Mouse —

Route of Exposure Inhalation, Ingestion

Carcinogen X Toratogen Mutagen

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Monitoring Recommendations:

Mini-Ram

Disposal/Waste Treatment:

Health Hazards and First Aid:

Large quantities of water, induce vomiting, medical attention: remove to fresh air, medical attontion immediately

Symptoms: Acute: irritation of nose and throat, coughing, chest pain, nausea, voaiting, dizziness, chills, stomach distress, diarrhea

Chronic: loss of smell, liver damage, kidney damage, cancer

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Chlorobenzene Date 3/23/92

DOT Name/U.N. No. 1134 Job No. UH8000

CAS Number: 101-90-7

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other: SAX, Aldrich

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Monochlorobenzene, Chlorobenzol, Phenyl Chloride, MCB)

Chemical Formula C_6H_5Cl Molecular Weight 113

Physical State liquid Solubility (H_2O) 0.1% Boiling Point 270° F

Flash Point 84° F Vapor Pressure/Density 1.1 mm Freezing Point -47° F

Specific Gravity 1.11 odor Characteristic 61 ppm Flammable Limits 1.3-7.1 %

Incompatabilities Strong oxidizers

Biological Properties:

TLV-TWA 75 ppm PEL 75 ppm Odor/Odor Threshold sweet/almond

IDLH 2400 ppm Human Aquatic Rat/Mouse

Route of Exposure Inhalation, Ingestion, Skin/Eye Dermal

Carcinogen experimental Teratogen experimental Mutagen experimental

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Respirators: 1000 ppm - use PAPR, 2400 ppm - use SCBA. Avoid skin/eye contact.

Monitoring Recommendations:

Flame ionization detector (OVA) or Photoionization detector (HNu) with 10.2 eV probe.

Disposal/Waste Treatment:

Health Hazards and First Aid:

ING: immediate medical attontion. INH: move to fresh air. CPR if necessary. DER: rinse with water, wash skin thoroughly with soap and water.

Symptoms: Acute: Irritation of skin, eyes and nose. Drowsiness, incoherence, vomiting.

Chronic: Liver and CNS damage.

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Chromium (hexavalent) Date 3/23/92

DOT Name/U.N. No. Job No. UH8000

CAS Number 7440-47-3

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other: SAX, Aldrich

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physicr

Chemical Properties: (Synonyms: Chromic Oxide, soluble chromic salts)

Chemical Formula Cr Molecular Weight 52

Physical State solid solubility (H2O) insoluble Boiling Point 4788°F

Flash Point N/A Vapor Pressure/Density 0 mm Freezing Point 3452°F

Specific Gravity 7.14 Odor Characteristic Flammable Limits

Incompatabilities Strong oxidizers

Biological Properties:

TLV-TWA 0.5 mg/m^3 PEL 1 mg/m^3 Odor/Odor Threshold

IDLH N/A Human Aquatic Rat/Mouse

Route of Exposure Inhalation, Ingestion

Carcinogen Teratogen Mutagen

Radiological Properties:

Handling Recommendations: (Personal protective measures)

APR: any detectable limit- SCM. Wear gloves and booties. Prevent skin/eye contact.

Monitoring Recommendations:

Disposal/Waste Treatment:

Health Hazards and First Aid:

ING: give large amounts of water, induce vomiting, immediate medical attontion. INH: move to fresh air, CPR if necessary, immediate medical attontion. DER: Rinse with largo amounts of water.

Symptoms: Acute: Contact dermatitis; irritation of mucous membranes and upper respiratory tract, coughing, wheezing, headache, fever, nausea, vomiting.

Chronic: Carcinogen, liver and kidney damage. bronchitis, ulceration of skin, lung cancer.

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HAZARD EVALUATION OF CHEMICALS

Chemical Name 1,2-Dichlorobenzene Date 3/23/92

DOT Name/U.N. No. 1591 Job No. UH8000

CAS Number 95-50-1

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual Other:

Rad Health Handbook. NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: o-Dichlorobenzene, o-DCB)

Chemical Formula $C_6H_4Cl_2$ Molecular Weight 147.0

Physical State liquid Solubility (H2O) 0.01% Boiling Point 357° F

Flash Point 151° F Vapor Pressure/Density 1 mm Freezing point 1° F

Specific Gravity 1.30 Odor Characteristic .7 ppm Flammable Limits

Incompatabilities Strong oxidisers, aluminum acid., acid fumes, chlorides

Biological Properties:

TLV-TWA 50 ppm PEL 50 ppm Odor/Odor Threshold pleasant, aromatic

IDLH 1000 ppm Human Aquatic Rat/Mouse

Route of Exposure Inhalation, Ingestion, Dermal

Carcinogen Teratogen Mutagen

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Monitoring Recommendations:

OVA or HNu

Disposal/Waste Treatment:

Health Hazards and First Aid:

ING & INH: seek medical attention; DER: wash with soap and water, seek medical attontion.

Symptoms: Acute: nausea, tearing of eyes, coughing

Chronic: Liver or kidney disfunction

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HAZARD EVALUATION OF CHEMICALS

Chemical Name 1,1-Dichloroethene

Date 3/23/92

DOT Name/U.N. No. 1303

Job No. UH8000

CAS Number 75-35-4

References Consulted (circle):

NIOSH/OSHA Pockmt Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Vinylidene chloride; 1,1-dichloroethylene)

Chemical Formula CH_2CCl_2 Molecular Weight 96.95

Physical State Liquid Solubility (H2O) Pract. Insol. Boiling Point 89°F

Flash Point 0°F Vapor Pressure/Density 3.3 mm Freezing Point 188°C

Specific Gravity 1.21 Odor Characteristic — Flammable Limits 7.3 - 16%

Incompatabilitims Chemically activm metals, oxidizers, acids, bases

Biological Properties:

TLV-TWA 5 ppm PEL 1 ppm Odor/Odor Threshold Sweet/Chloroform like

IDLU Not available Human Aquatic Rat/Mouse

Route of Exposure Inhalation, Ingestion, Dermal

Carcinogen X Teratogen Mutagen X

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Approved canister/cartridge or SCBA; goggles or face shield; rubbmr gloves and boots

Monitoring Recommendations:

OVA or HNu vith 11.7 eV probm.

Disposal/Waste Treatment:

Health Hazards and First Aid:

ING: give water or milk: do not induce vomiting; medical attention. INH: remove to fresh air. keep warm, seek medical attention. DER: wash immediately.

Symptoms: Acute: dizziness, drunkenness, irritates skin & eyes

Chronic: cancer in liver or kidney

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HAZARD EVALUATION OF CHEMICALS

Chemical Name 1,1-Dichloroethane Date 3/23/92

DOT Name/U.N. No. 2362 Job No. UH8000

CAS Number 75-34-3

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Ethylene dichloride)

Chemical Formula CHCl2CH3 Molecular Weight 98.96

Physical State Liquid Solubility (H2O) 0.8% Boiling Point 135 °F

Flash Point 22 F Vapor Pressure/Density 230 mm Freezing Point -32.3°F

Specific Gravity 1.253 Odor Charactristic 5 ppm Flammable Limits 6.2

Incompatabilities Strong oxidizers, caustics, chemically active metals

Biological Properties:

TLV-TWA 100 ppm PEL 100 ppm Odor/Odor Threshold Sweet

IDLH 4.000 ppm Human Aquatic Rat/Mouse 400 mg/kg

Route of Exposure Inhalation, contact, ingestion, eye (occular)

Carcinogen X Teratogen Mutagen

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Disposable coveralls (Saranex), full face mask, impermeable gloves, respirators with organic cartridges

Monitoring Recommendations:

Disposal/Waste Treatment:

Health Hazards and First Aid:

Ingestion - induce vomiting. Contact - flush with copious amounts of water. Get medical attention.

Inhalation- remove to fresh air.

Symptoms: Acute: Nausea, vomiting, drunkenness, CNS depression, corneal injury, chemical burns.

Chronic: Liver & kidney damage.

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HAZARD EVALUATION OF CHEMICALS

Chemical Name 1.2-Dichloroothano Date

DOT Name/U.N. No. 1184 Job No. UC3000

CAS Number 107-06-02

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Harardour Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Ethylene dichloride, Freon 150)

Chemical Formula $Cl_2C_2H_4$ Molecular Weight 98.96

Physical State liquid Solubility (H2O) 0.88 Boiling Point 182°F

Flash Point 55°F C.C. Vapor Pressure/Density 87 mm at 20°C Freezing Point -32°F

Specific Gravity 1.25 @ 20°C Odor Characteristic Sweet Flammable Limits 6.2% - 15.6%

Incompatabilities Oxidizers, caustics, active metals

Biological Proportios:

TLV-TWA 10 ppm PEL 1 ppm Odor/Odor Threshold 100 ppm

IDLH 1000 ppm Human Aquatic Rat/Mouse LD_5 .5-5 g/kg

Route of Exposure inhalation, ingestion, contact

Carcinogen X Teratogen Mutagen

Radiological Proportios:

Handling Recommendations: (Personal protoctivo measures)

Organic vapor/acid gas cartridge or SCBA, rubbor gloves, goggles, faceshield, rubbor boots

Monitoring Recommendations:

Organic vapor analyzers - continuous: explosimeter/O_2 analyzer

Disposal/Waste Treatment:

Health Hazards and First Aid:

Inhalation - remove to fresh air: contact - flush with water; got medical attention

Symptoms: Acute: Irritation. loss of equilibrium or consciousness, headache, nausea, vomiting, dry skin

Chronic:

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HAZARD EVALUATION OF CHEMICALS

Chemical Name: Ethylbenzene Date: 3/23/92

DOT Name/U.N. no.: 1175 Job No.: UN8000

CAS Number: 100-41-4

References Consulted (circle):

NIOSH/OSHA Pocket Guid. Verschueren Merck Index Hazardline Chris (Pol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCLU 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Ethylbenzol, Phenylethane)

Chemical Formula: $CH_3CH_2C_6H_5$ Molecular Weight: 106.2

Physical State: liquid Solubility (H2O): 0.01% Boiling Point: 277°F

Flash Point: 55°F Vapor Pressure/Density: 10 mm Freezing Point: -139°F

Specific Gravity: 0.87 odor Characteristic: 0.1 ppm Flammable Limits:

Incompatabilities: Strong oxidisers

Biological Properties:

TLV-TWA: 100 ppm PEL: 100 ppm Odor/Odor Threshold: aromatic, oily

IDLH: 2000 ppm Human: Aquatic: Rat/Mouse:

Route of Exposure: Inhalation, Ingestion

Carcinogen: Teratogen: Mutagen:

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Tyvek or saranex coveralls; APR in dusty/ windy conditions or known high concentrations.

Monitoring Recommendations:

OVA or 10.2 ev probe on HNu.

Disposal/Waste Treatment:

Health Hazards and First Aid:

ING: seek medical attention; INH: move to fresh air, seek medical attention; DER: wash promptly with soap and water.

Symptoms: Acute: irritation of eyes, nose, throat, skin; weakness; dizziness; drowsiness; unconsciousness

Chronic: skin rash, inflammation, dermatitis

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Lead Date 3/23/92

DOT Name/U.N. No. 2291 Job lo. UH8000

CAS lumber 7439-92-1

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonym: Plumbum)

Chemical Formula Pb Molecular weight 207.2

Physical State solid solubility (H2O) insoluble Boiling Point 3164 F

Flash Point N/A Vapor Pressure/Density 0 mm Freezing Point N/A

Specific Gravity 11.34 Odor Characteristic N/A Flammable Limits N/A

Incompatabilities Strong oxidizers, hydrogen peroxide, acids

Biological Properties:

TLV-TWA .100 mg/m^3 PEL .050 mg/m^3 Odor/Odor Threshold N/A

IDLH 700 mg/m^3 Human ___ Aquatic ___ Rat/Mouse ___

Route of Exposure Inhalation, Ingoation, Dermal

Carcinogen --- Teratogen --- Mutagen ---

Radiological Properties:

Handling Recommendations: (Personal protective measures)

5 mg/m^3 high efficiency particulate respirator: other concentrations- SCBA; avoid skin contact or ingoation.

Monitoring Recommendations:

Disposal/Waste Treatment:

Health Hazards and First Aid:

INQ: Give water, induce vomiting, medical attention immediately; INH: move to fresh air. medical attention: DER: wash with soap and water promptly.

Symptoms: Acute: stomach distress, vomiting, diarrhea, black stool, headache, dizziness, metallic taste

Chronic: muscle weakness, joint/muscle pain, insomnia, coma. death

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Methylene Chloride Date 3/23/92

DOT Name/U.N. No. 1593 Job No. UE8000

CAS Number 75-09-2

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Pol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Dichloromethane, Methylene Dichloride)

Chemical Formula CH_2Cl_2 Molecular Weight

Physical State Liquid solubility (H2O) Slightly Boiling Point 104°F

Flash Point Vapor Pressure/Density 350 mm Hg Freezing Point -142°F

Specific Gravity 1.33 Odor Characteristic Like chloroform Flammable Limits

Incompatibilities

Biological Properties:

TLV-TWA 50 ppm PEL 500 ppm Odor/Odor Threshold Sweet, pleasant/160 ppm

IDLH 5,000 ppm Human Aquatic Rat/Mouse

Route of Exposure Oral, inh, ing, derm

Carcinogen Human/animal Teratogen Mutagen Experimental

Radiological Properties:

N/A

Handling Recommendations: (Personal protective measures)

Tyvek, gloves (PVA, Viton); any detectable concentrations-SCBA; no APR cartridge available

Monitoring Recommendations:

WA continuously

Disposal/Waste Treatment:

Health Hazards and First Aid:

Inh: move to fresh air, APR if necessary; Eye/skin: flush with water for 15 minutes, wash skin with soap/water; Ing: seek medical attention

Symptoms: Acute: Mental confusion, light-headedness, nausea/vomiting, headache, staggering, unconsciousness, irritation of eyes/resp/skin, skin burns

Chronic: Heart palpitations. malaise, death

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Tetrachloroethylene Date 3/23/92

DOT Name/U.N. No. Job No. UH8000

CAS Number 127-18-4

References Consulted (circle):

NIOSH/OSHA Pockmt Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook . NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Perchloroethylene)

Chemical Formula $CL_2C + C\ Cl_2$ Molecular Weight 165.82

Physical State Liquid Solubility (H20) 0.015% Boilinq Point 121.2°C

Flash Point N/A Vapor Pressure/Density 15.8 mm/5.83 Freezing Point -23.35°C

Specific Gravity 1.631 Odor Characteristic Flammable Limits N/A

Incompatabilities Strong oxidizers, chemically active metals (barium, lithium, beryllium)

Biological Properties:

TLV-TWA 25 ppm, 167.5 mg/m^3 PEL 100 ppm Odor/Odor Threshold Ether, chloroform

IDLH 1000 ppm Human TCLO 230 ppm Aquatic -- Rat/Mouse --

Route of Exposure Inhalation, ingestion, dirmct contact.

Carcinogen Teratogen Mutagen

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Impervious clothing, gloves, and boots should bo worn: eye protection; respirators with cartridges worn at levels of 50 ppm; SCBAs at levels of 500 ppm.

Monitoring Recommendations:

Disposal/Waste Treatment:

N/A

Health Hazards and First Aid:

Remove form exposure; perform artificial respiration if necessary; wash skin with soap and water; irrigate eyes with water; if swallowed, induce vomiting.

Symptoms: Acute: Irritation of eyes, nose, or throat: nausea; flushed face; vmrtigo, dizziness; incoherence; headache; skin blisters.

Chronic: Liver damage; impaired memory; numbness of extremities; impaired visron.

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Toluene Date 3/23/92

DOT Name/U.N. No. 1294 Job No. UH6000

CAS Number 108-88-3

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Methyl benzene, Toluol, Phenyl methane)

Chemical Formula C_7H_8 Molecular Weight 92

Physical State Colorless Liquid Solubility (H_2O) 0.05g/100 H_2O Boiling Point 231°F

Flash Point 40°F Vapor Pressure/Density 22mm Freezing Point -139°F

Specific Gravity 0.8669 Odor Characteristic 0.2ppm Flammable Limits 1.3% - 7.1%

Incompatabilities Strong Oxidizers, HNO_3, H_2SO_4, O_2, Peroxides, Heat

Biological Properties:

TLV-TWA 100 ppm PEL 200 ppm Odor/Odor Threshold Benzene-Like

IDU 2,000 ppm Human IHL TCLD - 200 ppm Aquatic 96:100-10 ppm Rat/Mouse 4000 ppm

Route of Exposure Inhalation, Ingestion, Dermal Contact. Eye (Ocular)

Carcinogen Experimental Teratogen Experimental Mutagen Experimental

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Impervious clothing, Viton gloves, faceshield respirator w/organic vapor cartridge up to 1000 ppm, >1000 ppm use APR with chemical cartridge; 2000 ppm-SCBA

Monitoring Recommendations:

Disposal/Waste Treatment:

Concentrated: incineration; dilute discharge to municipal sewer after primary treatment, incineration for dilute organic mixture

Health Hazards and First Aid:

Flush area with water and wash with soap; move to fresh air if inhaled; if swallowed, do not induce vomiting. Contact physician immediately.

Symptoms: **Acute:** Dizziness, fatigue, nausea, headache, vomiting, irritates eyes, dries skin

Chronic: Bone marrow depression, defatting of skin, dermatitis, kidney and/or liver damage if ingested

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HAZARD EVALUATION OF CHEMICALS

Chemical Name 1,1,1-Trichloroethane Date 3/23/92

DOT Name/U.N. lo. 2631 Job lo. UH8000

CAS Number 71-55-6

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Proportios: (Synonyms: Methyl chloroform)

Chemical Formula CH_3CCl Molecular Weight 133.4

Physical State liquid solubility (H2O) 0.4% Boiling Point 165° F

Flash Point N/A Vapor Pressure/Density 100 mm Freezing Point -23° F

Specific Gravity 1.34 Odor Characteristic 390 ppa Flammable Limits

Incompatabilities Strong caustics or oxidizorr, water

Biological Properties:

TLV-TWA 350 ppm PEL 350 ppm Odor/Odor Threshold chloroform like

IDLH 1,000 ppm Human Aquatic Rat/Mouse

Route of Exposure Ingestion, Inhalation, Dermal

Carcinogen Toratogen Mutagen

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Monitoring Recommendations:

OVA or HNu with tho 11.7 eV probe.

Disposal/Waste Treatment:

Health Hazards and First Aid:

INH & ING: seek medical attontion promptly: DER: wash with soap and water.

Symptoms: Acute: light headed, drowsiness, headache, irritation of eyes and akin

Chronic: CNS depression

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Trichloroethylene Date 3/23/92

DOT Name/U.N. No. 1710 Job No. [illegible]

CAS Number 79-01-6

References Consulted (circle):

NIOSH/OSHA Pocket Guide Fersheuren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 of Chemistry and Physics

Chemical Properties: (Synonyms: Trichloroethene)

Chemical Formula $Cl_2C = CHCl$ Molecular Weight 131.39

Physical State Liquid Solubility (H2O) 0.1% Boiling Point 87°C(189°F)

Flash Point 90°F Vapor Pressure/Density 100mm Freezing Point -86.4°C(123°F)

Specific Gravity 1.46 Odor Characteristic 50 ppm Flammable Limits 4% 11%

Incompatabilities Chemically active metals (barium, lithium, sodium, magnesium, titanium)

Biological Properties:

TLV-TWA 50 ppm, 270 mg/m^3 PEL 100 ppm Odor/Odor Threshold Chloroform-like

IDLH 1,000 ppm LD50 857 mg/kg Aquatic — Rat/Mouse 4,920 mg/kg

Route of Exposure Inhalation, ingestion, dermal contact

Carcinogen Teratogen Mutagen

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Impermeable clothes, gloves, and boots; eye protection (face shields); respirators with organic vapor cartridges at levels of 50 ppm; SCBAs at levels of 1,000 ppm

Monitoring Recommendations:

Periodic examination should include the skin, respiratory, cardiac, and central and peripheral nervous systems, and liver and kidney function

Disposal/Waste Treatment:

Incineration: mix with another combustible fuel—must assure complete combustion to prevent the formation of phosgene.

Health Hazards and First Aid:

Remove from exposure; perform artificial respiration if needed; wash skin with soap and water; irrigate eyes with water; induce vomiting if swallowed.

Symptoms: Acute: Irritating to eyes, nose, and throat; nausea; vomiting; difficulty breathing; loss of consciousness

Chronic: Central nervous system depression, cardiovascular damage; liver and kidney damage; double vision; blindness; loss of coordination; loss of sense of smell; anxiety

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Xylene Date 3/23/92

DOT Name/U.N. No. 1307 Job No. UH8000

CAS Number 1330-73-8

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Dimethylbenzene, Xylol)

Chemical Formula C_8H_{10} Molecular Weight 106

Physical State Colorless Liquid Solubility (H2O) Boiling Point 292°F

Flash Point 77°F Vapor Pressure/Density 3.7 Freezing Point -12°F

Specific Gravity 0.86 Odor Characteristic 0.5 ppm Flammable Limits 1.0% - 7.0%

Incompatabilities Strong oxidizers, strong acid, heat, peroxide

Biological Properties:

TLV-TWA 100 ppm PEL 100 ppm Odor/Odor Threshold Aromatic

IDLH 1,000 ppm Human IHL TCL 0-200 ppm Aquatic Rat/Mouse IHL LD_{50} - 500 ppm/4HC

Route of Exposure Inhale, akin

Carcinogen Experimental Teratogen Mutagen

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Impervious clothing, PVC gloves, faceshield, avoid prolonged contact. Respirator w/organic vapor cartridge up to 5,000 ppm: >10,000 ppm use SCBA

Monitoring Recommendations:

Disposal/Waste Treatment:

OSHA standard 29 CFR 1910. 106 applies

Health Hazards and First Aid:

skin - wash w/soap and water: eyes - flush w/water; remove to fresh air if overcome

Symptoms: Acute: Eye and mucous membrane irritant, CNS depressant, ingestion causes gastrointestinal upset

Chronic: More severe than above, hyperplasia of bone marrow

APPENDIX B

SITE-SPECIFIC QUALITY ASSURANCE PROJECT PLAN

[Bold items enclosed in brackets denote **changes** to last version of document]

Section 1.0 -- Title Page

Vork Plan Group: N
Site No. : 36
Site Name: Industrial Waste Sewer

Prepared by: Dan Foss
Ecology and Environment, Inc.
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Prepared for: Department of the Navy
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive, P.O. Box 10068
Charleston, South Carolina 29411-0068
Contract Number N62467-88-C-0200

Signature Approvals:

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K. Walker

E & E ASC Director: Gary Hahn
G. Hahn

E & E QA/QC Project Officer: Marcia Meredith
M. 'heredith

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Section 3.0 — Project Summary

Vork Plan Group: N

Site No.: 36

Site Name: Industrial Waste Sewer

Site Description: A complete site description and history are presented. in sections 2.0 and 3.0 of the attached work plan.

Phase I — Field Screening

Physical Survey (check all that apply):

- X Overall Physical Reconnaissance
- X OVA Surface Emission Survey
- X Radiation Survey
- X Habitat/Biota Survey
- X Hydrologic Assessment

Geophysical Survey (check all that apply):

- ___ Electromagnetic Conductivity:
  - ___ EM-31 ___ EM-34
- ___ Magnetometry
- ___ Very Low Frequency
- ___ Ground Penetrating Radar
- ___ Seismic Refraction
- ___ Seismic Reflection

Analytical Screening (check all that apply):

- ___ Field Analyses
- ___ Soil Headspace Analyses: Planned number of samples ____
- ___ Soil Gas Analyses
- X Laboratory Analyses:

PLANNED NUMBER OF SAMPLES	
Surface Water	___
Sediment	___
Soil	370
Soil Gas	___
Groundwater	185
Duplicates	29
Soil Gas Duplicates	___
Trip Blanks	___
Field Blanks	___
Preservative Blanks	___

Rinsate Blanks ___

CATEGORIES OF ANALYSES

___ Purgeable Aromatics
___ Purgeable Halocarbons
___ Base/Neutral Extractables
___ Acid Extractables
X Volatile Organic Compounds
X Polynuclear Aromatic Hydrocarbons
X Phenols
___ Dioxins
___ Organophosphorus Pesticides
___ Eerbicides

X Pesticides
X Polychlorinated Biphenyls
X Total Recoverable Petroleum Hydrocarbons
X Metals
___ Cyanide

Phase 11—Characterization

PLANNED NUMBER OF SAMPLES

Surface Water	___
Sediment	___
Soil	790
Soil Gas	___
Groundwater	334
Duplicates	113
Soil Gas Duplicates	___
Trip Blanks	96
Field Blanks	1
Preservative Blanks	1
Rinsate Blanks	96

CATEGORIES OF ANALYSES

___ Purgeable Aromatics
___ Purgeable Halocarbons
X Base/Neutral Extractables
X Acid Extractables
X Volatile Organic Compounds
___ Polynuclear Aromatic Hydrocarbons
___ Phenols
X Dioxins
X Organophosphorus Pesticides
X Herbicides

X Pesticides
X Polychlorinated Biphenyls
X Total Recoverable Petroleum Hydrocarbons

X Metals
X Cyanide

Additional analytical categories are identified below:

X Gross Alpha
X Gross Beta
X Gamma Scan
X Total Organic Carbon
X Grain Size
X Alkalinity
X Total Suspended Solids (water only)
X Total Kjeldahl Nitrogen
X Ammonia Nitrogen
X Orthophosphate Phosphorus
X Dissolved Oxygen (in field)
X 5-day Biological Oxygen Demand
X Chemical Oxygen Demand

X pH
X Percent Moisture
X Hardness (water only)
X BTU Content
X Ash Content
X Total Organic Halogens
X Sulfur
X Ignitability
X Cation Exchange Capacity
X Sulfide

Section 4.0 — Project Organization and Responsibility

The overall organizational structure for this site is discussed in Section 4.0 of the GQAPP. Site-specific designated personnel and their responsibilities are listed below:

Site Manager:
Team/Task Leader(s): To Be Determined
Field Support Personnel:

Biographies for those personnel listed above which are not included in the GQAPP are included in Appendix A of this document.

Section 5.0 — QA/QC Objectives for Measurement Data

Criteria for reporting the accuracy, precision, and completeness of data are presented in Section 5.0 of the GQAPP. Detection limits for screening and quantitative analyses are presented in Section 9.0 of the GQAPP. Procedures used to assess data accuracy, precision, and completeness are presented in Section 14.0 of the GQAPP. All analytes (including field parameters), sample media, and method numbers relevant to the investigation of this site are listed in the folloving table, which also identifies any modifications to the accuracy (A), precision (P), completeness (C), and detection limit (DL) criteria specified in the above-referenced GQAPP sections.

Section 6.0 — Fieldwork and Sampling Procedures

Fieldwork and sampling procedures are presented in Section 6.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Analyte	Uedia	Hethod No.	A	P	C	DL
*						
Laboratory Screening Analyses						
Volatile Organic Compounds	S/W	--	N/M	N/M	N/M	N/M
Polynuclear Aromatic Hydrocarbons	S/W	--	N/M	N/M	N/M	N/M
Pesticides	S/W	--	N/M	N/M	N/M	N/M
Polychlorinated Biphenyls	S/W	--	N/M	N/M	N/M	N/M
Total Recoverable Petroleum Hydrocarbons	S/W	EPA 418.1	N/M	N/M	N/M	TBD
Phenols	S/W	--	N/M	N/M	N/M	N/M
Arsenic	S/W	--	N/M	N/M	N/M	N/M
Cadmium	S/W	--	N/M	N/M	N/M	N/M
Chromium	S/W	--	N/M	N/M	N/M	N/M
Copper	S/W	--	N/M	N/M	N/M	N/M
Lead	S/W	--	N/M	N/M	N/M	N/M
Nickel	S/W	--	N/M	N/M	N/M	N/M
Silver	S/W	--	N/M	N/M	N/M	N/M
Zinc	S/W	--	N/M	N/M	N/M	N/M
Laboratory Analyses						
Gross Alpha	S/W	EPA 900	N/M	N/M	N/M	N/M
Gross Beta	S/W	EPA 900	TBD	TBD	TBD	TBD
Gamma Scan	S/W	EPA 901.1	TBD	TBD	TBD	TBD
TCL Purgeables + xylene	S/W	EPA 8240/624	N/M	N/M	N/M	N/M
TCL BNAs	S/W	EPA 8270/625	N/M	N/M	N/M	N/M
TCL Pesticides & PCBs	S/W	EPA 8080/608	N/M	N/M	N/M	N/M
Dioxins	S/W	EPA 8280	TBD	TBD	TBD	TBD
Organophosphorus Pesticides	S/W	EPA 8140	N/M	N/M	N/M	N/M
Herbicides	S/W	EPA 8150 (modified)/509B	N/M	N/M	N/M	N/M
Total Recoverable Petroleum Hydrocarbons	S/W	EPA 418.1	N/M	N/M	N/M	N/M
TAL Metals:						
Aluminum	S/W	EPA 6010	N/M	N/M	N/M	N/M
Antimony	S/W	EPA 6010	N/M	N/M	N/M	N/M
Arsenic	S/W	EPA 7060	N/M	N/M	N/M	N/M
Barium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Beryllium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Boron	S/W	EPA 6010	N/M	N/M	N/M	N/M
Cadmium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Calcium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Chromium	S/W	EPA 6010	N/M	N/M	N/M	N/M

Analyte	Media	Method No.	A	P	C	DL
Cobalt	S/W	EPA 6010	N/H	N/M	N/M	N/M
Copper	S/W	EPA 6010	N/M	N/M	N/M	N/M
Iron	S/W	EPA 6010	N/M	N/M	N/M	N/M
Lead	S/W	EPA 7421	N/H	N/M	N/M	N/M
Magnesium	S/W	EPA 6010	N/H	N/M	N/H	N/M
Uanganese	S/W	EPA 6010	N/H	N/M	N/M	N/M
Mercury	S/W	EPA 7471/7470	N/H	N/M	N/M	N/M
Nickel	S/W	EPA 6010	N/M	N/M	N/M	N/M
Selenium	S/W	EPA 7740	N/M	N/M	N/M	N/M
Silver	S/W	BPA 6010	N/U	N/M	N/M	N/H
Sodium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Thallium	S/W	EPA 7841	N/M	N/M	N/U	N/H
Tin	S/W	EPA 6010	N/M	N/M	N/M	N/M
Vanadium	S/W	EPA 6010	N/M	N/U	N/M	N/H
Zinc	S/W	EPA 6010	N/M	N/M	N/H	N/M
Cyanide	S/W	EPA 9010/335.2	N/M	N/M	N/M	N/M
Sulfide	S/W	EPA 376.1	N/M	N/M	N/M	N/U
TOC	S/W	EPA 415.1	N/M	N/M	N/M	N/M
Hardness	V	EPA 130.2	N/M	N/M	N/M	N/M
Alkalinity	V	BPA 310.1	N/M	N/H	N/M	N/M
Total Suspended Solids	V	EPA 160.2	N/M	N/M	N/M	N/H
Total Kjeldahl Nitrogen	S/W	EPA 351.3	N/M	N/H	N/M	N/M
Nitrogen-Ammonia	S/W	EPA 350.2	N/M	N/M	N/M	N/M
Orthophosphate Phosphorus	S/W	EPA 365.2	N/M	N/M	N/M	N/M
5-day Biological Oxygen · Demand	W	SM S210B	N/M	N/H	N/M	N/M
Chemical Oxygen Demand	V	EPA 410.4	N/M	N/M	N/M	N/M
pH	V	EPA 150.1	N/M	N/M	N/M	N/M
Percent Hoisture	S	ASTM D-2216-80	N/M	N/H	N/M	N/M
Grain Size	S	ASTM D-422-63	N/M	N/M	N/M	N/H
BTU Content	S	ASTn D-2015-77	N/M	N/H	N/M	N/M
Ash Content	S	ASTn D-482	N/M	N/H	N/M	N/M
Total Organic Halogens	S	SV 9020	TBD	TBD	TBD	TBD
Sulfur	S	ASTM D-129-64	N/M	N/M	N/M	N/M
Ignitability	S/W	EPA 1010	N/H	N/M	N/M	N/M
Cation Exchange Capacity	S	EPA 9081	75-125	35	95%	100mg/kg

Analyte	Media	Method No.	A	P	C	DL
Field Parameters						
pH	W	150.1	N/M	N/M	N/M	N/M
Specific Conductance	W	120.1	N/M	N/M	N/M	N/M
Temperature	W	170.1	N/M	N/M	N/M	N/M
Dissolved Oxygen	W	EPA 360.1	N/M	N/M	N/M	N/M

Notes: S = Soil and/or sediment
W = Groundwater and/or surface water
N/M = No modifications from GQAPP
TBD = To be determined.

*With the exception of total recoverable petroleum hydrocarbons, the laboratory screening analyses do not have EPA method numbers.

Section 7.0 — Sample Custody

Sample custody procedures are presented in Section 7.0 of the GQAPP. Hodifications to these procedures are described below:

No Modifications

Section 8.0 — Calibration Procedures and Frequency

Calibration procedures and frequency are presented in Section 8.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Section 9.0 — Analytical Procedures

Screening and quantitative analytical procedures are presented in Section 9.0 of the GQAPP. Site-specific accuracy, precision, completeness, and detection limit criteria are presented in Section 5.0 of this SQAPP. Modifications to any other of the analytical procedures are described belov:

No Modifications

Section 10.0 — Data Reduction, Validation, and Reporting

Data reduction, validation, and reporting procedures are presented in Section 10.0 of the GQAPP. Modifications to these procedures are described below:

No Hodifications

Section 11.0 — Internal Quality Control Checks

Internal quality control check procedures are presented in Section 11.0 of the GQAPP. Hodifications to these procedures are described belov:

No Modifications

Section 12.0 — Performance and System Audits

Performance and system audit procedures are presented in Section 12.0 of the GQAPP. Specific audits planned for this site investigation are listed below:

Audit Type	Frequency/Date	Description
	To Be Determined	

Section 13.0 -- Preventive Maintenance

Preventive maintenance procedures are presented in Section 13.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Section 14.0 — Procedures Used to Assess Accuracy, Precision, and Completeness of Data

Procedures used to assess the accuracy, precision, and completeness of data are presented in Section 14.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Section 15.0 -- Corrective Action

Corrective action procedures are presented in Section 15.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Section 16.0 — Quality Assurance Reports to Management

Quality assurance report procedures are presented in Section 16.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Appendix A — Additional Personnel Biographies

Personnel assigned to this site investigation whose biographies do not appear in the GOAPP are listed below; biographies for these site personnel are presented on the following pages.

To Be Determined

APPENDIX C

THREATENED AND ENDANGERED FLORA AND FAUNA ASSOCIATED WITH NAS PENSACOLA

[Bold items enclosed in brackets denote *changes* to last version of document)

APPENDIX C
THREATENED AND ENDANGERED FLORA AND FAUNA OBSERVED OR LIKELY TO OCCUR WITHIN THE NAS PENSACOLA FACILITY OR NEARBY

Scientific Name	Common Name	Base * Status	Status FGFWFC(or FDA)	Status USFWS	Habitat
FISHES					
Acipenser oryrhynchus	Atlantic sturgeon	M	SSC	UR 2	Gulf coast, estuarine
Ammocrypta asprella	Crystal darter	U	T	UR 2	Fresh water
Etheostoma histrio	Harelquin darter	U	SSC		Fresh water
Fundulus jenkinsi	Salt marsh topminnow	P	SSC		Salt, fresh, brackish waters
Lepisosteus spatula	Alligator gar	U	SSC		Brackish, fresh, salt water
Moxostoma carinatum	River redhorse	U	SSC		Fresh water
AMPHIBIANS AND REPTILES					
Alligator mississippiensis	American Alligator	R	SSC	TIS/A)	Swamps, marshes, ponds
~~Caretta~~ ~~Caretta~~ ~~Caretta~~	Loggerhead turtle	M ?	T	T	narine. coastal
Chelonia mydas mydas	Green turtle	M ?	E	E	Marine, coastal
Dermochelys coriacea	Leatherback turtle	M	E	E	Marine, coastal
Drymarchon corais couperi	Eastern indigo snake	P	T	T	Open areas nrar water
Eretmochelys imbricata	Hawksbill turtle	M ?	E	E	Marine, coastal
Gopherus polyphemus	Gopher tortoise	P	SSC	UR 1	Sandy coastal plains
Graptemys pulchra	Alabama map turtle	U	SSC		Swampa, streams, marshes, ponds
Lepidochelys kempi	Atlantic ridley	M ?	E	E	Marine, coastal
Rana areolata aesopus	Florida gopher frog	P	SSC	UR 2	Sand hill communities
Macroclemys temmincki	Alligator snapping turtle	SR	SSC	UR 2	Swampa. marshes, ponds
MAMMALS					
Mustela vison lutensis	Florida mink	U		UR 2	Terrestrial habitats
Peromyscus polionotus trissyllepsis	Perdido Key beach mouse	N/A	T	E	Beach dunes
Trichochus manatus latirostris	West Indian manatee	M	E	E	Atlantic and Gulf coasts
Ursus americanus floridanus	Florida black bear	N/A	T	UR 2	Titi swamps

Appendix C (Cont).

Scientific Name	Common Name	Base * Status	Status FGFWFC(or FDA)	USFWS	Habitat
BIRDS					
Charadrius melodus	Piping Plover	P	T	T	Open dry, sandy beaches
Charadrius alexandrinus	Snowy plover	P	T	UN 2	Open dry, sandy beaches
Dendroida dominica etoddardi	Stoddard's yellow-throated warbler	P-u		UR 2	Woodod habitatm
Dendroica kirtlandii	Kirtland's warbler	U	E	E	Woodod habitats
Haematopus palliatus	American oymtorcatchor	U	SSC		Coastal habitatm
Egretta rufescens	Reddish egret	P-U	SSC	UR 2	Freshwater/coastal wetlands
Egretta caerulea	Little blue heron	P-U	SSC		Freshwater/coastal wetlands
Egretta thula	Snowy egret	P-u	SSC		Freshwater/coastal wetlands
Grus canadensis pratensis	Florida sandhill crane	U	t		Freshwater wetlands
Falco peregrinus tundrius	Arctic peregrine falcon	M	E	T	Winters on coasts
Falco sparverius paulus	Southeastern kestrel	a	T	UR 2	Open pine forests, clearings
Haematopus palliatus	American oystercatcher	P-U	SSC		Open coastal beaches
Haliaeetus leucocephalus	Bald eagle	P-u	T	E	Pine forests/coastal habitat
Pandion haliaetus	Osprey	R	SSC		Near water
Pelecanus occidentalis	Brown pelican	a	SSC	AC	Mangrove trees, coasts
Picoides borealis	Red-cockaded woodpockor	P-u	T	E	Cavity nests/old pine stands
Vermivora bachmanii	Bachmann's warbler	U	E	E	Woodod habitatm
Campephilus principalis	Ivory-billed woodpockor	U	E	L	Woodod habitatm
Sterna antillarum	Least torn	U	T		Coastal habitats
Mycteria americana	Wood stork	U	E	E	Freshwater/coastal wetlands
Rostrhamus sociabilis	Snail kite	U	E	t	Freshwater/coastal wetlands
INVERTEBRATES					
Copris gopheri	Scarab beetle	P		UR 2	Associated w/Gopher Tortoise

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Appendix C (Cont.)

Scientific Name	Common Name	Base status	statu. FGFWFC(or FDA)	USFWS	Habitat
PLANTS					
Chrysopsis gosrypina cruiseana	Cruise's goldon-artor	P	E	UR 1	Coastal dunes
Drosera intermedia	Spoon-leaved sundew	R	T		Aquatic habitats
Epigaea repens	Trailing arbutus	U	E		Dry, acid, sandy soil
Kalmia latifolia	Mountain laurel	U	T		Rich, moist, shady woods
Lilaeopsis carolinensis	Carolina lilaeopsis	R		UR 2	
Lilium iridollae	Panhandle lily	U	E	UR 2	Black, mucky soils
Pinguicula planifolia	Chapman's buttorwort	U	RE	UR 2	
Polygonella macrophylla	Large-leaved jointweed	R	T	UR 1	Sand pine-oak scrub
Rhododendron austrinum	Orange azalea	U	E	UR 5	Hoist, woody habitats
Sarracenia leucophylla	White-top pitchorplant	R	E		Open acid bogs
Sarracenia rubra	Sweet pitcherplant	U	E	UR 2	Acid bogs/slash pine woods
Stewartia malacodnedron	Silky camellia	U	E		Slopes of wooded ravines

E = Endangorod
T = Threatened
UR 1 = Under review, for Federal listing with substantial evidence in existence indicating at least soma degree of biological vulnerability and/or throat.
UR 2 = Under review, insufficient biological data available.
UR 5 = Candidate species, but taxa has proven to bo more widespread than was previously believed and/or those species that are not subject to any identifiable throat.
FDA = Florida Department of Agriculture.
FGFWFC = Florida Game and Freshwater Fish Commission.
USFWS = U.S. Fish and Wildlife Service.

Appendix C (Cont.)

Base * = Status of species on tho NAS Pensacola facility.
R = Resident.
M = Migrant.
SR = Suspected resident.
P = Possible resident duo to available habitat; survey required.
U = Unknown, survey required.
N/A = lot expected to occur on tho NAS Pensacola facility.

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[APPENDIX D

JUNE 1990 SECTION **14.2—CHARACTERIZATION]**

[Bold items enclosed in brackets denote
changes to last version of document]

14.2 Phase II — Characterization

The primary objectives of the Phase II field investigation are as follows:

- To characterize the nature and magnitude of the full spectrum of potential site contaminants;
- To confirm and validate the contaminant distributions indicated by the Phase I analytical screening results by collecting and analyzing samples under full-scale CERCLA-type QA/QC requirements;
- To support the preliminary identification, screening, and evaluation data requirements of potential remedial alternatives.

The actual Phase II sampling locations, especially with respect to the Phase I locations, will primarily be a function of how uniform the Phase I results were with respect to contaminant type, magnitude, and distribution across the site.

Phase II investigation of Site 36 will involve the collection of soil and groundwater samples and the installation of additional permanent, shallow monitoring wells. Air sampling will be conducted only if warranted by the results of Phase I efforts. In addition, limited aquifer testing will be performed.

The analytical requirements for Phase II samples are provided in Table 14-2.

During the Phase II investigation of Site 36, which is covered by RCRA requirements, at least one sample per contaminated medium will also be analyzed for Appendix IX parameters (40 CFR, Part 264). These samples will be collected from the area of highest contamination for each medium as determined during the Phase I investigation. Additional Appendix IX samples may be required depending on the extent of contamination detected.

TABLE 14-2

PHASE II SAMPLING AND ANALYTICAL REQUIREMENTS—GROUP N

SITE 36

Medium	No. of Samples	Dupli-cates	Trip Blanks[a]	Field Blanks	Rinsate Blanks	[Preservative Blanks[b]]	Total*	Analytical Suite[c,d]
Soil	95	10	4	[1]	4	[1]	[115] (15)	A C
Groundwater	19	2	2	[NR]	2	[NR]	[25] (4)	A B
TOTAL	114	12	6	[1]	6	[1]	[140](19)	

[a]Trip blanks will be analyzed for [Target] Compound List (TCL) volatile organic compounds only.

[[b]Preservative blanks will be analyzed for TCL volatile organic compounds, total recoverable hydrocarbons, total TCL metals, and cyanide.]

[c]Analytical suite designations are as follows:

A = TCL volatile organic compounds plus xylene and ketones, TCL base/neutral and acid extractable orgaoic compounds, TCL pesticides and PCBs, total recoverable hydrocarbons, TCL metals (total [i.e., unfiltered] and dissolved [i.e., millipore-filtered]), cyanide, gross alpha, total organic carbon, hardness (water only), and alkalinity (water only).

B = Total suspended solids. total Kjeldahl nitrogen, ammonia nitrogen, orthophosphate phosphorus, dissolved oxygen (in field), 5-day biological oxygen demand (BOD_5), aod chemical oxygen demand (COD).

C = pH, alkalinity. percent moisture, grain size, BTU contont, ash content, total organic halogens, sulfur, ignitability, and cation exchange capacity.

[d]Specific constituents encompassed *by* tho various chemical groups included within tho above-listed analytical suites are identified in Tables 9-5 through 9-13 of tho Generic Quality Assurance Project Plan.

*The number of samples shown in parentheses will bo analyzed for tho additional parameters indicated.

[NR = Not required.]

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14.2.1 · Biota Sampling

The need for formal biological sampling will be based on the results of the Phase I habitat/biota survey and analytical screening results. If biological sampling is required, a separate biological sampling plan will be prepared which outlines sample locations, sampling methodologies, analytical parameters, etc.

14.2.2 Soil Sampling

Soil samples will be collected as part of the shallow monitoring well installation, described below in Section 14.2.2. At each location, composite samples will be collected from the following depth intervals: surface to 0.5 feet, 0.5 to 2.5 feet, and every 2.5 feet to the water table.

The soil samples will be collected using a split-spoon sampling device during well drilling. All sampling, compositing, and lithologic logging will be performed in accordance with Section 6.6 of the GQAPP. Equipment decontamination will be performed in accordance with Section 6.10 of the GQAPP.

For planning purposes, five soil samples are assumed at each well location. The following section assumes 19 shallow monitoring well locations in Phase 11, thus a total of 95 soil samples is tentatively projected.

14.2.3 Shallow Monitoring Well Installation and Development

The actual number and locations for shallow monitoring wells to be installed in Phase II will be determined based on Phase I findings. For planning purposes, the number of permanent, shallow monitoring wells to be installed is 19. The shallow monitoring wells will be installed to a depth of 15 feet and will be constructed of two-inch PVC, and bracket the water table with 10 feet of 0.10-inch screen. The wells will be installed utilizing hollow-stem auger techniques and in accordance with sections 6.7 and 6.10 of the GOAPP.

[Bold items enclosed in brackets denote changes to last version of document]

Depending on the results obtained during Phase I, the delineation of the extent of shallow groundwater contamination may be possible during Phase II by the installation of a few monitoring wells in addition to the number proposed. When and where possible and/or practical, additional monitoring wells will be installed during Phase II in order to expedite the overall investigation schedule.

14.2.4 Groundwater Sampling

Groundwater samples will be collected from the estimated 19 newly installed permanent wells. The purging and sampling of wells will be conducted in accordance with sections 6.8 and 6.10 of the GQAPP.

14.2.5 Hydrologic Assessment

Well head elevations will be surveyed for all newly installed monitoring wells and water levels will be measured in all wells.

Limited aquifer testing will be conducted on all newly installed and existing monitoring wells. These will consist primarily of performing short-duration specific capacity tests during development of the newly installed monitoring wells and slug or specific capacity tests on the existing monitoring wells. Specific capacity and slug tests are particularly useful for deriving first estimates of aquifer hydraulic properties (i.e., hydraulic conductivity, transmissivity).

The advantages of conducting specific capacity tests in conjunction with well development is that the test itself does not generate additional potentially contaminated water, which requires disposal. Slug testing does not generate any potentially contaminated water.

Physical and chemical aquifer data collected during Phase II will be evaluated to determine lateral contaminant migration characteristics. A plan for deep well installation will be developed based on the findings of phases I and 11.

[Bold items enclosed in brackets denote changes to last version of document]

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14.2.6 Air Sampling

The need for formal air sampling will be based on the findings of the Phase I surface emissions survey and particulate air sampling, and the Phase I shallow soil sampling.