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DEFENSE DEPOT MEMPHIS, TENNESSEE (DDMT)

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REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)

FINAL WORK PLANS

INTRODUCTION - VOL. 1

JOB No. 11-8531-01

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CONTRACT No. DACA 87-88-C-0082

- SOIL BORING AND MONITORING WELL INSTALLATION PLAN VOL. II
- SAMPLING AND ANALYSIS PLAN VOL. III
- SAFETY HEALTH AND EMERGENCY RESPONSE PLAN VOL. IV

PREPARED FOR:

U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE, ALABAMA

JANUARY, 1989



112 TOWNPARK DRIVE KENNESAW, GEORGIA 30144-5599 404-421-3400

Correspondence No. OT8-420

February 1, 1989

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U.S. Army Corps of Engineers Huntsville Division P.O. Box 1600 Huntsville, AL 35807-4301

Attention: Mr. Tim Smith Project Manager

Dear Mr. Smith:

Subject: Final Work Plans RI/FS at Defense Depot Memphis, TN LEGS Job. No. 11-8531-01 Contract No. DACA87-88-C-0082

Law Environmental, Inc., Government Services Division is pleased to submit the final Work Plan for the DDMT project. Only Volumes I through IV are attached as no comments relative to Volume V have been received by this office.

In accordance with the Statement of Work, we are submitting copies of the final Work Plan to the Agencies listed on the attached sheet.

Should you have any questions concerning the final plans or other aspects of the project, please do not hesitate to call.

Sincerely,

Thomas L. Richardson, P.E. Project Principal

R. Absalon, P.G.

Project Manager

FWT/cb

cc: see attached list

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Commander U.S. Army Corps of Engineers Attention: CEHND-ED-PM Tim Smith, Project Manager P.O. Box 1600 Huntsville, AL 35807-4301	4 copies
Commander Defense Logistics Agency Attention: DLA-WS/Depot Bill Randall Cameron Station Alexandria, VA 22304	2 copies
Commander U.S. Army Environmental Hygiene Agency Attention: HSHB-ME-SG Aberdeen Proving Ground, MD 21010-5422	2 copies
Commander Defense Depot Memphis, TN Attention: Danny Chumney 2163 Airways Blvd. Memphis, TN 38114-5000	2 copies
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DDMT WORK PLAN - VOLUME I

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INTRODUCTION

FOR

REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)

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DEFENSE DEPOT MEMPHIS, TENNESSEE (DDMT) CONTRACT NO. DACA87-88-C-0092

Prepared for:

U.S. Army Corps of Engineers Huntsville Division P.O. Box 1600 Huntsville, Alabama 35807

Prepared by:

Law Environmental, Inc. Government Services Division 112 TownPark Drive Kennesaw, Georgia 30144-5599

January, 1989

TABLE OF CONTENTS

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1.0	Introduction1-1
2.0	Review of Installation Environmental Setting2-1
3.0	Review of Past Installation Hazardous Material
	Use, Storage and Disposal
4.0	Review of Installation Environmental Studies4-1
5.0	Review of Current Hazardous Material/Waste Management5-1
6.0	Conceptual Site Model
7.0	Proposed ARARS
8.0	Preliminary Evaluation of Remedial Alternatives8-1

LIST OF FIGURES

Figure 1-1	Site Layout1-3
Figure 3-1	Dunn Field Disposal and Storage Site
Figure 3-2	Main Installation Disposal and
	Storage Sites
Figure 6-1	Conceptual Site Model6-3

LIST OF TABLES

Table 3-1	Dunn Field Disposal and Storage Sites3-4
Table 3-2	Main Installation Disposal and
	Storage Sites
Table 6-1	Potential Exposure Pathways
Table 6-2	Contaminants of Concern
Table 7-1	Proposed ARARs7-2
Table 8-1	Summary of Potential General Response
	Actions and Associated Remedial
	Technologies8-5

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1.0 INTRODUCTION

The Work Plan has been prepared as the scoping document for the remedial investigation/feasibility study (RI/FS) at Defense Depot Memphis, Tennessee (DDMT). The purpose of the Work Plan submittal is threefold: (1) to provide a consolidated report on history, current site activities, site and resulting environmental impacts; (2) to familiarize personnel working on the project with site conditions; and (3) to provide project plans for conducting the RI/FS (reference the DDMT Project SOW). This document, Volume I of the Work Plan, fulfills the first two objectives previously stated. Field investigations plans (i.e., Volume II - Soil Boring/Monitoring Well Plan; Volume III -Sampling/Analysis and QA/QC Plan; Volume IV - Safety Plan) will be submitted at a later date along with a Data Management Plan (Volume V) in order to fulfill the third objective above.

Volume I covers the following areas:

- . Site location, history, mission and organization (1.0)
- . Environmental setting (2.0)
- . Past and current hazardous materials use, storage and disposal (3.0)
- . Past environmental studies (4.0)
- . Findings (5.0)
- . Conceptual Site Model (6.0)
- . Proposed ARARs (7.0)
- . Potential remedial alternatives (8.0)

<u>Location</u>

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Defense Depot Memphis is located in Memphis, Tennessee, in the extreme southwestern portion of the state. The Depot lies approximately five miles east of the Mississippi River near the junction of Interstate 40 and 55.

The Depot is located in the south central section of Memphis approximately five miles southeast of the Central Business District and three miles northwest of Memphis International Airport. Airways Boulevard borders the Depot on the east and provides primary access to the installation. Dunn Avenue, Ball Road, and Perry Road serve as the northern, southern, and western boundaries, respectively. Figure 1-1 shows a layout of the DDMT facility.

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<u>History, Mission and Organization</u>

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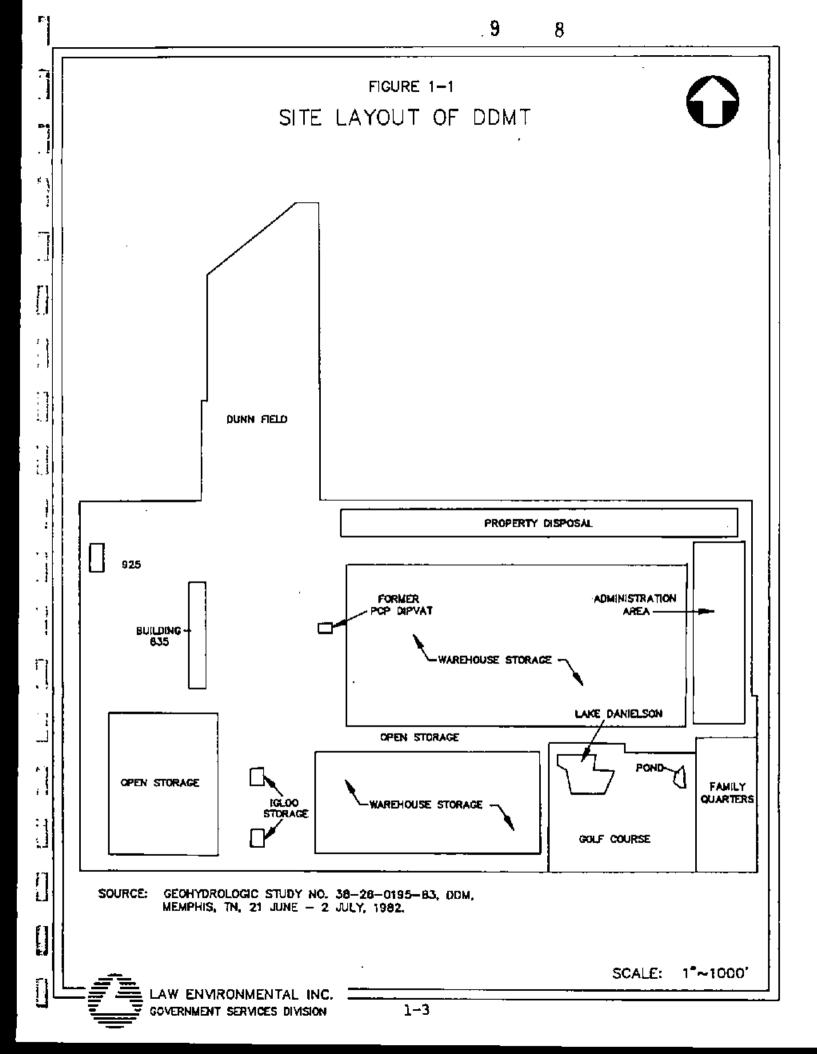
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Construction of the Defense Depot Memphis began in June 1941 and was completed in May 1942 on land which was previously used as a cotton field. Operation of the DDMT began January, 1942.

The initial mission and functions of the DDMT were to supply, provide stock control, and storage and maintenance services for the Army Engineer, Chemical, Quartermaster Services. During World War II, the Depot served as a prisoner of war camp for 800 prisoners. The Depot also performed supply missions for the signal and ordnance technical services.

In 1963 the installation was chosen by the Defense Supply Agency (DSA), currently the Defense Logistics Agency (DLA), to be a principal distribution center for a complete range of DSA commodities. On January 1, 1964, the U.S. Army released the installation to DSA and the installation became the Defense Depot Memphis. The DDMT's current mission, as a major DLA field element, is to store and distribute Department of Defense commodities within the south-central United States.

The installation consists of 642 acres of land and 127 structures.



Interface with Headquarters and Other DOD Agencies

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DDMT is under the direction of the Defense Logistics Agency (DLA). DLA is responsible to the Secretary of Defense for providing services and supplies used in common by all the military services. Several other organizations are co-located at DDMT and report directly to DLA. These include Defense Industrial Plant Equipment Center (DIPEC), Defense Reutilization Marketing Region (DRMR), Defense Reutilization Marketing Organization (DRMO), Defense Logistics Agency (DLA), Customer Supply Assistance Center, Defense Contract Administrative Services (DCAS), and Defense Systems Automation Command (DSAC).

As host activity, DDMT provides administrative support to the DLA co-located activities. Services include accounting, personnel, and travel arrangements.

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2.0 REVIEW OF INSTALLATION ENVIRONMENTAL SETTING

<u>Geology</u>

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The majority of Memphis is located in the Gulf Coastal Plain Province, locally referred to as the West Tennessee Plain. Memphis is near the center of the Mississippi Embayment, a large trough-shaped depression extending from southern Illinois to Jackson, Mississippi. Underlying geologic formations consist primarily of unconsolidated sand, clay, and gravel. Wellconsolidated rocks occur at depths greater than approximately 2,000 feet.

Surficial Soils

According to the U.S. Department of Agriculture Soil Conservation Service Soil Survey for Shelby County, the predominant surface soil association found on the DDMT site prior to construction of the Depot was the Memphis-Granada-Loring Association. Characteristics of this association include yellow brown to dark brown, sloping, well-drained to moderately well-drained, silt soil deposits varying in thickness from 6 to 8 inches. Construction activities for the Depot have altered the soil on the majority of the site to such an extent that the soil type is now classified as graded land, with silty materials.

Two areas on the site which have not been significantly altered include the northeast corner of Dunn Field and the southeast corner of the golf course. The predominant soil type in these areas is the Memphis Association, a clay, sandy, silt loam which is good for pasture lands and crops. The Memphis soil type is well drained; however, it is subject to erosion if unprotected.

Topography

The majority of the DDMT site is fairly level with an average elevation of 300 feet, National Geodetic Vertical Datum of 1929

(NGVD). Areas where elevation changes are fairly significant include the area south of Dunn Avenue in the vicinity of the railroad switch yard where elevations range from 297 to 317 feet NGVD. The area in the vicinity of the golf course was not extensively altered during construction of the DDMT, and elevations there range from 267 to 301 feet. Elevations in the southwest portion of the DDMT site, north of Ball Road and east of Perry Road in the vicinity of Building 995, range from 297 to 308 feet. A concrete paved slope, which ranges in elevation from 291 feet to 301 feet separates the bulk storage buildings from the binnable storage buildings. North of Dunn Road, elevations range from 269 to 311 feet.

<u>Hydrogeology</u>

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The Gulf Coastal Plain is characterized by gently rolling to steep topography formed by erosion and covered by loess deposits during Pleistocene glaciation. The gently rolling to steep topography is broken in many places by flat lying alluvial deposits of streams that cross the area. In descending order Quaternary and Tertiary geologic formations of importance alluvium, loess, fluvial deposits, Jackson Formation include: and upper part of Claiborne Group (undifferentiated), Memphis Sand, Flour Island Formation, Fort Pillow Sand and Old Breastworks Formation. The principal freshwater aquifers are the alluvium/fluvial deposits which make up the surficial unconfined aquifer, and the Memphis Sand and the Fort Pillow Sand, which are confined aquifers. The Memphis Sand is considered to be an aquifer of regional significance. Most of the water used for municipal and industrial supplies in the Memphis area is drawn from the Memphis Sand (97%) and the Fort Pillow Sand (3%). (USGS WRI Report No. 85-4295).

Seven monitoring wells have been drilled at DDMT in the Dunn Field area. Soil samples collected during drilling range from inorganic clays of high plasticity to well-graded gravels/gravelsand mixtures with little or no fines, silty gravels or gravel-

sand-silt mixtures. The data suggests that the upper zone (less than 30 feet) is less permeable than the lower zone. Water was encountered at two levels in the subsurface - a perched zone about 20 feet below ground surface (bgs), and the regional water table 59 to 73 feet bgs. Ground-water flow appears to be toward the west or southwest.

<u>Drainage</u>

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Surface drainage on the DDMT site is accomplished by an effective storm drainage system. Dunn Field and the area along the site's northern boundary drain into a storm water outfall which discharges into the city ditches and small unnamed creeks. The creeks flow northerly into Cane Creek and then southwesterly into Nonconnah Creek which lies approximately three-fourths of a mile south of the DDMT. Drainage along the eastern, western and southern boundaries of the Depot site is also into city ditches and small creeks which flow southerly into Nonconnah Creek. Nonconnah Creek flows westerly into Lake McKellar which empties directly into the Mississippi River.

Lake Danielson, a four-acre surface storm water storage area available for fire fighting, and a small pond on the Depot golf course are the only surface waters located on the DDMT site. Lake Danielson collects surface water runoff from the golf course and discharge from an on-site storm sewer. Overflow from the lake discharges into storm drains which eventually empty into Nonconnah Creek. The pond located on the golf course collects runoff from the golf course and adjacent developed areas and discharges into the drainage system on the south side of the DDMT site.

Vegetation and Wildlife

The majority of the DDMT site is developed with urban uses. Vegetative resources are limited to Bermuda grass, a few deciduous black oaks, and several species of decorative shrubs

and trees. Landscaping programs have concentrated decorative species around the lake and golf course and in the housing area.

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Very little natural habitat is available for wildlife on DDMT property. Dunn Field is the only undisturbed open area on the site. Animals which have been observed at Dunn Field include squirrels, red foxes, quail, mourning doves, and turtles. Rats and mice occupy the developed portions of the site, attracted by subsistence stocks.

Lake Danielson (Fire Reservoir) has been periodically stocked with bluegill and bass. Catfish are also found in the lake. The lake is a closed ecosystem which is directly impacted by installation operations. A fish kill in the lake occurred in 1976 and to a lesser extent in 1988. Although the source of the fish kills have not been officially identified, speculation points to pesticide treatment of the golf course. A small goldfish pond is also located on the golf course.

No threatened or endangered species are known to inhabit or utilize the DDMT site.

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3.0 REVIEW OF PAST INSTALLATION HAZARDOUS MATERIAL USE, STORAGE AND DISPOSAL

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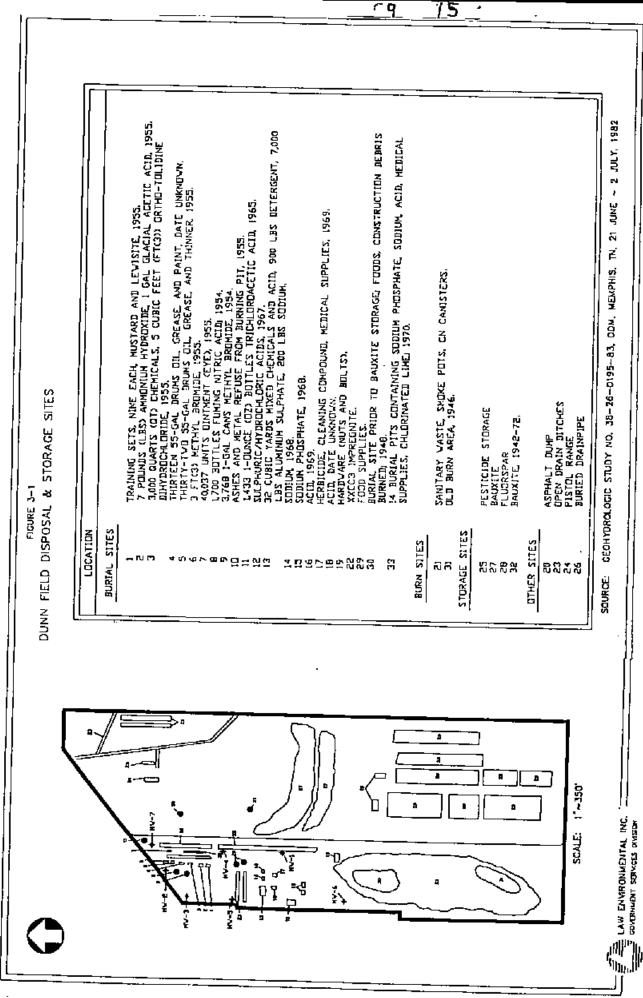
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The information evaluated under Task 1 of this project indicates that as a result of DDMT's complex site utilization history, large quantities of potentially hazardous materials have been stored, repackaged, shipped or disposed on installation property. In addition, leaks or spills of stored goods or substances used on site have been reported. Past and recent facility use conditions were reviewed to determine the following:

- What impact, if any, past/current conditions might affect RI/FS project goals.
- 2) What constraints, if any, conditions of concern could place on planned facility monitoring and sampling efforts.
- 3) What effects, if any, conditions of concern could exert on the interpretation of project monitoring and analytical data.

The examination of available facility utilization information commenced with the review of Dunn Field material storage and disposal records. A total of 33 individual sites were identified at Dunn Field. Descriptive information is summarized on Table 3-1. The individual site locations are illustrated on Figure 3-1.

Available facility utilization information included some U.S. Army Environmental Hygiene Agency (USAEHA) and U.S. army Toxic and Hazardous Materials Agency (USATHAMA) records describing past conditions on the main installation. A total of forty specific locations or conditions of potential environmental concern were noted. This information is listed on Table 3-2. The locations of individual sites are illustrated on Figure 3-2.



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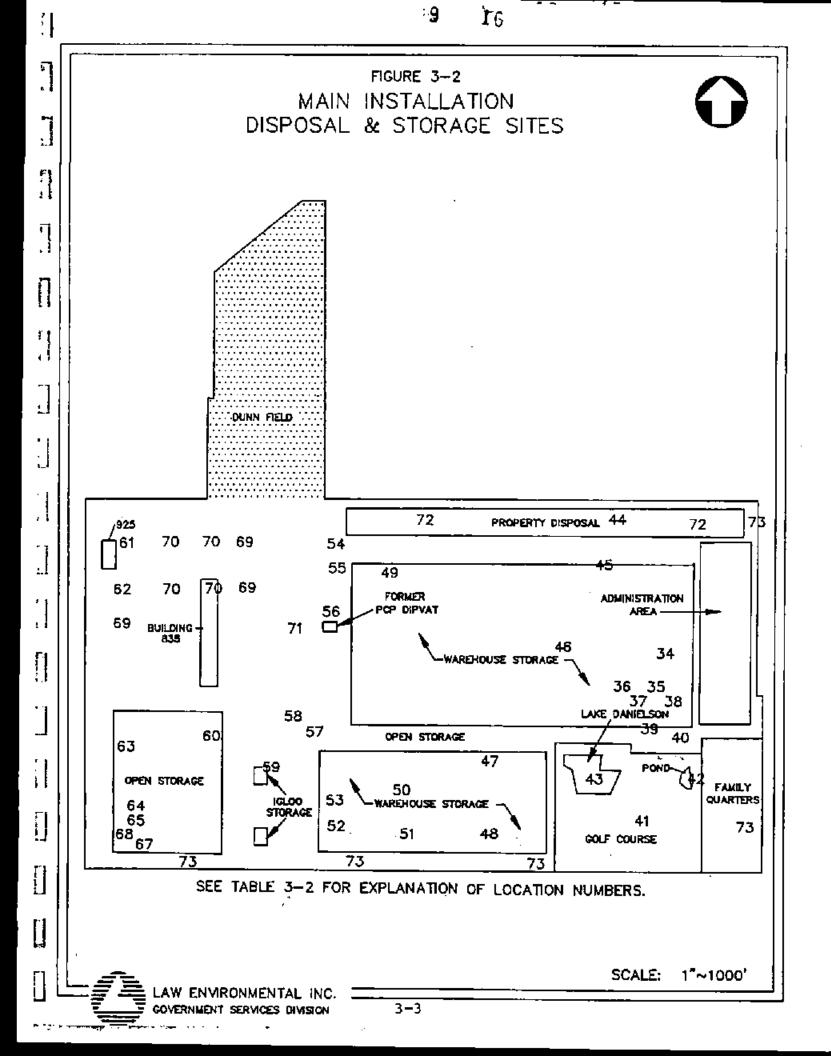


			TABLE 3-1		
			DEFENSE DEPOT MEMPHIS TENNESSEE		
			DULUN FIELD SITES		
		SUMMARY OF	SUMMARY OF MAZARDOUS MATERIAL USE, STORAGE, AND DISPOSAL SITES	D DISPOSAL SITES	
NAP NO.	D. ZOKE	LOCATION	NATERIALS/WASTE	QUANTITY, DIMENSIONS OR SIZE	REMARKS
		IN QUADRANT	MUSTARD AND LEWISITE	NIME TRAINING SETS	DISDOSED TU POSS
	2 DUMN FIELD	NU' OLADRANT	AMMOWIUM HYDROXIDE &	7 POCHOS SOLID. 1 CAL. LIGUTO	
			GLACIAL ACETIC ACID		
	3 DUNN FIELD	NV QUADRANT	VARIOUS CKEMICALS; ORTHO-	3,000 GLARTS/5 CU.FT OTD	DISPOSED IN 1955
			TOLIOINE DIHYDROCHLORIDE		
-		NU OLADRANT	POL AND PAINT	13-55 GAL.DRUMS	
		NN CLADRAUT	POL AND THINKER	32-55 GAL DRUMS	DISPOSED IN 1955
		NU QUADRANT	NETHYL BROWIDE	3 CUBIC FEET	DISPOSED IN 1955
	DUKN	NU GUADRANT	EYE DINTMENT	\$11NU 750,04	3
-	DUNK	NN QUADRANT	FUNING NITRIC ACTD	1.700 BOTTLES	2
	6 DUNN FIELD	IN OLADRANT	NETHYL BROWLDE	3.768 OFF-CALION CANE	
2	D DUNH FIELD	NU CLUDRANT	ASHES AND METAL LASTF		TIPLETON IN TACK
=	1 DUNN FIELD	NU QUADZANT	TRICHLODARETIC ACID	1 211 AME ANNAL ANALY AN	
2	2 DUNN FIELD	NU CLADRANT	SUDDAYDIC AND UVNOVCHINGLE LEVES	TA DIVENUAL BUILES	UISPOSED IN 1965
₽ 3-	S DUWN FIELD	NU CLADPANT	MINED PUERIANI 6 MAIN ATTACAMENT ALIVA		DISPOSED IN 1967
			ALACE CREMICAL & ACTU, DETERGENT,	•	÷
			ALUMINUM SULPHATE & SODIUM	& ACID, 8,100 POUNDS SOLIDS	
1	GUNN	NN QUADRANT	600 LUM	ONE PALLET	
ħ	OUNN FIELD	NY QUADRANT	SIDDILM PHOSPHATE	OKE PALLET	DISPOSED IN 1648
15	DUNN	NU OULDRANT	ACID	QNE PALLET	
1	DUNN FIELD	KN QUADRANT	HERBICIDE, MEDICAL SUPPLIES &	UNCERTATE	
			CLEANING COMPOUND		
8	DUKN	NU QUADRANT	ACID	UNCERTAIN	:
4	DUNN FIELD	NN QUADRANT	HARDLARE (NUTS & BOLTS)	UNCERTAIN	1.
2	DUKN FIELD	NE CUADRANT	ASPHALT	UNCERTAIN	7
2	DUNN FIELD	KE QUADRANT	SANITARY WASTE, CN CANISTERS,	UXCERTAIN	
			& SHOKE POTS		10-224 LANA 1323-101
2	DUNN FLELD	NE QUADRANT	GNITE	UNCERTAIN	:
រ	DUNK FIELD	NE OLADRANT	DRAJNAGE DITCHES		
ž	DUNN FIELD	BUILDING 1184	TLENCE		MAT HAVE REC'D RUNDFF FROM STORAGE & DISPOSAL AREAS
22	N A N	KF OIANDout		UNCERTAIN	
1 1				UNCERTAIN	•••
			[PE	UNCERTAIN	
2	DUNN FIELD	NE GLADRANT	BAUXITE	THO SEMI-CONTAINED PILES	

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່ 1 ມ	I NEKSI DAS	
DEFENSE DEPOT NEMPHIS TENKESSEE	QUARTITY, DINENSIONS OR SIZE	TEN BINS UNCERTAIN GEBRIS LUCERTAIN CNICERTAIN CNICERTAIN CONTAINED PILE CID, UNDERTAIN
KESSEE		P Contraction of the second seco
DEFENSE DEPOT NEMPHIS TENRESSEE DUXN FIELD SITES		FLUCASPAR FOCOS SUPPLIES FOCOS, BURNED CONSTRUCTION DEBRIS VARIOUS CONBLISTIBLES BAUXITE BAUXITE SODILM PROSPHATE, ACIO, COLORINATED LINEANEDICAL SUPPLIES COLORINATED LINEANEDICAL SUPPLIES
TABL TABL DUWK FI	MATERIALS/WASTE	FLUCASPAR FLUCASPAR FOCOS, BURNED CONSTRU VARIOUS CONBUSTIBLES BAUXITE SODILM, SODILM PROSPI CHLORINATED LINELMEDI CHLORINATED LINELMEDI
DEFENSE	MATERIALS/	FLUCASPAR FOCOS, BURNED VARIOUS COMBUI BAUXITE SODILM, SODILA CHLORINATED LI
MULRY OF 1		
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[]		DUNN FIELD DUNN FIELD DUNN FIELD DUNN FIELD DUNN FIELD
	JUNE COME	· ·
Live Level	NUP NO.	% % ភ ឝ ឝ ឝ 3~5

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			TABLE 3-2			
			DEFENSE DEPOT NEWPHIS TENNESSEE			
			MALK INSTALLATION			
		SIDULARY OF KAZARDOUS	SUDWARY DF KAZARDOUS AND NOW-HAZARDOUS MATERIAL USE, STORAGE, AND DISPOSAL SITES	TORAGE, AND DISPOSAL SITES		
NAP NO.	ZONE	LOCATION	MATERIALS/WASTE	QUANTITY, DIMENSIONS OR SIZE		
4	MAIN INSTAL.	BUILDING 249	XXCC+3	UKCERTAIK	STORAGE/HAMDLING CNCERTAIN	
32	MAIN INSTAL.	BUILDING 253	Pol	50 X 125 FEET	SMALL CONTAINERS	
2	MAIN INSTAL.	BUILDING 257	MDGAS	57,700 EALLONS	TANKS NOT TESTED	
37	MARN INSTAL.	BUTLDING 263	POL	20 X 40 FEET	SMALL CONTAINERS	
8	MAIN JUSTAL.	PAD 267	PESTICIDES, HERBICIDES	150 X 200 FEET	BULK LOTS USED ON POST	
8	MAIN INSTAL.	AREA 272	PCBS	100 X 225 FEET	TRANSFORMER LEAKS SUSPECTED	
3	NAIN INSTAL.	BUILDING 273	PESTICIDES, CLEANERS	10 X 50 FEET	*-•	
41	HATH INSTAL.	COLF DOURSE	2,4,D. N2A1844 FLAMETKRONER	22 ACRES	SURFACE APPLICATION	
			LIQUID FUELS			
27	MAIN INSTAL.	POIND	2,40	D.5 ACRE	SURFACE APPLICATION	
3	MAIN INSTAL.	LAKE DANIELSON	2,40	4 ACRES	SURFACE APPLICATION	
4	MAIN INSTAL.	BUTLDING 308	DDT	11,000°- 12,000 GALLONS	SPILLS SUSPECTED	
3	MAIN INSTAL.	BUILDING 319	FLAMMABLES, TOXICS, ETC.	UNCERTAIN	RADIOACTIVE LIENS REPACKED IN VEST END OF BLDG.	
3 -(NAIN INSTAL.	BUILDING 359	NEDICAL SUPPLIES & WASTE	30 X 60 FEET		
5	MAIN INSTAL.	VICINITY BLDG. 470	UNICIPATI	UNCERTAIN	:	
Ş	MAIN INSTAL.	VICINITY BLDG. 490	UKKNOM	200 X 400 FEET	:	
6 7	MAIN THSTAL.	BUILDING 629	DOT, HERBICIDES, SOLVENTS,	DDT-70 TONS, LARGE DUANTIFIES	HYDROFLUCES ACTD SPILL	
			OXIDIZER, DORROSIVE, REACTIVE, ETC.	OF BULK LIQUIDS		
8	MAIN INSTAL.	VICINITY BLOG, 689	CMK NDMN	UNCERTAIN	:	
2	MAIN INSTAL.	VICINITY BLDG. 690	LINK NOLN	UNCERTAIN	:	•
2	KAIN INSTAL.	VICINITY BLDGS.689-690UNKNOWN	PIDLINK NOLIN	UNCERTAIN	:	9
3	MAIN INSTAL.	BUILDING 689	ALCOHOL, ACETONE, TOLUENE,	3,000 CALLONS	HYDROFLUORIC ACID SPILL	
			MAPHTHA, HF			
2	MATH JUSTAL.	VICINITY S702	FUELS, MISC.LIQUIDS, NOOD, PAPER	UNXNOWN	UTILIZED 1968-72	1
5	MAIN INSTAL.	BUTLDING 720	FUEL & CLEANERS DISPENSING	POL-12,000 GALLONS		9
2	NAIN INSTAL.	BUILDING 737	PCP, DIOXIN, FURAN	E 600 CUBIC YARDS	BUILDING, OF PVAT, PUMPHOUSE & UST REMOVED.	
			·.		SOIL CONTAMINATION RENAINS	
5	MALK INSTAL.	BUILDING 765	RVEL OIL	•	***	
Se	HALM INSTAL.	BUILDING 770	HASTE OIL AND FUEL OIL		;	
2	MACH INSTAL.	BUILDING 783	FLAMMABLES	i	;	
3	MAIN INSTAL.	BUILDING 873	FOL	500,000 GALLONS	CONFIRMED DDE.DDT & ALDRIN CONTAK. EAST OF BLDG.	
61/62	MAIN INSTAL.	BLDGS. 925 £ 949	. אַאַ	VARIES	REPLACES X+25	

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ZQXE MAIN INSTAL. MAIN INSTAL.	;	TABLE 3-2 Defeuse depot nemphis tennessee Kain installatich Kain installatich Kocatich disposal sites Locatich Materials/Maste quantity, dimensions or i	STORAĜE, AKO DISPOSAL SITES Guantity, dineksioals or size			-
2222 22222	:		QUANTITY, DIMENSIONS OR 512E			
				REMARKS		
		E OIL.	tc.ukcertain	LEAKERS" RECOUPED IN 1981 - UNDERGROUND TANK USED	- UKDERGROUND TANK USED	
2222 2222		DUL, "DAMED FESTILIUSS" POL	SELLI DUANTITIES	VENICIE POLISE DARY		
222 2222		VARTOUS WASTES	UNCERTAIN	TERTICE WEAR ANA		
22 2222		ZINC CHROMATE PRIMER	UNCERTAIN	:		
2 2222	TAL. BUILDENG 1089	SQIDS	UNCERTAIN	ACID LEAKS SUSPECTED		
2222	TAL. AREAS X-13,X-15,X-25		UNDERTAIN	A FEW LEAKS SUSPECTED		
5555		MEK, NAPHTHA				
122		KM HRACKS 1,2,3,4,3,6 POL, VARICUS CHEMICALS 11. De terve	UNCERTAIN	A FEU LEAKS SUSPECTED		
		DISTRICT	UACER AIN MUTERTIN	HEMBICIDE USED TO CLEAR TRACKS	(CCS	
		2,4 D	UNCERTAIN	USED FOR DUST CUNIKUL		
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4.0 REVIEW OF INSTALLATION ENVIRONMENTAL STUDIES

In conformance with DOD policies, a number of pesticide/ herbicides, waste management environmental quality, land use and industrial hygiene studies have been performed by government agencies and private consultants. A number of outside information sources have also been identified. The studies and related supporting information known to Law Environmental, Inc., includes the following:

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- City of Memphis, Memphis Light, Gas and Water Division, Miscellaneous file data, October 18, 1988 (Contact: F.P. Von Hofe) Memphis Tennessee.
- Harland Bartholomew & Associates, Inc. Master Plan Defense Depot Memphis, Tennessee, July 1988
- O.H. Materials Company, Summary Report: On-Site Remedial Activities at Defense Depot Memphis, Feb. 1986 Phoenix Environmental Consultants, Inc., Environmental Assessment for Hazardous Materials Mission Expansion, January, 1984
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5.0 REVIEW OF CURRENT HAZARDOUS MATERIAL/WASTE MANAGEMENT

This section is based on the Master Plan Report: Defense Depot Memphis, Tennessee, prepared by Harland Bartholomew and Associates, Inc., July, 1988.

DDMT routinely receives and ships hazardous materials. The amount of materials handled was estimated to be 37,000 tons in FY 1987. In February 1986, the position of Environmental Coordinator was created. Responsibilities of the position include overseeing all operations involving hazardous material and assuring compliance with appropriate guidelines.

The current utilization of DDMT land resources is illustrated on Figure 1-1.

The following hazardous materials are warehoused and issued at DDMT:

- 1) Flammable Liquids
- 2) Flammable Solids
- Corrosives (Acids and Bases)
- Poisons (A&B) including insecticides
- 5) Compressed Gases (non-flammable)
- 6) Compressed Gases (flammable)
- 7) Class C Explosives
- 8) Oxidizers

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- 9) Radioactive Materials
- 10) Other Regulated Material (ORM)

These materials are received as packaged commodities from manufacturers in containers that range in size up to 55-gallon drum quantities. While in storage, these materials are segregated by hazardous storage compatibility groups to assure optimum safety conditions are met.

<u>Storage</u>

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Existing locations of hazardous materials storage at DDMT are summarized below (see Figures 3-1 and 3-2, Tables 3-1 and 3-2).

<u>Location</u>	<u>Item</u>
Building 629	Various chemicals (toxics,
	corrosives, oxidizers)
Building 319	Flammable materials, toxics
Area X-25	Flammable materials
Building 835	Anti-Freeze
Building S-873	POL products and overflow
	chemicals from 629
Building 689	Short-term storage of
	flammable liquids, for
	shipping and receiving

The majority of chemical stock items are stored in Building 629. This building is constructed on a concrete foundation without floor drains and contains five bays separated by concrete walls and fire doors. Spill booths containing absorbent materials and cleanup equipment are located in each separate area. These booths are marked to preclude incompatible chemicals being placed in the same booth. The capacity of Building 629 is currently inadequate, and overflow chemicals are stored in Building S-873.

Building 319 is the flammable materials storage area and contains mostly alcohols with lesser amounts of other items (ether, pesticides, and solvents). Hazardous materials requiring temperature-controlled environments are also stored in this warehouse, as are pilferable hazardous materials. The building is concrete-bermed and is on a concrete foundation with no floor drains. One mechanically ventilated, separately bermed room in the west end of the building contains cyanide compounds. The building is equipped with explosion-proof lighting and spill booths similar to those in Building 629. Security restrictions

at Building 319 are tight. Building 319 storage will be replaced by the proposed new hazardous materials warehouse.

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The X-25 area is a bermed, concrete pad in the open storage area on the northwest side of the installation, where only Class 1 flammable liquids are stored. These liquids are normally stored in 55-gallon drums and include a wide range of industrial grade organic solvents. Three tension fabric roof structures have recently been constructed over the area, however, the northernmost structure fell in January 1988 and has not been replaced.

Building S-873 is an open-sided shed for POL products storage. Overflow chemicals, which would normally be stored in Warehouse 629, are also stored at Building S-873. The new recoupment facility, Building 865, is adjacent to the new hazardous materials warehouse, Building 835. The recoupment facility is used for repackaging of selected materials that are damaged in transport. Any material that cannot be repackaged must be classified as hazardous material excess and turned over to DRMO.

The drums which are now stored in areas X-13 and X-15 will then be moved into the free space in S-873. In this manner, all open storage of drummed products, except at X-25, will be eliminated. Building 529 is partially utilized for non-compliance storage. An additional 20,000 square feet of material will be relocated from Building 529 to the new warehouse.

The Flammable Liquids Holding Area, also known as the "hot house", is where flammable materials are temporarily stored (less than 24 hours), after receipt or before shipping. Typical items in this area include alcohols, ketones, aromatics, and ethers. The "hot house" is located at the northwest corner of Building 689.

A new hazardous materials warehouse is presently under construction in the northwest quadrant of DDMT. The total area

of the building is 141,100 square feet. The building will provide 138,000 square feet of storage area for hazardous materials with the remainder being used for general office and ancillary activities. Sources of DDMT hazardous wastes include spill cleanup residue, mission stock which has reached expired shelf life, and satellite generation areas. Hazardous materials operations at DDMT are increasing. In 1984, DDMT was responsible for 30,000 tons of hazardous material, while in 1987, the amount was about 37,000 tons.

<u>Hazardous Waste Generation and Disposal</u>

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DDMT is a RCRA generator of hazardous wastes in the State of Tennessee, under generator number TN 42100205780. DDMT is a small quantity generator, because less than 220 pounds of hazardous wastes are generated per month. The only source of DDMT hazardous wastes result from the cleanup of small hazardous materials spills. Of the approximately 100,000 hazardous material transfers per year at DDMT, only an estimated 50 per year results in an out-of-container event. More than 90 percent of these events result from packaging failures in transport. The remaining events are attributed to handling at DDMT.

Defense Reutilization and Marketing Region (DRMR) is a tenant activity of DDMT. DRMR supports several installations in the region and is responsible for providing disposal of hazardous material through contractors. The old Defense Property Disposal Office has been redesignated Defense Reutilization and Marketing Office (DRMO). DRMO provides property disposal services and conforming storage facilities for hazardous materials and hazardous wastes generated by DDMT, Memphis Naval Air Station and Air Force Air National Guard. Under the present permit, the time limit for hazardous waste storage is 90 days. The installation is seeking a Part B permit from EPA which would allow storage up to 180 days.

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Building 308 is where hazardous materials in DRMO's possession are stored. It is a wood-framed tin structure with a concrete A two-foot concrete foundation surrounds the floor to floor. provide secondary containment, except for two doorways. Spill containment and cleanup materials are kept in the building. Building 308 will be replaced by the planned DRMO Conforming Storage Facility. The project was planned for FY 1987. It will provide a 14,000 square foot storage facility with auxiliary facilities required to accomplish the hazardous materials Recoupment is used as much as possible to disposal mission. minimize losses and to keep waste quantity to a minimum. Cleanup residuals are transferred to DRMO for resale or disposal.

Sampling investigation of the PCP DIP Tank Building commenced in August, 1985 when U.S. Army Environmental Hygiene Agency personnel obtained analytical results arranged by O.H. Materials which revealed the presence of high levels of highly chlorinated isomers of dioxins and furans.

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Samples taken of soil under the dip vat showed the presence of contamination. O.H. Materials used a portable drill rig to systematically depth sample the area. O.H. Material in conjunction with state and federal authorities determined a target clean-up criteria figure of 200 ppb total dioxins and furans.

Although contaminants exceeding the 200 ppb were found at a depth of 27 feet, the U. S. Army, Region IV EPA, and the State of Tennessee Department of Health and Environment determined a 10 foot removal depth.

The contaminated soil was stored on roll-off containers near Building 670. The roll-off containers have been removed and the soil has been disposed at an approved facility. The Dioxin was removed to an approved hazardous waste disposal facility in spring 1988.

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Traces of zinc have been found in the bottom sludge of Lake Danielson. This is believed to have been caused by drainage from cooling towers. Many cooling towers are constructed of hotdipped galvanized metal parts. Prior to assembly, the metal parts are dipped in a vat of molten zinc to obtain a coating for protection against corrosion. At present, the contaminant level of the sludge is within compliance limits and is not considered to be a significant problem. However, monitoring of the sludge should be continued, and should the sludge approach the maximum allowable contaminant level, it should be dredged out and disposed of in a manner prescribed by the governing environmental agency.

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DDMT has instituted spill response and control measures which avoid significant releases of spilled hazardous material to the environment. The following programs have been implemented to mitigate adverse impacts.

- Spill Prevention, Control, and Countermeasures (SPCC) Plan. The plan is designed to improve responses to and decrease the potential for hazardous materials spills.
- (2) <u>Installation Spill Contingency Plan (ISCP)</u>. The Plan provides specific steps to follow for reporting of a spill, mobilization of the spill response team, and cleanup of a spill. Also included are telephone numbers for emergency services (police, fire department, hospitals, etc.), reportable quantities of hazardous materials, and the responsibilities of the spill response team members.
- (3) <u>Personal Training</u>. The training includes courses for hazardous materials warehouse personnel, spill team members, and management. The training program includes initial orientation; an in-house course, "Introduction to Hazardous Materials--Handling and Storage, Packing and Marketing"; certification training for packers, "Defense Packaging of Hazardous Materials for Transportation," which is conducted

by the Joint Military Packaging Training Center; and opportunities to take technical courses and attend appropriate seminars outside the DLA system for certain personnel. Safety meetings are conducted once per week. Unannounced drills on safe work practices are conducted monthly by the Safety and Health Office.

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(4) <u>Spill Response Vehicle</u>. The vehicle has a variety of spill response equipment for personnel protection (chemicalresistant coveralls, boots, hard-hats, face shields, gloves, respirators, first aid kits, fire extinguishers, etc.), spill control (shovels, absorbents, neutralizing chemicals, etc.), communications, and analysis (explosimeter, oxygen meter, pH paper, etc.) plus other safety gear. In addition to the DDMT vehicle, the City of Memphis Fire Department Hazardous React Team is on call for emergencies at the installation. This team has a national reputation for its hazardous spills response expertise.

Prior to 1976, the north end of Dunn Field was used for burial of toxic and carcinogenic compounds, ID sets, pesticides, and foodstuff. Burning sites were also formerly located there. The Resource Conservation Recovery Act, Code Federal Regulation 40 was enacted in 1976, and since then, burial and incineration of hazardous wastes at the site has not been practiced. The area is monitored for ground-water contamination.

<u>Explosives</u>. DDMT does not handle significant quantities of ammunition. There are small quantities of ammunition confiscated by the FBI that are stored in an igloo on the west side of 9th Street. The storage of these materials is not considered to be a significant hazard to personnel or facilities.

The only other explosives on the Depot are flammable materials stored in temporary structures on the west side of the installation. An adequate safety distance is maintained.

9 32 6.0 CONCEPTUAL BITE MODEL

Background information gathered during the initial site visit to the Defense Depot, Memphis, Tennessee (DDMT) were utilized in developing a conceptual site model which evaluates potential risks to human health and the environment. As suggested in the SPA guidance documents, the conceptual model includes all known and suspected sources of contamination, types of contaminants and affected media, known and potential routes of migration, and all known or potential human and environmental receptors. Thus the model may be considered a worst case analysis. In addition to assisting the identification of sampling sites, the model will also assist in the identification of appropriate remedial technologies.

A preliminary conceptual model of exposure pathways at the DDMT is included as an aid in evaluating areas which need investigation at the depot (Table 6-1). Potential receptors include employees of the depot, inhabitants of the surrounding area and the entire population of Memphis. A schematic presentation of the model is found in Figure 6-1.

6.1 <u>POTENTIAL SOURCES</u>

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Dunn Field is identified as the area with highest potential for ground water contamination. Dunn Field has served as a burial site for many hazardous waste materials including mustard and Lewisite gas, oil and grease, paint and thinner, methyl bromide, pesticides and herbicides. According to Lt. Marks at Edgewood Arsenal, the M-1 War Gas Set (which is believed to be the identity of the mustard/Lewsite training sets which are buried at Dunn Field) consists of 48 hermstleally sealed pyrex glass tubes, each containing 40 cc of agent. Each kit contains 12 tubes each of mustard, Lewsite, phosgene and chloropickrin. The Mustard and Lewsite are in concentrations of 5% solution in chloroform. Twelve tubes, each enclosed in an outer cardboard tube, were

	TABLE 6-1		
POTENT	POTENTIAL EXPOSURE PATHWAYS	PATHWAYS	
SOURCE/RELEASE	TRANSPORT MECHANISM	EXPOSURE POINT/ROUTE	
1. MIGRATION OF CONTAMINANTS FROM DUNN FIELD	SHALLOW AGUIFER RECHARGE OF MEMPHIS SAND	WATER SUPPLY WELLS FOR MEMPHIS (WELL NO. 115 IN ALLEN FIELD)	
	SHALLOW AGUIFER DISCHARGE TO SURFACE WATER (CANE CREEK)	RECREATIONAL USES OF CANE CREEK AQUATIC LIFE IMPACTS TO CANE CREEK INGESTION OF FISH FROM CANE CREEK	
2. SURFACE RUNOFF OF CONTAMINANTS FROM STORAGE AREAS	STORMWATER DISCHARGE TO GOLF COURSE POND AND LAKE DANIELSON	AGUATIC LIFE IMPACTS IN POND/LAKE	
	DISCHARGE FROM POND/LAKE TO NONCONNAH CREEK	AQUATIC LIFE IMPACTS IN NONCONNAH CREEK RECREATIONAL, USES OF NONCONNAH CREEK INCESTION OF FISH FROM NONCONNAH CREEK	<u> </u>
3. MIGRATION OF CONTAMINANTS FROM PCP-DIP TANK	SHALLOW AQUIFER RECHARGE OF MEMPHIS SAND	WATER SUPPLY WELLS FOR MEMPHIS (WELL NO. 115 IN ALLEN FIELD)	33
	SHALLOW AGUIFER DISCHARGE TO SURFACE WATER (POND/LAKE/ NONCONNAH CREEK)	AQUATIC LIFE IMPACT IN SURFACE WATERS RECREATIONAL USES OF SURFACE WATERS INGESTION OF FISH FROM SURFACE WATERS	
	FUCITIVE DUST-GENERATION IN CONTAMINATED AREAS	INHALATION OF CONTAMINATED DUSTS BY ON-SITE PERSONNEL	

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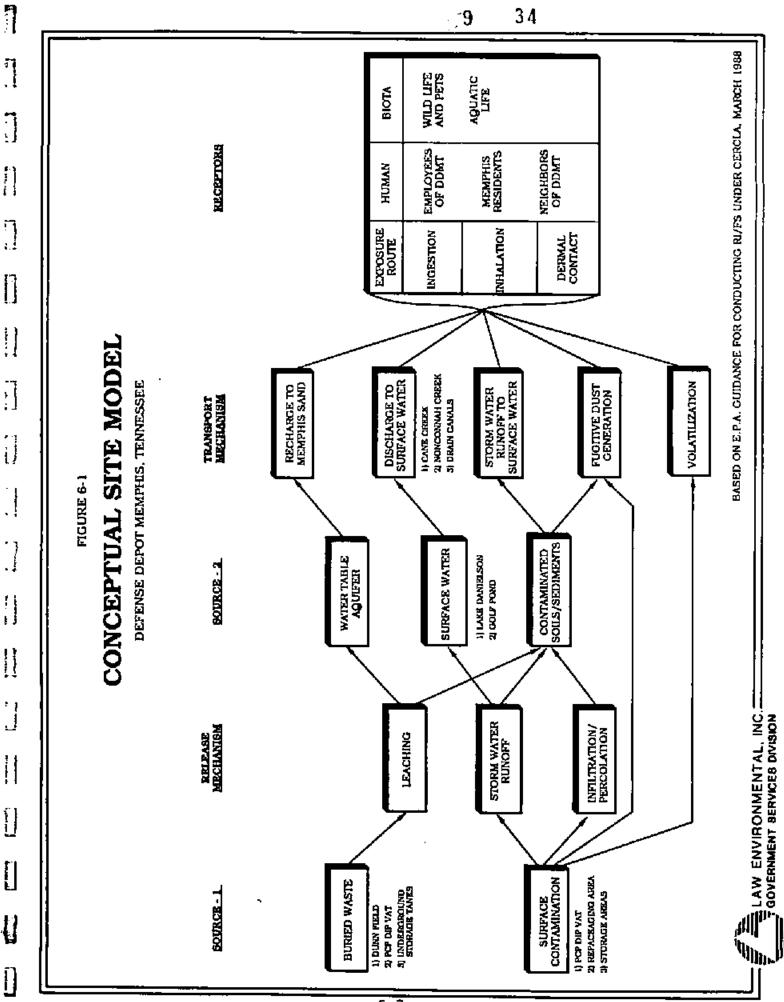
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packed in a metal container of dimensions $5.75" \times 9.5"$. The record indicates that only nine of these sets were buried in Dunn Field. The listing of contaminants of concern will be based on substances found during this investigation. The current listing found in Table 6-2 indicates those substances already found in the ground water at DDMT. Thiodigycol, a by-product formed when mustard reacts with water, has not been found in previous ground water studies. It has been included in Table 6-2 due to the possible presence.

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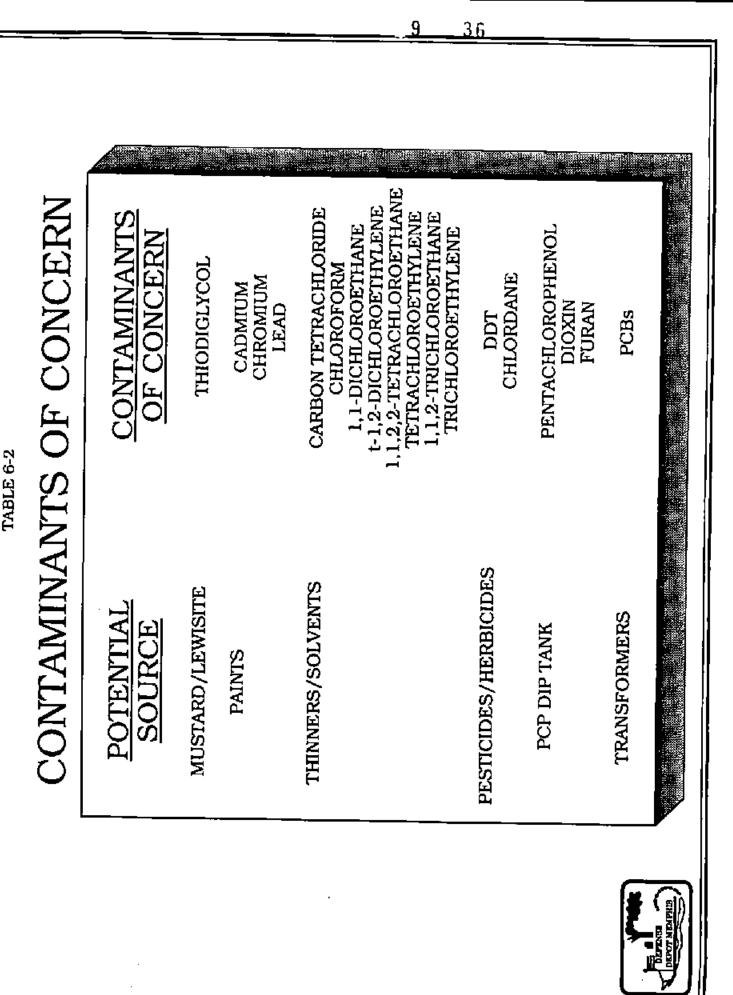
The former PCP dip vat area is another potential source of contamination. Although the area was remediated in 1986 it is possible that some contamination of the subsurface still exists. According to the 1986 O.H. Materials report "Soil containing contamination exceeding the targeted 200 ppb clean-up level for total dioxins and furans currently remains below the 10 foot level to which excavation in Building 737 reached." The migration of PCP and its contaminants from contaminated subsurface soils which remain on sight may eventually reach the water table aquifer. The soils at DDMT are low to moderately permeable and are low in organic matter.

Underground storage tanks are also potential sources of contamination to surrounding soils with contaminants potentially migrating to ground water. At least nineteen underground storage tanks are located at DDMT and have contained fuel, waste oil, and pesticide rinse water. Most of the UST's at DDMT were leak tested and replaced by fiberglass tanks. No leaks were detected.

Storage areas on the east side of the depot drain into Lake Danielson. A pesticide storage area was previously placed upgradient to Lake Danielson, but the original building has been removed, a new concrete foundation poured and a new fabric building installed. Pesticide storage has been moved to another area. Pesticide and PCB residues have been found in fish tissues and in sediment samples from Lake Danielson and the golf course pond (USAEHA, 1986). Lake Danielson and, possibly, the

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Many outdoor areas with gravel bases have served as repackaging or recoupment areas at DDMT. These areas which include the corner of 21st and E streets, the DRMO storage yard and areas surrounding Bldg. S873 were exposed to infrequent ground spills (USAEHA, 1985). Tables 3-1 and 3-2, and Figures 3-1 and 3-2, respectively, list and show areas at the installation where potential waste sources may be located. It should be noted that .most repackaging was done in areas with concrete floors.

6.2 EXPOSURE PATHWAYS

The DDMT is located within the city limits of Memphis and is east of the Allen Well Field, one of six well fields owned by the Memphis Light, Gas and Water Division. The Allen Well Field iraws water from the Memphis Sand aquifer which is the water source for all the City of Memphis and most of Shelby County. Studies have shown that "windows" occur in the confining layer of the Memphis Sand aquifer which may allow leakage of contaminants from water table aquifers (USGS, 1988). It has been documented that contaminants from the DDMT have contaminated the water table aquifer (U.S. Army Environ. Hygiene Agency Ground-water Consultation No: 38-26-0815-87 DDMT, 1986). Although this aquifer is not used as a source of drinking water, contaminants pould potentially reach the Memphis Sand aquifer if "windows"

A preliminary well survey of the area within a one mile radius of the depot did not reveal the existence of any residential wells. Two industrial wells are located within a one mile radius, but are not used as a potable water source (Memphis and Shelby County HD,1988). The State of Tennessee and the local health department track the number of wells in the area by requiring drilling permits and annual permit renewals for continuous well operation.

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The land uses surrounding DDMT are a mixture of residences and commercial or manufacturing establishments. The area is well populated. Storm water runoff from the depot travels by open concrete-lined canals through residential sections surrounding DDMT until reaching either Cane Creek on the north side or Nonconnah Creek to the south and west. Cane Creek eventually drains into Nonconnah Creek. Nonconnah Creek is a tributary of the Mississippi River.

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Inhalation exposures to fugitive dust or volatile organic vapors from areas with surface contamination are release mechanisms to be considered in the potential exposure of employees and neighbors of DDMT. Highly permeable, non-compacted surface soil aids the migration of surface contaminants to subsurface soils and eventually to the water table and groundwater aquifers. It should be noted, however, that the installation as a whole is well vegated or concreted leaving very small areas susceptible to wind erosion.

It was noted during the initial site investigation that storm water runoff leaves the depot via several open storm canals. These canals could serve as a contact point for inhabitants of the areas surrounding the DDMT. Therefore, sampling of storm drain waters will be valuable in discerning whether contaminants are leaving DDMT via storm water runoff and surface water drainage.

The majority of DDMT employees are civilians working during two shifts per work day. The number of employees is estimated to be 2,700 (Chumney, 1988). Employees are potentially exposed via inhalation, ingestion and dermal contact to contaminated surface soils and waters. Inhabitants of areas surrounding DDMT may be exposed to contaminated dusts or volatile vapors escaping from the DDMT or by contact with storm water runoff and drainage from DDMT.

The entire population of Memphis, which uses groundwater from the Memphis Sand as a drinking water source, must be considered as potential receptors. The population of Memphis is estimated at 700,000 for the city and 800,000 for all of Shelby County.

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Most of the DDMT contains structures or paved surfaces. The limited unsurfaced areas (i.e., Dunn Field and the golf course) support native Bermuda grass and deciduous black oaks (<u>Quercus</u> <u>velutina</u>). Some shrubbery is located in previously landscaped areas such as the housing area, golf course and lake. Small, urban-living animals such as squirrels, birds, snakes and turtles are the potential residents of "natural" areas in Dunn Field and the golf course. Game fish such as bluegill, bass and catfish have been previously stocked in Lake Danielson. Goldfish inhabit the golf course pond. Fishing is currently prohibited in the lake and golf course pond.

Aquatic life is potentially impacted by contamination of surface waters such as Lake Danielson, the golf course pond, Cane Creek and Nonconnah Creek. Wildlife and area pets may be exposed via contact with contaminated soil or surface waters.

The conceptual site model highlights several areas deserving investigation. Because the Allen Well Field is less than one mile downgradient of DDMT, buried wastes from Dunn Field, the former PCP Dip Vat, and underground storage tanks may impact these water supply wells. Buried wastes may leach into surrounding soils and be transported by surface water discharge, storm water runoff and fugitive dust generation. Surface contamination from the depot must be assessed as contaminants from this source can be transported by surface water, storm water runoff, fugitive dusts and volatilization. Populations potentially impacted are employees and neighbors of DDMT, residents of Memphis, wildlife, pets and aquatic life.

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7.0 PROPOSED ARARS

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CERCLA guidelines specify that remedial actions meet any Federal standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate requirements (ARARS). State ARARS must be met if they are more stringent than Federal requirements.

Charles Pietrosewicz of the Agency for Toxic Substances and Disease Registry (ATSDR), Liaison-EPA IV, was consulted concerning the proposed ARARS for the DDMT sites. Mr. Pietrosewicz agreed that the ARARS listed on Table 7-1 were appropriate for the public health and environmental assessment of the DDMT sites.

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TABLE 7-1 OPOSED ARARS	ARARs*	MAXIMUM CONTAMINANT LEVELS (MCLs) TENNESSEE DRINKING WATER STANDARDS	AMBIENT WATER GUALITY CRITERIA TENNESSEE WATER GUALITY CRITERIA TENNESSEE EFFLUENT LIMITATIONS		<u>TENN. H₂0 QUALTTY CRITERIA:</u> RULES & REGULATIONS OF THE STATE OF TENN., CHAPTER 1200-4, DEPARTMENT OF HEALTH, BUREAU OF ENV. HEALTH SERVICES, DIV. OF WATER QUALITY, RULE 3	<u>S & STANDARDS;</u> ROL BOARD CHAPTER 1200-4-5	<u>TENN. DRINKING WATER STANDARDS:</u> TENN. DEPT. OF HEALTH, BUREAU OF ENV. HEALTH SERVICES, DIV. OF WATER SUPPLY, RULE 1	RINKING WATER REGULATION : 40 CFR 141	304 (a) AND 307
PR	AREA OF CONCERN	1. MEMPHIS SAND AGUIFER	2. CANE CREEK LAKE DANIELSON GOLF COURSE POND NONCONNAH CREEK		 (1) <u>TENN. H₂0 QUALITY CRITERIA:</u> RULES & REGULATIONS OF TH BUREAU OF ENV. HEALTH SEN 	(2) <u>TENN. EFFLUENT LIMITATIONS & STANDARDS:</u> TENN. WATER QUALTIY CONTROL BOARD CHAPTER 1200-4-5	(3) <u>TENN, DRINKING WATER STAI</u> TENN, DEPT, OF HEALTH, BU	(4) <u>SAFE DRINKING WATER ACT:</u> (MCLs) E.P.A. NAT. PRIMARY DI	(5) AMBIENT H ₂ O QUALITY: CLEAN WATER OF 1977 SECT 304 (a) AND 307

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8.0 PRELIMINARY EVALUATION OF REMEDIAL ALTERNATIVES

8.1 INTRODUCTION

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The purpose of this section is to discuss potential remedial approaches and associated data that may be needed to evaluate alternatives during the Feasibility Study. The following discussion considers alternatives potentially suitable for the mitigation of site conditions at DDMT. This section has been prepared in response to the Statement of Work, Section 1, General Statement of Services and the Subtask 3.2.1.3 description. As information is gathered during the Remedial Investigation, potential remedial approaches will be reconsidered.

Under SARA, remedy selection is based upon four generalized concepts which are:

- The remedy must protect human health and the environment;
- The remedy must be cost-affective;
- 3. The remedy must utilize treatment technologies to the maximum extent practicable; and
- 4. The remedy must meet applicable or relevant and appropriate requirements (ARAR's).

A detailed Risk and/or Health Assessment must be conducted for any remedy selected.

8.2 IDENTIFICATION OF REMEDIAL ALTERNATIVES

For each affected media, a remedial alternative will be identified as necessary in each of the broad categories:

- No action
- Containment
- Treatment with walk-away potential

Treatment reducing contaminant toxicity, mobility, and volume

A brief overview of each broad category is provided in the following subsections.

8.2.1 No Action Alternative

Under the No Action Alternative, the site would not receive any further remedial action. Before this alternative can be selected, the extent and rate of migration of contamination must be determined and projected into the future. The No Action Alternative could be viable if health factors can be addressed and rates of migration and impact on potential receptors can be adequately determined. A detailed Risk Assessment must be conducted before this alternative could be chosen.

8.2.2 <u>Containment</u>

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Containment usually consists of site capping and the installation of barrier walls to preclude surface water infiltration, leachate generation, ground-water underflow and waste contaminant migration into the receiving environment. Containment may be synonymous with isolation, as the site is theoretically separated from its environmental setting by the barrier system. Containment may also be employed to channel leachate or ground water to collection points for subsequent treatment.

The data required to evaluate this alternative might include a description of disposed waste materials, the delineation of site-related contamination in the adjacent receiving environment and a characterization of the concentrated wastes present in the landfill. The waste characterization data would be required to determine contaminant compatibility with potential containment systems.

8.2.3 Treatment With Walk-Away Potential

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Treatment with walk-away potential may involve several technologies. A few technologies identified here may also be applicable, with some differences, to a discussion of treatment reducing contaminant toxicity, mobility or volume, described in following subsection. the This type of treatment may be performed on site, or off site. A possible approach is to apply conventional processes such as biological treatment, physical/chemical treatment or solidification/stabilization. All of these approaches require that site waste materials be mixed with agents that render them harmless or inert, preferably Biological and physical/chemical treatment processes in-situ. may reduce toxicity, but not mobility or volume. Solidification/ stabilization techniques may reduce mobility, but usually will not address toxicity. Fixation techniques may also increase contaminant volumes by the addition of the stabilization material(s) to the waste materials.

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The site data required to evaluate these candidate methodologies include landfill environmental setting, contaminant concentrations and extent, waste characterization and treatability studies.

8.2.4 <u>Treatment Reducing Contaminant Toxicity, Mobility</u> <u>or Volume</u>

Thermal destruction and incineration are two potential remedial alternatives that could possibly reduce contaminant toxicity, mobility or volume. Thermal destruction methods may be utilized to destroy organic contaminants in gaseous, liquid and solid waste. The purpose is to degrade a substance into relatively inert or easily managed materials. Technologies associated with thermal destruction include molten salt, wet air oxidation, plasma arc, circulating bed, high temperature fluid wall, pyrolysis, etc. Incineration technologies generally considered applicable include liquid injection, rotary kiln, fluidized bed

and multiple hearth (Remedial Action at Waste Disposal Sites, USEPA, 1985). Incinerators require combustion temperatures on the order of 1300° F to 3000° F; residence times are highly variable.

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In addition to thermal destruction and incineration, more conventional approaches such as biological treatment, physical/chemical treatment or solidification/stabilization may be utilized. These techniques may be applied singly or in conjunction with other techniques to obtain the desired results.

The site data required to evaluate this candidate methodology include site environmental setting, waste characterization, BTU content, water content, viscosity, halogen content and ash content. Pilot-scale tests may be needed to establish start-up conditions, maintenance requirements and operating parameters.

8.3 <u>PRELIMINARY IDENTIFICATION AND SCREENING OF GENERAL</u> <u>RESPONSE ACTIONS</u>

This subsection provides a preliminary identification and screening of general response actions and associated technologies potentially useful for Defense Depot Memphis Tennessee. The actions and technologies considered address site remediation with respect to suspected site conditions and anticipated contaminant migration pathways. Each action and associated technology is briefly described in Table 8-1. Significant capabilities and limitations are listed, based upon the incomplete data presently available and numerous assumptions. This procedure is used to begin the process of technology screening so that remedial alternatives can be developed, as the RI/FS process proceeds.

A total of eight general response actions have been initially recognized for application at DDMT. These actions were selected in accordance with USEPA guidance documents and our experience on similar projects.

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REMARKS	ktaln option	Retain uption for possible conjunctive use with pthere. Generally not applicable at CONT, could be used with others at Curn Figid.	Potentially applicable for buried usstes at Durn Field and rediments in Late Danielson,
CROUND VATER	×		
GURFACE WATER	-		
SOLUS E SOLUS L MASTE SEDIMENTS	*	×	× c .
LENITATIONS	Ney not adequately address site problems, Potential for contami- nent migration. May be objectionable to the community.	Contominents remain in place. Dependent on site geology. Dependent on climate. Dependent on waste compatibility. Not a long-term solution,	Waste character la not brown. Nay not be pos- sible to sepregate wastes to allow selective removal. Landfill excavation to removo wastes may be difficult and potentially dangerous. Does not address ground-water contamination.
45 HEF 12	Bingless, Innat costly option.	A desona trated, convent foral procedure.	More cost effective than complete removal. May be more favorable to the community then no betion alternative.
ACTICALS RESPONSE ASSOCIATED SOLIS & GURFACE GROUND ACTICALS RECHARCINGT DESCRIPTICAL developments	A no action alternative. Monitor aita by periodic environamital sampling and munitation, per SARA.	Isolates the site from its anvirons, precluding leschate generation and unfittration, duping controls infiltration, while barriers prevent leschate leakage and underfilos, in some prevent leschate collection and leachate collection and treatment.	Remove druce, Remove selected wartes beend solls, endinents, on contaminant levels, degree liquid wastes, of risk to humans and the environment,etc. Fechnology hay be applied to ground water, when combined with treatment.
RECHNOLDET	Fite Konitaring	Capping and barriar wells	solla, eedimenta, solla, eedimenta, liquid uustes, etc.
GEVERAL, RESPONSE ACTIONS Contementation Externa	te Action	contactions Contac	Selected Wasta Removal

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	GENERAL RESPONDE ASSOCIATED AUTIONS TECHNOLOGY DESCRIPTION	BEWEF175	SOLLS & SURFACE GROUND Bewefits Limitations vaste sediments water vater temaks	VASTE	SOLLS L VASTE SEDIMENTS	SURFACE LATER	CROLOD VATER	LEWARKS
move contan Iter or liqu mpira to tr	Romowe contaminated ground water or liquid wastes by purping to treataont systems.	A demonstrated, conventional approach.	Dependent on alle gealogy. Dependent on waste character. Long term speration and taintenance raquired. Existing aquifer vill be affacted.	×			×	Possible for use in any area where water toble aguiter has been conteminated.
Indicates some form of transment performed at t after which renders the material non-bazerdous. Includes on-site inciner biological, chemical and physical treothent and mojidification	Indicates some form of transment performed at the site which renders the material non-hazerdous. Includes on-site incineration, biological, themical and physical treatment and mojidification	Avoids transportation bazerds. Treatment heips ensure re- duction in future tiability. Ebesical/ physical or site treatment would be lower cost options witable for foorganic contaminants found on the site. En-site treatment of ground water by physical/ chastes by physical/	Inclneration is a more costly alternative. Solidification and/or on-site landfill could result in future contami- nation. Un-site solidi- fication with subsequent off-site disposal may be acceptable. Biological treatment would not be effective on inorganice,	×		×	×	Retein option for further consideration. Possible for use in any erea of soil, sediment, or ground-water contemination.

TABLE 20-1 Defense depot nendmis, tennessee Summar of potential general response actions and associated renedial technologies

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TABLE 0-1	DEFENSE DEPOT NEMPALS, TENNESSEE	SUMMARY OF POTENTIAL GENERAL RESPONSE ACTIONS AND ASSOCIATED REVEDIAL TECHNOLOGIES
-----------	----------------------------------	--

GENERAL RESPONSE ACTIONS	ASSOCIATED Technology	DESCEIPTION	BEMEFT TS	LINITATIONS	IISVA	SOILS A E SEDIMENT	VASTE SEDIMENTE LATER	SURFACE CROMIN	D Renarce
0ff-5lt+ Treatment	Incineration, biological, chonical and/or physical treatment.	Off-5ilte Incinentation, Same as above, except that Same as above. X K X K X Retain option for further consideration. Treatment biological, usstes are excervated and function for the further consideration. Cheatical and/or transported to an off-site for the function for the fun	1. abova.	5480 66 ADOV6.	*	*	×	×	Retain option for further consideration. Doot not eppear seriously applicable.
5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	Lendf/ll and Lend freatment for some contasinants,	Refers to the construction of a landitit and/or a land application facility on site.	Avoida transportation hazarda. A demon- strated conventional approach. Very cost approach. Very cost affective when compared to removal/ resiling achemes.	Mot è viable long-term telution, sa contami- nanta remain on sita, May result in incressed risk, Perpetual csre required.	×	×			Probably not apply as would require a permitted tandfill,
014-61 1 tpoest 1 tpoest 1 t 1 tpoest 1	Remove wastes to a secure tandfill. Use tand treatment for setected conteminated water for treatment.	Renove wastes to includes the excevation of a secure contantneted collectents tendfill. Use and reasoned of druces with tend treatment multicequent tendfill in a for setected secure landfill. tend contentnets, sepulcation is applicable tentanineted sediments, it involves the uster for seteriate with the soll-plant perfection, and famobilitation.	Landfill presents e proven, economic means of sefely disposing of harardous special molid wastes containing nu free liquid.	Land treatment is useful only for organic materials, and is thus not entirely applicable to this waste. Landfill of contaminated waster could result in future contamination at the new site. Way result in increased risk,	ж.	×	×	ж	Potential for removal of contaminated soils of sociments or buried wastes.

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8.4 <u>PERFORMANCE CRITERIA AND STANDARDS</u> FOR GENERAL <u>RESPONSE ACTIONS</u>

The performance criteria and standards which must be considered for the previously described actions are outlined below, based on ARARs, environmental, public health, institutional, and cost considerations.

8.4.1 <u>Environmental Protection</u>

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Alternatives posing significant adverse environmental effects will be excluded from further consideration. Only those alternatives that satisfy the RI objectives and contribute to the protection of the environment will be considered further. Environmental criteria which must be considered include:

- Impact of construction on flora, fauna, and the natural drainage system
- o Impact of treatment systems operation on ambient air quality
- Destruction of flora and wildlife habitat or natural drainage systems during contaminated soils excavation process
- Impact of pollutant release to downgradient surface waters, ground waters, and/or sensitive habitats
- Criteria for effluent discharge to surface waters, through off-site disposal of contaminated ground water options
- Potential for offsite contaminant spills during transportation of soils or ground water, for off-site treatment and disposal options.

8.4.2 Public Health

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Only those alternatives which will minimize or mitigate the threat of harm to public health and the environment will be considered. Specific consideration will be given to:

- Guidelines for allowable chemical concentrations in an underground source of drinking water for migration management options
- Assessment of long-term risk to downgradient receptors for migration management options
- The potential for continued release of pollutants from the source into the ground water for all options
- The potential for contaminated ground-water interaction with surface water, and potential surface water receptors, for the no action alternative
- Assessment of risk through air emissions from on-site treatment options and excavation of contaminated soils
- Assessment of risk through off-site transport options

8.4.3 Institutional

An alternative that does not meet technical requirements of the applicable environmental laws (e.g., RCRA, CWA, CAA, TSCA, Safe Drinking Water Act, UIC) will usually be excluded from further evaluation. Specific consideration will be given to:

 Department of Transportation (State and Federal) requirements and restrictions for hazardous waste transport for off-site treatment and disposal options

- Pretreatment standards for discharge into publicly owned treatment works, for off-site treatment and disposal options
- NPDES permitting requirements for off-site discharge of ground water or effluent options
- Clean Air Act permitting requirements for on-site treatment options
- State and local land use zoning restrictions for construction and operation of on-site treatment systems, pipelines, and wells.

8.4.4 <u>Cost</u>

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An alternative whose cost significantly exceeds that of other alternatives and does not provide substantially greater public health or environmental benefits will be eliminated. Total cost of an alternative should be considered and will include the cost of implementing the alternative and the cost of operation and maintenance. Costs will be presented in terms of present worth to provide for comparison among alternatives having different useful lives. Specific considerations could include:

- Transportation costs for off-site disposal or treatment options
- Disposal fees for hazardous waste landfilling for offsite disposal options
- o Treatment costs and/or acceptance fees for off-site treatment options
- Pipeline costs based on size, length and construction constraints for off-site discharge of contaminated ground water

- Well construction costs for contaminated ground-water recovery systems and deep well injection options
- Operation and maintenance costs for ground-water recovery and treatment options
- Facilities construction and operating costs for on-site treatment options
- Excavation, filling and grading costs for source removal options
- Permitting fees for off-site discharge (NPDES) and deep well disposal (RCRA) options
- Engineering design fees for recovery, treatment, and off-site discharge options

8.5 APPROACH TO ALTERNATIVE EVALUATION

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The results of the screening of remedial alternatives will depend on factors selected for making comparisons and how they are applied. Alternatives will be evaluated and ranked in terms of cost-effectiveness, technological feasibility and reliability, and ability to provide adequate protection of human health, and the environment. The detailed evaluation of selected alternatives will consider, at a minimum, the following factors:

- Special engineering considerations required to implement the alternatives (e.g., pilot treatment facilities, additional studies needed to proceed with final remedial design)
- Environmental impacts and proposed methods and costs for mitigating any adverse effects

8-11

- Operation, maintenance, and monitoring requirements of the remedy
- Off-site disposal needs and transportation plans
- Temporary storage requirements
- Safety requirements for remedial implementation, including both on-site and off-site health and safety considerations
- A description of how the alternatives could be phased into operable units, including a discussion of how various operable units of the total remedy could be implemented individually or in groups, resulting in a significant improvement in the environmental protection or savings in costs
- o A review of any national off-site treatment and disposal facilities to consider compliance with applicable RCRA requirements, both current and proposed. In addition, the capacity of such facilities should be examined.

8.6 <u>IDENTIFICATION OF DATA REQUIREMENTS</u>

Additional data are required to formulate cost effective remediation concepts. These data requirements are based on a review of existing data, possible remedial alternatives, and predicted performance. The requirements are as follows:

Source Control

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- Volume (area and depth) of material to be considered
- Chemical nature of the material
- Soil and subsoil characteristics

Ground-Water Related Migration

- Volume of water involved (area, depth)
- Aquifer characteristics
- Background information
- Current ground-water use
- Surface Water Related Migration
 - Degree and extent of surface water involvement
 - Identification of surface drainage channels

8.7 FEASIBILITY STUDY

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Following the data collection phases of the Remedial Investigation, the information obtained will be used in the FS to evaluate and cost those remedial alternatives deemed appropriate.

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DDMT WORK PLAN - VOLUME II

FINAL SOIL BORING AND

MONITORING WELL INSTALLATION PROGRAM

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For

REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)

At

DEFENSE DEPOT MEMPHIS, TENNESSEE (DDMT) CONTRACT NO. DACA87-88-C-0092

Prepared for:

U.S. Army Corps of Engineers Huntsville Division P. O. Box 1600 Huntsville, Alabama 35807

Prepared by:

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January 1989

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TABLE OF CONTENTS

	Title	<u>Page No.</u>
1.0	INTRODUCTION	1-1
2.0	SOIL BORING LOCATIONS AND DEPTHS	2-1
	2.1 Soil Boring Locations	2-1
	2.2 Soil Boring Depths	2-4
	2.3 Soil Boring Justification	2-4
	2.4 Soil Boring Sampling	2-5
3.0	MONITORING WELL LOCATIONS AND DEPTHS	3-1
	3.1 Monitoring Well Locations	3-1
	3.2 Monitoring Well Depths	3-1
	3.3 Monitoring Well Justification	3-2
	3.4 Surface Soil Sample Locations	3-6
	3.5 Optional Work	3-6
4.0	DRILLING EQUIPMENT AND MATERIALS	4-1
	4.1 Drilling Techniques	4-1
	4.2 Well Casing and Screen Materials	4-1
	4.2.1 Surface Casing	4-2
	4.2.2 Well Casing (Riser)	4-2
	4.2.3 Well Screen	4-2
	4.2.4 Sand-Sump	4-5
	4.2.5 Centralizers	4-5
	4.3 Sand Pack Filter	4-5
	4.4 Bentonite Seal	4-5
	4.5 Grout Mixture	4-6
	4.6 Drilling Fluids	4-6
	4.6.1 Water	4-6
	4.6.2 Drilling Mud	4-6
	4.7 Well Completion Details	4-7
	4.7.1 Concrete Pad	4-7
	4.7.2 Steel Security Cap	4-7
	4.7.3 Protective Posts	4-7
	4.7.4 Well Painting	4-7
	4.7.5 Well Identification	4-8
	4.7.6 Temporary Capping	4-8
5.0	DRILLING PROCEDURES	5-1
	5.1 Initial Activities	5-1
	5.2 Drilling Procedures	5-1
	5.3 Soil Boring Log	5-1
6.0	DECONTAMINATION PROCEDURES	6-1
	6.1 Drilling Equipment Decontamination	6-1
	6.2 Sampler Decontamination	6-1

-

1

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TABLE OF CONTENTS (Continued)

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	Title	<u>Page No.</u>
7.0	WELL DESIGN AND INSTALLATION	7-1
	 7.1 Monitoring Well Design 7.2 Monitoring Well Installation 7.2.1 Hollow Stem Auger Technique 7.2.2 Mud Rotary Technique 	7-1 7-1 7-2 7-2
8.0	MONITORING WELL DEVELOPMENT	8-1
9.0	IN-SITU HYDRAULIC CONDUCTIVITY	9-1
10.0	PROJECT ASSIGNMENTS AND RESPONSIBILITY	10-1

LIST OF FIGURES

<u>Figure</u>	Title	Page
2-1	Recommended Monitoring Locations at the Main Installation	2-2
2-2	Recommended Monitoring Locations at Dunn Field	2-3
4-1	Type II Monitoring Well Installation Diagram	4-3
4-2	Type III Monitoring Well Installation Diagram	4-4
5-1	Soil Test Boring Record	5-3
8-1	Well Development Data	8-3
9-1	In-Situ Hydraulic Conductivity Test	9-3

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1.0 INTRODUCTION

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Because of potential contamination at the Defense Depot Memphis, Tennessee (DDMT), the Defense Logistics Agency (DLA) has initiated this investigative program through the Huntsville Division, Corps of Engineers. The purpose is to determine if contamination has occurred and assess feasible alternatives for clean-up. To accomplish these objectives, ground-water, surface water, soil and sediment samples will be collected at DDMT. This plan describes the soil boring and monitoring well installation program and is Volume II of the DDMT Work Plan.

Soil borings drilled for the purpose of soil sample collection for analytical testing must be advanced in a manner which allows the collection of representative soil samples. Similarly, monitoring wells must be properly installed in order to accomplish the following objectives: to collect representative groundwater samples; to prevent contamination of the aquifer by the drilling activities; to prevent inter-aquifer contamination; and to prevent vertical seepage of surface water into the monitoring well water-intake zone. The soil sampling and well installation plan discusses the equipment, procedures and personnel that will be used at DDMT to accomplish these objectives.

DDMT is located in Memphis, Tennessee and is currently managed by the DLA. The mission of the Depot is to stockpile and distribute material goods. Background information about the depot history, environmental setting and past waste disposal practices is discussed in Volume I of the Work Plan. As previously mentioned, Volume II is the Soil Boring and Monitoring Well Installation This plan covers soil boring and monitoring well locations Plan. and depths, drilling equipment and materials, drilling procedures, decontamination procedures, well design and installation, well development, permeability testing, and project assignments and responsibilities. This plan was prepared to meet the requirements of the DDMT statement of work.

2.0 SOIL BORING LOCATIONS AND DEPTHS

Law will install five soil borings during the RI/FS at DDMT as specified in the project scope of work. The purpose of the soil borings will be to characterize the subsurface geology and to collect soil samples for chemical analysis. To accomplish these objectives, both geotechnical samples and soil samples for chemical analysis will be collected from the soil borings. The soil borings will be drilled using hollow stem augering techniques. Borings will be sampled continuously from the ground surface to a depth of 10 feet. After a depth of 10 feet is reached, samples will be taken at a minimum of 5 foot intervals. The soil borings will be backfilled with a grout bentonite mixture.

This section of the plan discusses the location, depth and sampling of the borings.

2.1 SOIL BORING LOCATIONS

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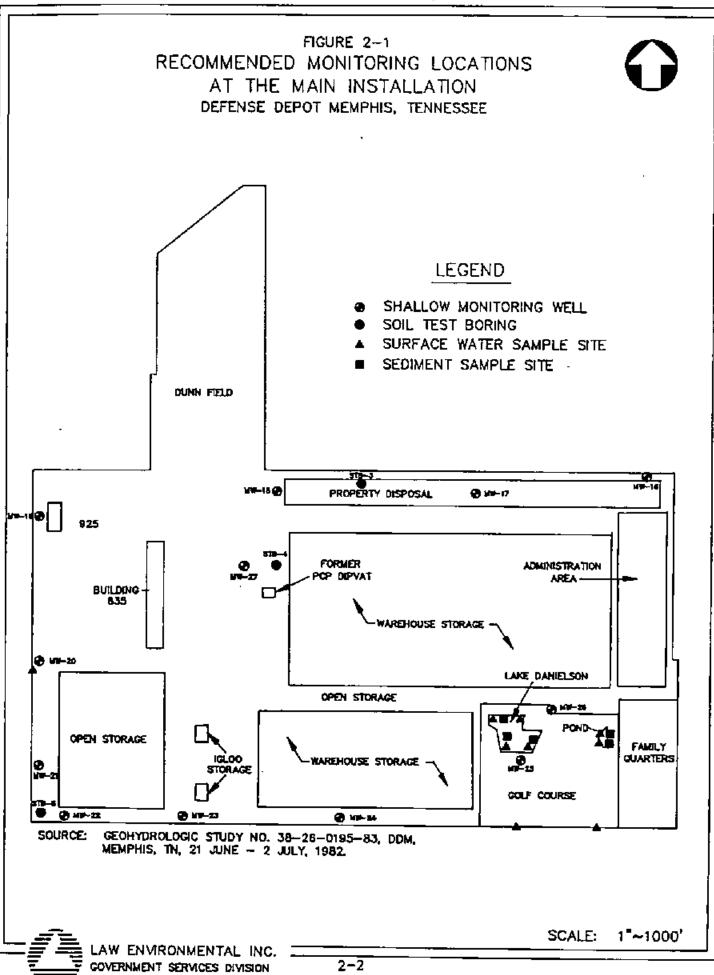
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As stated previously, the purpose of the soil borings is to collect samples for chemical analysis and to obtain geologic information on the site. Therefore, the soil borings have been located to optimize both objectives. Figures 2-1 and 2-2, respectively, show the proposed sampling locations for the main installation and Dunn Field. As shown on the figures, the five borings form a north-south transect of the entire site. Two borings (Figure 2-1) will be on the main part of the installation and three will be in Dunn Field (Figure 2-2). These locations will provide chemical samples and geology data for the installation.

It should be noted that these locations are well away from the mustard/lewisite burial site (reference Figure 3-1, Work Plan, Volume I). No sampling will occur at this burial site except by the U.S. Army Technical Escort Unit (TEU).



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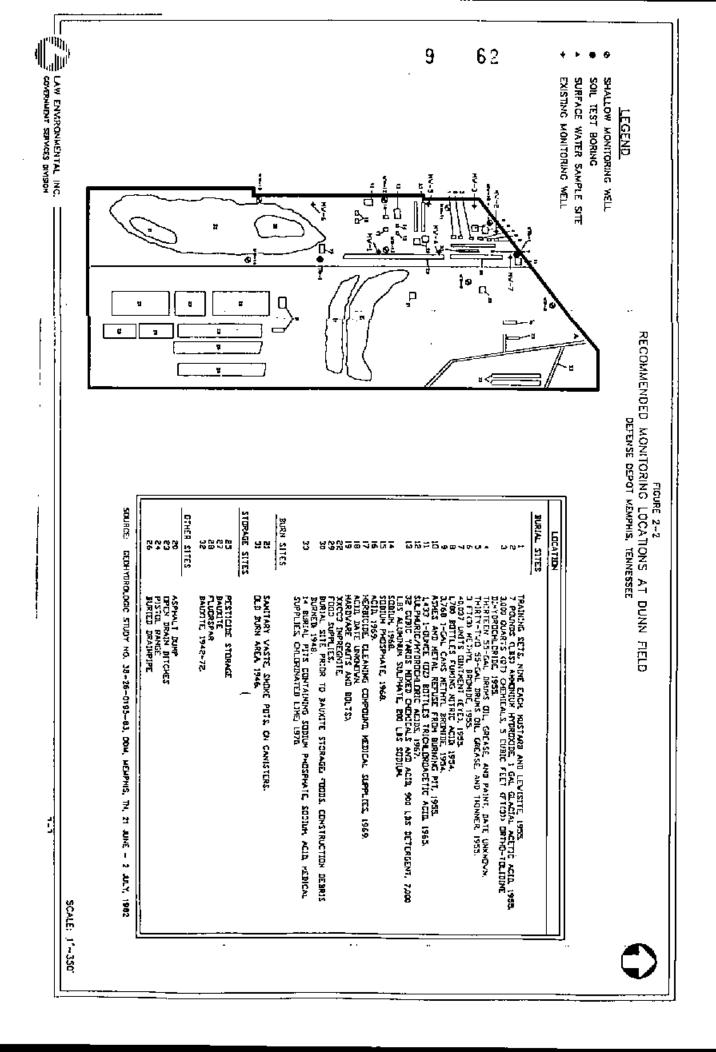
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2.2 <u>SOIL BORING DEPTHS</u>

The statement of work (SOW) for the DDMT RI/FS provides for five soil test borings with a total footage not to exceed 400 feet of drilling. Therefore, it is estimated that each soil test boring will average 80 feet in depth. Based on a review of background information, an 80 foot soil boring will provide adequate geologic data on the unsaturated zone and the water table aquifer beneath DDMT. Some of the borings may reach the confining unit beneath the water table aquifer, but that will not be known until actual borings are installed.

2.3 SOIL BORING JUSTIFICATION

BORINGS STB-1 and STB-2

LOCATION - DUNN FIELD

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JUSTIFICATION - Borings in Dunn Field will serve two purposes, i.e., for collection of soil samples for chemical analysis and to describe the geology beneath Dunn Field. Previous borings installed at Dunn Field were sampled by collecting auger cuttings during the drilling operation. While this method is adequate to provide a general description of the subsurface, it is not adequate to provide the site specific detail that can be obtained using continuous sampling procedures. A continuous soil profile will provide the detail necessary to understand the subsurface environment at Dunn Field.

BORING STB-3

LOCATION - PDO YARD, MAIN INSTALLATION

JUSTIFICATION - Collection of soil samples for chemical analysis and to describe the subsurface stratigraphy in the vicinity of the PDO yard. No soil test borings have been installed in the vicinity of the PDO yard.

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BORING STB-4

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LOCATION - FORMER PCP VAT AREA, MAIN INSTALLATION JUSTIFICATION - Although the area has been remediated, the contractor only removed soil to a depth of ten feet. STB-4 will test the soil at depths below ten feet and indicate the effectiveness of the remediation efforts.

BORING STB-5

LOCATION - SOUTHWEST CORNER, MAIN INSTALLATION JUSTIFICATION - The location, on the edge of the open storage area, will help to describe the subsurface stratigraphy of the area as well as allow the collection of soil samples for chemical analysis in an area of known chemical spills.

2.4 SOIL BORING SAMPLING

Soil samples for chemical and geotechnical analysis will be collected from the 5 soil test borings. Two potential sampling protocols will be either using a split spoon sampler collecting samples with the standard penetration test (ASTM-D- 1586-67) or with a CME continuous sampling device (or equivalent continuous sampler). Subsurface conditions will dictate the most reasonable sampling procedures.

For chemical analysis, three samples will be taken from each boring. The depth of each chemical sample will be based on photoionization detector (PID) readings during drilling. If PID readings indicate organic contamination, the chemical samples will be collected from the zone with the highest readings. If no PID readings register above zero, then samples will be obtained at depths judged by the field manager to represent the greatest potential for contamination (i.e., low permeability layers in the unsaturated zone, at the water table, etc.).

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A geologist or engineer will be assigned to each drilling rig to assure that samples are properly collected and that geologic strata are adequately identified and mapped.

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3.0 MONITORING WELL LOCATIONS AND DEPTHS

As specified in the Scope of Work, 20 shallow monitoring wells will be installed during the RI/FS. The monitoring well locations and depths for each site are discussed below.

3.1 MONITORING WELL LOCATIONS

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Monitoring wells will be drilled in the main installation and at Dunn Field. The proposed locations are shown in Figures 2-1 and 2-2. These locations have been selected based upon reviews of background data regarding geology, geohydrology, and past waste practices at DDMT (reference Figure 3-1, Work Plan, Volume I). Twelve wells are proposed for the main installation and eight wells at Dunn Field. Each location is near a potential waste source, or downgradient of waste sources. Ground water within the Memphis Sand formation flows predominantly toward the Mississippi River west of the installation. Data from the AEHA installed wells indicate a westerly direction of ground water flow in the surficial aquifer.

As with the soil borings in Section 2.0, no wells will be drilled near the mustard/lewisite burial location. Monitoring wells have been selected to avoid this type of chemical contact. If monitoring wells are necessary near the mustard/lewisite burial site, the U.S. Army TEU will have sole responsibility for installing these wells.

3.2 MONITORING WELL DEPTHS

The DDMT SOW states that 20 wells will be installed with a total footage not to exceed 1700 feet of drilling. Previous monitoring wells installed at DDMT have shown that the water table occurs at a depth of approximately 70 feet below land surface. Each new monitoring well and soil test boring will terminate approximately

15 feet into the water table aquifer as per the SOW. However if the confining unit is reached then drilling will terminate. Therefore, it is estimated that each well will average 85 feet in depth.

3.3 MONITORING WELL JUSTIFICATION

MONITORING WELL MW-8

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LOCATION - NORTH CENTRAL DUNN FIELD

JUSTIFICATION - This well will be located up-gradient to MW-7 which has shown significant ground water contamination. The new well will define the extent of the contaminate plume in this direction.

MONITORING WELL MW-9

LOCATION - NORTH CENTRAL DUNN FIELD

JUSTIFICATION - This well will be located up gradient to known burial sites of hazardous wastes as well as ground water monitoring wells (MW-2, MW-3, and MW-5) which have shown significant ground water contamination. The new well will define the extent of the contaminate plume in this direction.

MONITORING WELL MW-10

LOCATION - NORTH WEST DUNN FIELD

JUSTIFICATION - This well will be located near MW-2 which is screened at 30 feet and was unable to produce enough water for analysis during the last sampling event. MW-2 is though to be screened in a perched zone that may or may not produce water. Therefore no water samples have been obtained from the water table aquifer in the vicinity of MW-2.

MONITORING WELL MW-11

LOCATION ~ NORTH WEST DUNN FIELD

JUSTIFICATION - This well will be located midway between MW-3 and MW-5 both of which indicated ground water contamination. The new

well will further delineate the extent of the contamination plume immediately down-gradient of the burial sites.

MONITORING WELL MW-12

LOCATION - WEST DUNN FIELD

JUSTIFICATION - This well will be located midway between MW-5 and MW-6 both of which indicated ground water contamination. The new well will further delineate the extent of the contamination plume.

MONITORING WELL MW-13

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LOCATION - CENTRAL DUNN FIELD

JUSTIFICATION - This well will be located adjacent to an area where hazardous wastes were buried. It is also up gradient to MW-4 and MW-6 which both indicated ground water contamination. This well will define the extent of the plume of ground water contamination in this direction. It replaces monitoring well MW-1 which was previously destroyed.

MONITORING WELL MW-14

LOCATION - CENTRAL DUNN FIELD

JUSTIFICATION - This well will be located up-gradient to an area where various wastes were buried or burned. It is also up gradient to MW-6 which had the highest levels of ground water contamination of any well at DDMT. The well will further delineate the extent of the plume of ground water contamination in this area.

MONITORING WELL MW-15

LOCATION - WEST DUNN FIELD

JUSTIFICATION - This well will be located adjacent to MW-6 which had the highest levels of contamination of any ground water well at DDMT. It will further delineate the plume of ground water contamination indicated by MW-6.

MONITORING WELL MW-16

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LOCATION - NORTHEAST EDGE OF MAIN INSTALLATION JUSTIFICATION - Based on the suspected regional hydraulic gradient it is anticipated that MW-16 will function as an upgradient or background monitoring location. Therefore, this well should provide information on the background water quality.

MONITORING WELL MW-17

LOCATION - PDO YARD, MAIN INSTALLATION

JUSTIFICATION - This well will be located in the Property Disposal Yard which in the past has handled large amounts of hazardous materials. Data from the well should indicate whether past hazardous material handling practices have affected the surficial aquifer.

MONITORING WELL MW-18

LOCATION - PDO YARD, MAIN INSTALLATION JUSTIFICATION - Same as MW-17 above.

MONITORING WELL MW-19

LOCATION - WESTERN EDGE OF MAIN INSTALLATION

JUSTIFICATION -MW-19 is located on the downgradient boundary of DDMT. It is in the vicinity of the flammable storage yard (X-13, X-25) and other storage activities. It should provide water quality in the surficial aquifer leaving DDMT.

MONITORING WELL MW-20

LOCATION - SOUTHWESTERN EDGE OF MAIN INSTALLATION

JUSTIFICATION - This well will be located downgradient of the Open Storage Area. Numerous hazardous wastes are known to have contacted the environment in this area which necessitates monitoring. Potential contamination on the western boundary includes paints, solvents, pesticides, hydrocarbons and others.

MONITORING WELL MW-21

LOCATION - SOUTHWESTERN EDGE OF MAIN INSTALLATION JUSTIFICATION - Same as MW-20 above. MONITORING WELL MW-22

LOCATION - SOUTHWESTERN EDGE OF MAIN INSTALLATION JUSTIFICATION - Same as MW-20 above.

MONITORING WELL MW-23

LOCATION - SOUTHERN EDGE OF MAIN INSTALLATION

JUSTIFICATION - This well will be located near an area which underwent a remediation effort in 1985. Numerous damaged containers of acids, bases, solvents and cleaners were repackaged or disposed of and a substantial quantity of contaminated soil was removed. A ground water monitoring well inn this area will indicate if the surficial aquifer was impacted by past material handling practices.

MONITORING WELL MW-24

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LOCATION - SOUTHERN EDGE OF MAIN INSTALLATION JUSTIFICATION - This well will be located near a former drum storage area. Records indicate that from time to time leaks were discovered in some of the drums stored in this area. A ground water monitoring well should indicate if the surficial aquifer was impacted by the leaking drums.

MONITORING WELL MW-25

LOCATION - LAKE DANIELSON/GOLF COURSE POND AREA, MAIN INSTALLATION

JUSTIFICATION - Past herbicide or pesticide releases in this area have affected the aquatic life in these surface waters. A ground water monitoring well in this area will indicate if the surficial aquifer was impacted by these chemicals.

MONITORING WELL MW-26

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LOCATION - LAKE DANIELSON/GOLF COURSE POND AREA, MAIN INSTALLATION - Same as MW-25 above.

MONITORING WELL MW-27

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LOCATION - FORMER PCP DIPVAT DRIP AREA

JUSTIFICATION - This well will be located down gradient of the former PCP dipvat drip area, which was remediated in 1985. A ground water monitoring well will indicate what affect activities at the dipvat area had on the surficial aquifer.

3.4 Surface Soil Sample Locations

A total of 40 shallow (less than 18 inches in depth) surface soil samples will be collected. Past waste management practices and hazardous materials handling locations will be the quiding factors in choosing locations for the samples. The following table lists areas where samples will be obtained:

- Dunn Field Area
- Property Disposal Area
- Former PCP Dipvat Area
- Open Storage Area
- Lake Danielson/Pond Area
- Former Recoupment Area
- Paint Shop/Sand Blast Area

The exact locations of the sample points will be determined in the field by the Field Manager based upon visual inspection of the area and using best engineering judgment.

3.5 OPTIONAL WORK

Additional ground-water monitoring wells have been included as optional tasks to the basic contract. All of the optional tasks are listed below. Those necessary for completion of the RI/FS will be exercised at the discretion of the Contracting Officer.

Option 1 - Install two deep wells Option 2 - Install three deep wells

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Option 3 - Install three shallow wells Option 4 - Install seven shallow wells Option 5 - Additional ground water sampling Option 6 - Additional surface water sampling Option 7 - Additional soil/sediment sampling Option 8 - Additional soil borings Option 9 - Treatability Plans Option 10 - Community Relations assistance Option 11 - Feasibility Study

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We recommend exercising Option 1 to install two deep wells at DDMT. Contamination has been identified in the water table aquifer at Dunn Field. However, the major concern is whether this contamination is penetrating the Jackson - Upper Claiborne confining units and affecting the Memphis Sand.

The Memphis Sand and the overlying water table aquifer are separated by approximately 110 feet of clay in the Allen field Low levels of contamination (below drinking water area. standards) have been detected in the Memphis Sand. The installation of two deep wells would allow a direct indication of the presence or absence of contamination of this aquifer, along with providing geologic information about the confining unit. One well each would be located on the downgradient side of the site in Dunn Field and in the main part of the installation. The wells would be drilled through the confining unit and into the Memphis Sand aquifer. To prevent vertical leakage from the water table aquifer into the Memphis Sand, Type III wells would be used instead of Type II wells.

4.0 DRILLING EQUIPMENT AND MATERIALS

4.1 DRILLING TECHNIQUES

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The DDMT soil borings will be installed utilizing hollow stem auger (HSA) drilling techniques. The monitoring wells at the site will be installed utilizing one of the following drilling techniques:

- Hollow Stem Auger (HSA)
- Wash Rotary (WR)

It is acknowledged that the Hollow Stem Auger technique is preferable for installation of the monitoring wells, and will be used if possible at DOMT. The drill rigs will install a minimum 7-inch diameter borehole in order to facilitate installation of 2-inch (ID) ground-water monitoring wells. For installation of deep wells a larger diameter boring will be drilled for installation of the surface casing and four inch well. The drill rig will have the capability to collect split spoon samples according to ASTM procedures. At a minimum, the rig will be equipped with a cathead operated, 140-pound hammer with a 30-inch Continuous sampling may be utilized at the discretion of draw. the Site Manager. Augers and drill rods will be free from oil and grease, and will be cleaned with steam prior to initiating drilling on each well. Toxic and/or contaminating substances will not be used during any part of the drilling, well development processes. All drilling activities and methods will be sufficient to prohibit the introduction of contaminants from one water bearing stratum to another via the well bore.

4.2 WELL CASING AND SCREEN MATERIALS

The nature of the geologic material and the location of the water bearing zone to be monitored will dictate the selection of the

appropriate monitoring well type. At DDMT, both Type II and Type III monitoring wells may be installed. The design and installation of these wells is discussed in Section 7.0. Figure 4-1 and 4-2 show Type II and Type III wells, respectively.

4.2.1 <u>Surface Casing</u>

All surface casing used in the construction of Type III wells will consist of minimum 8-inch PVC or steel metal pipe. No glue joints will be used in the surface casing. The pipe will be of sufficient strength to ensure structural integrity during the installation process.

4.2.2 <u>Well Casing (Riser)</u>

Well riser pipe will consist of new, threaded, flush-joint PVC pipe. For deep wells the riser will be of Schedule 80 and of 4 inches minimum inside diameter (ID). Risers for the shallow wells will consist of 2 inch minimum ID, Schedule 40 PVC pipe. The risers will conform to the requirements of ASTM-D 2241 for PVC pipe and will bear markings that will identify the material as that which is specified. No solvents or glue of any kind will be used in the well bore. Upon completion of the well, a vented PVC cap will be installed to prevent material from entering the well.

4.2.3 <u>Well Screen</u>

The well screen will consist of 15 to 20 feet of PVC material similar in specification to the well riser. The screen will be new, noncontaminating, commercially fabricated and of continuous wrap or mill slot, #10 slot size (0.010 inch). The screen will be placed in an appropriate location in the borehole to accommodate fluctuations in the water table.

75 69 FIGURE 4-1 TYPE II MONITORING WELL INSTALLATION DIAGRAM JOB NAME ____ LAW ENVIRONMENTAL, INC. WELL, NO.____ JOB NO_ GOVERNMENT SERVICES DIVISION DATE _ TIME_ KENNESAW, GEORGIA WELL LOCATION _ GROUND SURFACE ELEVATION ____ 8ENTONITE TYPE MANUFACTURER TOP OF SCREEN ELEVATION ____ CEMENT TYPE REFERENCE POINT ELEVATION ____ MANUFACTURER ___ GRADATION ____ BOREHOLE DIAMETER TYPE SAND PACK . SAND PACK MANUFACTURER____ SCREEN DIAMETER ______ SLOT SIZE___ SCREEN MATERIAL - LAW ENVIRONMENTAL, INC. MANUFACTURER _ FIELD REPRESENTATIVE RISER MATERIAL ___ DRILLING CONTRACTOR _ MANUFACTURER ___ - AMOUNT BENTONITE USED ____ RISER DIAMETER _ AMOUNT CEMENT USED _____ DRILLING TECHNIQUE - AMOUNT SAND USED _ BIT SIZE AND TYPE . STATIC WATER DEPTH (after dev.) AUGER SIZE AND TYPE ____ STRATUM DESCRIPTION _ STRATUM DEPTH PROTECTIVE POSTS (NOT TO SCALE) F-LOCKABLE COVER VENTED CAP -GROUND SURFACE --WELL PROTECTOR -STICKUP DIMENSIONS OF CONCRETE PAD TOTAL DEPTH OFWELL DEPTH TO TOP OF LENGTH OF BENTONITE SEAL SOLID RISEA DEPTH TO TOP OF GRANULAR MATERIAL RISER -STABILIZED WATER LEVEL____FEET LENGTH OF SOFTEEN -TOP OF CASING SCREEN MEASURED ON GROUT BENTONITE LENGTH OF TAIL CAP -GRANULAR BACKFILL PIPE _

QA / QC INSTALLED BY: ______ INSTALLATION OBSERVED BY: ______ DISCREPANCIES: ______

GOVERNMENT SERVICES DIVISION

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TYPE III MONITORING	
	WELL INSTALLATION DIAGRAM
LAW ENVIRONMENTAL, INC. GOVERNMENT SERVICES DIVISION KENNESAW, GEORGIA	WELL LOCATION TIME
TYPE SAND PACK	CEMENT TYPE
SCREEN MATERIAL	SCREEN DIAMETERSLOT SIZE LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE DRILLING CONTRACTOR AMOUNT BENTONITE USED
DRILLING TECHNIQUE (above casing)	
VENTED CAP	COVER (NOT TO SCAL
DIMENSIONS OF CONCRETE PAD DEPTH TO TOP OF BENTONITE SEAL	
DEPTH TO TOP OF GRANULAR MATERIAL RISER	STABILIZED WATE
SCREEN	LENGTH OF TAIL PIPE
QA / QC INSTALLED BY: DISCREPANCIES:	INSTALLATION OBSERVED BY:

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4.2.4 Sand Sump

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A 2-foot minimum length sand-sump constructed of PVC similar in specifications to the well riser will be placed below the base of the screen. The sand-sump will be installed only if the screen can be placed at the appropriate interval without the sand-sump penetrating through the aquitard. The bottom of the deepest screen or casing section will be sealed with a threaded PVC plug.

4.2.5 <u>Centralizers</u>

Depending upon the type of drilling technique and the well depth, centralizers may be necessary to maintain the well casing and screen in the center of the boring. Centralizers will only be installed on the solid riser pipe and not on the screen. When hollow stem augering is used centralizers will not be necessary.

4.3 SAND PACK FILTER

A continuous sand pack will be installed as a filter in the annulus between the boring well and the well screen. The sand pack will consist of clean, inert, non-carbonate materials. The sand pack will be placed from the bottom of the well to at least 2 feet above the top of the screen. A tremie pipe will be used, if appropriate, to place the sand pack in the well.

4.4 BENTONITE SEAL

A minimum 2 foot bentonite seal will be placed into the annular space between the riser and the boring wall at the top of the sand pack. The bentonite will be wetted and at least 30 minutes will be allowed to expire prior to grouting to allow for swelling of the bentonite pellets.

4.5 GROUT MIXTURE

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A non-shrinking, cement-bentonite grout mixture will be placed in the annular space between the well casing and boring from the top of the bentonite seal to the ground surface. The cement mixture will consist of Portland cement (ASTM--C150), and water added in the proportion of not more than 7 gallons per 94 pound bag of cement. Additionally, 3 percent by weight of bentonite powder will be added to the mixture to help reduce shrinkage.

4.6 DRILLING FLUIDS

4.6.1 <u>Water</u>

Clean, non-chlorinated potable water or formation water from the well being drilled is recommended in the SOW for use as a drilling fluid. However, the acquisition of non-chlorinated water is typically not feasible, and local water supplies containing chlorine are generally acceptable for use. A sample of the drilling water will be collected and analyzed according to approved protocols. Any proposed use and source of water will be approved by the Contracting Officer prior to use in drilling.

4.6.2 <u>Drilling Mud</u>

It is currently anticipated that the wells will be installed without the need for drilling mud. However, in the event that drilling mud is necessary, bentonite is the only approved drilling fluid additive. No organic additives will be used. Data on the bentonite will be provided including: brand name, manufacturer, manufacturer's address, product description, and mixing ratios.

4.7 <u>WELL COMPLETION DETAILS</u>

4.7.1 <u>Concrete Pad</u>

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A minimum 3 foot by 3 foot by 4 inch concrete pad will be installed around each of the monitoring wells at the site. The pads will consist of ready-mix concrete mixed in appropriate proportions (i.e. ready-mix and water). The pad will be sloped slightly from the well to the edges of the pad to facilitate surface run off. A 3 foot by 3 foot form will be constructed (out of 2x4 lumber) to pour the pad. The form may remain inplace. A survey marker shall be permanently placed in each pad.

4.7.2 Steel Security Cap

A round, or square, steel security cap will be installed over the PVC well stick-up. It is anticipated that the steel security cap will extend above the ground approximately 24 to 36 inches. The security cap will have a hinged locking cap feature. The diameter of the security cap will allow easy access to the PVC well stick-up and will be installed in the concrete pad. There will be no openings in the protective casing well below its top. Key-alike locks will be provided for each of the wells.

4.7.3 Protective Posts

Three protective posts consisting of nominal 2 inch diameter steel will be embedded into the concrete pad equally spaced around the well and to a sufficient height (30 - 36 inches) to protect the well pipe from being damaged.

4.7.4 Well Painting

The steel security cap and the protective posts will be painted with a bright, (yellow or orange) rust-inhibiting paint (i.e., Krylon, or equal).

4.7.5 <u>Well Identification</u>

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A permanent marking or tag will be affixed to the outer steel protective casing of each well. The well number, a U.S. Army Corps of Engineers identification, and the top of casing elevation will be identified on each tag.

4.7.6 Temporary Capping

Any well that is temporarily removed from service, or left incomplete during installation will be capped with a watertight cap and equipped with a "vandal proof" cover satisfying state or local regulations.

5.0 DRILLING PROCEDURES

5.1 INITIAL ACTIVITIES

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The drill rig head assembly, table, and tools will be steam cleaned prior to setting up on a sampling location. Prior to setting up the drilling rig on a boring location, written permission will be obtained from DDMT for approval of the drilling location. Drilling will only proceed in areas free of service lines. All drilling will proceed under strict compliance with the Safety Plan (Volume IV).

5.2 DRILLING PROCEDURES

Drilling with both hollow-stem augers and rotary wash methods may be required. Hollow-stem auger drilling is to be given first preference for both the soil test borings and the shallow monitoring wells (Type II Wells). Wash drilling may be required if hollow-stem augering does not provide a stable borehole for sampling or well installation. Rotary wash drilling will probably be required to install the Type III wells.

5.3 <u>SOIL BORING LOG</u>

A field soil boring log will be completed during the drilling operation. The log will record the following information:

- . Sample number and depth
- . Standard penetration test blow counts per six inch advance
- . Recovery
- . Unified Soil Classification, color, consistency or density, and moisture content
- . Depth of boring
- Boring refusal
- . Water table depth
- . Water losses, if applicable

- . Method of advancing boring
- Depth, thickness, identification and description of stratum changes
- . Depth interval sampled

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- . Depth at which hole diameter (bit size) changes
- . Depth and location of loss of circulation
- . Location of fractures, joints, faults, cavities or weathered zones.
- . Water-bearing strata
- . Static water level initially and after development
- . Elevations will be shown on final logs

Figure 5-1 shows the soil test boring field report that will be used at DDMT. Once the boring is completed, a well will be installed as soon as practical, but no later than within 24 hours. Measures will be taken to protect the integrity of the well during any interim periods. In the event that a boring should prove to be unusable for any reason, it will be grouted from the base to the land surface.

	S	OIL	ΤĒ	ST	вО	RIN	١G	RE	co	RD 09 83		
LAW ENVIRONMENTAL, INC. GOVERNMENT SERVICES DIVISION KENNESAW, GEORGIA				JOB NO JOB NAME DATE: WEATHER DRILLER HOURS DRILLING						GROUND SURFACE	BORING NO GROUND SURFACE ELEV HOURS MOVING	
DEPTH ⁻€ET)	STRATA DESCRIPTION	#	1	2	3	4	м	P I D	R E C	SOIL CLASSIFICATO AND REMARKS	N DEPTH (FEET)	
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1					-							
				—								
	G TERMINATED:									F ADVANCING BORING	DEPTH	
BORING REFUSAL:										то то		
CASING: SIZE LENGTH ROTARY DRILL: W/MUD: W/WATER TO												
	C INSTALLED BY: CHECK	ED B.	Y: _		I	DISC	REP	ANC	IES:			

6.0 DECONTAMINATION PROCEDURES

All drilling and sampling will be performed in a manner to minimize the unnecessary contact of contaminated soil with field personnel and equipment. Decontamination at DDMT has two primary goals: to prevent the spread of contamination to noncontaminated areas; and to prevent the cross contamination of samples used for chemical analysis. The decontamination of field personnel is discussed in Section 6.0 of the Safety Plan (DDMT Work Plan - Volume IV).

6.1 <u>DRILLING EQUIPMENT DECONTAMINATION</u>

The drill head assembly, table, and tools will be steam cleaned between each sampling location. Gross contamination adhering to the augers, drill head, or rig will be manually removed with a shovel or trowel. High-pressure steam will then be used to wash the drilling equipment. Wash/Rinse water will be allowed to infiltrate into the soil.

6.2 <u>SAMPLER DECONTAMINATION</u>

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A split spoon or a continuous CME sampler will be used to collect soil samples for chemical analysis. The split spoon will be decontaminated prior to collecting soil samples. The continuous decontaminated sampler will be between each boring. Decontamination will consist of a high-pressure steam wash or decontamination with alconox, nitric acid, methanol and deionized water as described in the Sampling/Analysis Plans (Work Plan -Volume III). Sampling utensils, such as mixing bowls, spatulas, and spoons will be similarly cleaned. Decontamination fluids will be allowed to infiltrate into the soil.

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7.0 WELL DESIGN AND INSTALLATION

7.1 MONITORING WELL DESIGN

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Type II and Type III water quality monitoring wells are shown in Figures 4-1 and 4-2, respectively. The Type II diagram will be completed for each shallow monitoring well and the Type III diagram will be completed for each deep monitoring well. Each well diagram will provide the following data:

- total well depth
- depth of well screen
- depth to top of sand pack
- depth of surface casing (Type III well only)
- thickness of bentonite seal
- depth to base of grout seal
- water table elevation
- well stick-up
- screen length, location, diameter, slot sizes
- date installed
- quantity and type of materials installed
- manufacturer of materials installed
- professional in charge of well installation
- any sealing-off of a water-bearing stata

7.2 MONITORING WELL INSTALLATION

Installation of the well casing and screen can differ slightly depending upon the drilling technique utilized in advancing the boring. The following sections discuss well installation using either a Hollow Stem Auger (HSA) technique or Mud Rotary (MR) techniques.

7.2.1 <u>Hollow Stem Auger Technique</u>

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When a boring is advanced using Hollow Stem Augers, the following protocol will be followed to install the well casing and screen in the shallow wells.

- install the 2-inch PVC screen, riser and 2 foot sump through the hollow stem augers with enough riser pipe to extend the well casing about 2 feet above the ground surface.
- install artificial sand pack through the annular opening.
 Water in small amounts may be used to prevent bridging of the sand in the annulus.
- remove hollow stem augers incrementally as the annulus space fills with sand.
- continue installing sand pack until at least 2 feet above the top of the well screen.
- install a minimum 2-foot bentonite seal (allowing 30 minutes swell time).
- remove hollow stem augers from boring.
- grout boring annulus to land surface with grout/bentonite mixture. Install steel security cap, concrete pad and posts.
 The grout will be allowed to set a minimum of 48 hours before developing the well.

7.2.2 <u>Mud Rotary Technique</u>

When a boring is advanced using Mud Rotary Technique, the following protocol will be followed to install the well casing and screen in the shallow wells.

- after termination of boring, all drilling rods will be removed.

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- install the 2-inch PVC screen, riser and 2 foot sump with enough riser pipe to extend about 2 feet above the ground surface. Centralizers may be necessary to center the pipe in the borehole.
- remove the mud cake from the boring wall by pumping potable water through the well casing and screen.
- install the sand pack with a tremie pipe from the bottom of the boring until at least 2 feet above the top of the well screen.
- install minimum 2-foot bentonite seal.

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 grout boring annulus to ground surface with grout/bentonite mixture. Install steel security cap, concrete pad and posts. The grout shall be allowed to set a minimum of 48 hours before developing the well.

8.0 MONITORING WELL DEVELOPMENT

The development of the wells will be performed as soon as practical after well installation, but no sooner than 48 hours after placement of the internal grout collar. Development protocol will be as follows:

- a. measure static water level in well
- b. measure total well depth

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- c. record start time of development
- d. remove formation water using compressed air technique, by pumping and/or surging, without the use of acids, dispersing agents, or explosives
- collect water sample initially, as necessary during development and at the end of development, and perform field measurement of specific conductance, pH and temperature
- f. development will continue for 4 hours or until specific conductance, pH and turbidity are constant and the water produced is relatively free of turbidity
- g. denote physical characteristics of water throughout well development (color, odor, turbidity, etc.)
- h. record completion time of development
- i. record the total quantity of water removed
- j. record any problems or unusual occurrences
- k. measure static water level
- 1. measure total well depth.

Well development will continue for 4 hours and until the following conditions are met: well water is reasonably clear; sediment thickness remaining in the well is less than 5 percent of the saturated screen length; and, at least 5 well volumes (including saturated annulus sand pack, 30% porosity) have been removed. After final development of the well a one liter sample of water from the well will be collected in a clear glass jar and labeled. The sample will be photographed with a 35 mm color slide and submitted as part of the well log. Well development data will be recorded on a form similar to Figure 8-1.

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	WELL D			A		
	RI/FS AT DE	FENSE DEPOT	MEMPHIS	, TN		
LAM	ENVIRONMENTALINC. JOB N	NAME		JOB NO.		
	DATE					
		DEVELOPMENT		·		·
1,	Well No.					
2.	Date of Installation:					
3.	Date of Development:	<u> </u>				
4.	Static Water Level: Before Dev.		<u>ft</u> .; 24	ours After		
5.	Quantity of Water Loss During Dr	rilling, If Used			Gal.	
6.	Quantity of Standing Water in We					Gal
-	Septific Conductores Instant	Start	Du	ring	End	
7.	Specific Conductance (umbos/cm)			·		
	Temperature (c°)			• •		
	PH (s.u.)					
8.	Depth From Top of Well Casing to				<u>ft</u> ,	
9.	<u> </u>					
	Depth to Top of Sediment: Befor	re Dev		t.; After De	v	<u></u>
11.	Physical Character of Water:	<u> </u>	· · ·		<u>-</u>	
				- ·		
12.	Type and Size of Well Developmen	nt Equipment:			•	
			<u> </u>		<u> </u>	
13.	Description of Surge Technique,	If Used:				
			<u> </u>			
14.	Height of Well Casing Above Grou	-			<u>ft.</u>	
15.	Quantity of Water Removed:		Gai	<u>.</u>		
	Time for Removal:		Hr./Min.			
16.	1-Pint Water Sample Collected:			(Time)		
	2) Se	ell Water if Reas diment Thickne emoval of 5 Well	ss < 5% of S	Screen Lenoth	1	C: /s
-	4) St	abilization of Speedule				-1166

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9.0 IN-SITU HYDRAULIC CONDUCTIVITY

A hydraulic conductivity test will be performed on each well after well development. The in-situ hydraulic conductivity tests which will be performed at this site are known as the "slug in" and "slug out" tests. The "slug in" test involves inserting a slug (solid PVC rod) into the water column in the well to raise the water level. The recovery back down to static water level is recorded over time. The slug is removed for the "slug out" test and the recovery back up to static water level is recorded over time. Test results will be measured using an electronic hydrologic monitoring device.

The data are then plotted on semi-logarithmic paper. The following formula is utilized to calculate hydraulic conductivity (X):

	r ₂ rc	ln(R _e /r _w)	1	lnY _O
K =		2L _e	 t	Yt.

Where r - well radius

- R_e effective radial distance over which the head difference is dissipated
- r_w radial distance between well center and undisturbed aquifer
- L_e height of saturated screen

yo - water level y at time zero

yt - water level y at time t

t - time since yo

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This formula is taken from Bower, H. and R.C. Rice, <u>A Slug</u> <u>Test for Determining Hydraulic Conductivity of Unconfined</u> <u>Aquifers with Completely or Partially Penetrating Wells</u>, Water Resources Research, Vol. 12, No. 3, June 1976, and is essentially the same as the formula referenced in Section 10.3 of the SOW.

The test conditions and measurements will be recorded on a form similar to Figure 9-1. The raw test data of time and well recovery will be field plotted to identify anomalous readings. The formation permeability will be computed using appropriate predictive equations.

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FIGURE 9-1 IN-SITU HYDRAULIC CONDUCTIVITY TEST

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1.	Well Number:	
2.	Type of Test:	Slug In Slug Out
3,	Well Constants:	Boring Diameter (r _w) Casing Diameter (r _c) Well Depth (feet) Static Water Level (feet) Saturated Screen Length (feet)

4. Test Data

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<u>Point No.</u>	<u>Time (t)</u>	<u>Hydraulic Head (h)</u>
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2		
	<u> </u>	<u> </u>
3	<u> </u>	<u> </u>
4	<u></u>	
5		
6		
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REMARKS:

10.0 PROJECT ASSIGNMENTS AND RESPONSIBILITY

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A geologist or engineer, shall be present at each operating drill rig and be responsible for the logging of samples, monitoring of drilling operations, recording of water losses/gains and groundwater data, preparing the boring logs and well diagrams, and recording the well installation procedures of each rig. Each geologist, or engineer, will have on-site QA/QC and safety responsibility and will have a copy of the Safety Program Plan and Soil Boring and Well Installation Plan. The geologist/engineer will report directly to the Site Manager.

The Site Manager for DDMT will be Mr. Robert Manson. He is a professionally registered geologist with over 10 years experience. Mr. Manson will report directly to the Project Manager regarding field work and safety at DDMT.

DDMT WORK PLAN - VOLUME III

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FINAL SAMPLING AND ANALYSIS PLAN

For

REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)

At

DEFENSE DEPOT MEMPHIS, TENNESSEE (DDMT) CONTRACT NO. DACA87-88-C-0092

Prepared for:

U.S. Army Corps of Engineers Huntsville Division P. O. Box 1600 Huntsville, Alabama 35807

Prepared by:

Law Environmental, Incorporated Government Services Division 112 TownPark Drive Kennesaw, Georgia 30144-5599

January 1989

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TABLE OF CONTENTS

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- I - 1 - 1

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بالموسات والمتحاصين

				<u>Page</u>
1.0	INTR	ODUCTION		1-1
	1.1	Site Toxic and	d Hazardous Substances	1-1
2.0	PROJ	ECT ORGANIZATI	ON AND RESPONSIBILITY	2-1
	2.1	Project Organ	ization	2-1
		2.1.1 Law En 2.1.2 Interna	vironmental, Inc. ational Technology Corp.	2-1 2-1
	2.3	Key Individual Project QA Res Analytical Lab		2-3 2-6 2-8
		and Per	tory Organization rsonnel ties and Equipment	2-8 2-8
3.0	SAMP	LING		3-1
	3.1	Selection of S	Sampling Locations	3-1
		3.1.3 Monitor 3.1.4 Surface 3.1.5 Surface	est Boring Locations ring Well Locations a Soil Sample Locations	3-1 3-1 3-3 3-3 3-3 3-3 3-4
	3.2	Samples to be	Collected	3-4
		3.2.2 Ground	ediment Samples Water Samples Water Samples Dies	3-4 3-5 3-5 3-5
	3.3	Sample Collect	ion Methods	3-7
		3.3.1 Ground	Water Samples	3-7
		3.3.1.1 3.3.1.2	. Sampling Equipment 2 Sampling Protocol	3-7 3-8
		3.3.2 Soil Sa 3.3.3 Sedimer		3-9 3-12
	3.4 3.5	Sample Contain Sample Preserv		3-13 3-15

		 0	
	3.6 Sa	ample Identification	3-15
	3.7 T	ransportation and Chain-of-Custody	3-16
	3	.7.1 Chain of Custody Records	3-16
	3	.7.2 Custody Seals	3-18
	3	.7.3 Laboratory Custody	3-18
4.0	ANALYSI	ES	4-1
		arameters	4-1
		nalytical Methods	4-1
	4.3 La	aboratory QC/QA	4-1
5.0	DATA AN	NALYSIS AND REPORTING	5-1
6.0	PROGRAM	CONTROLS	6-1
	6.1 Ca	alibration Procedures and Frequency	6-1
		nternal QC Checks	6-1
		reventative Maintenance	6-1
	6.4 E)	sternal Certification	6-1

APPENDIX A - Resumes of Key Individuals APPENDIX B - Anticipated Method Detection Limits

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LIST OF FIGURES AND TABLES

•1

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]

FIGURES

<u>Figure</u>	<u>Title</u>	<u>Page</u>
2-1	Project Organization and Responsibilities	2-2
2-2	Project Relationship of Corporate Organization and QA Responsibilities	2-7
2-3	ITAS Organization	2-9
3-1	Sampling Locations	3-2
3-2	Law Field Sampling Report Form	3-10

TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
2-1	Certifications - ITAS-Knoxville	2-4
2-2	Laboratory Equipment - ITAS Knoxville	2-12
3-1	Required Quality Control/Quality Assurance Samples	3-6
3-2	Sample Containers, Preservatives and Holding Times	3-14
4-1	Ground Water and Surface Water Samples - Required Analysis and Approved EPA Methods	4-2
4-2	Soil and Sediment Samples - Required Analysis and Approved EPA Methods	4-3
4-3	Approved Analytical Methods	4-4

1.0 INTRODUCTION

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of this project is to perform a CERCLA Remedial The purpose Investigation/Feasibility Study (RI/FS) at Defense Depot Memphis. Tennessee (DDMT). It has been shown or is strongly suspected that contaminants of concern have been released to the environment at this site. The objectives of this RI/FS are: (1) to determine the presence or absence of environmental contamination at DDMT; to determine the extent and (2) potential for migration of those contaminants detected; (3) to identify public health and environmental concerns; and (4) to recommend appropriate remedial actions. The RI serves as the collection mechanism for site and waste characterization, data and for conducting treatability testing as necessary to evaluate the performance and cost of the treatment technologies and support the design of selected remedies. The FS provides for the screening, development and detailed evaluation of potential remedial alternatives.

This project will be performed in accordance with the US Army Corps of Engineer (USACE) Scope of Work dated June 28, 1988, and the U. S. Environmental Protection Agency's (USEPA's) Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. Law Environmental, Inc., Government Services Division (LEGS) will perform the data collection and analyses in order to evaluate the extent of constituent release at each of the sites based on the directed sampling program, and will compile, evaluate and report the results of the evaluation to the USACE in accordance with the guidance provided in the above mentioned documents.

1.1 SITE TOXIC AND HAZARDOUS SUBSTANCES

Based on prior investigations, the chemicals which have been detected in samples from the study sites at DDMT include the following groups and specific chemicals:

VOLATILE ORGANICS:

1,1-Dichloroethylene Trichloroethylene Trans-1,2-Dichloroethylene Tetrachloroethylene Chloroform 1,1,2,2-Tetrachloroethane 1,1,2-Trichloroethane Methylbromide

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METALS:

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Manganese

HERBICIDES

PESTICIDES/POLYCHLORINATED BIPHENYLS

PENTACHLOROPHENOL (with DIOXIN and FURAN)

MUSTARD GAS (THIODIGLYCOL)

LEWISITE (CHLOROVINYLARSINE DICHLORIDE)

OIL, GREASE & PAINT THINNER

METHYLENE CHLORIDE

This Sampling/Analysis and QA/QC Plan has been designed to monitor site media for these constituents. The purpose of this Plan is to provide protocols for all Sampling/Analysis and QA/QC regarding the DDMT RI/FS. The Plan covers project organization and responsibility, sampling, and analysis. It is Volume III of the DDMT Work Plan.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

2.1 PROJECT ORGANIZATION

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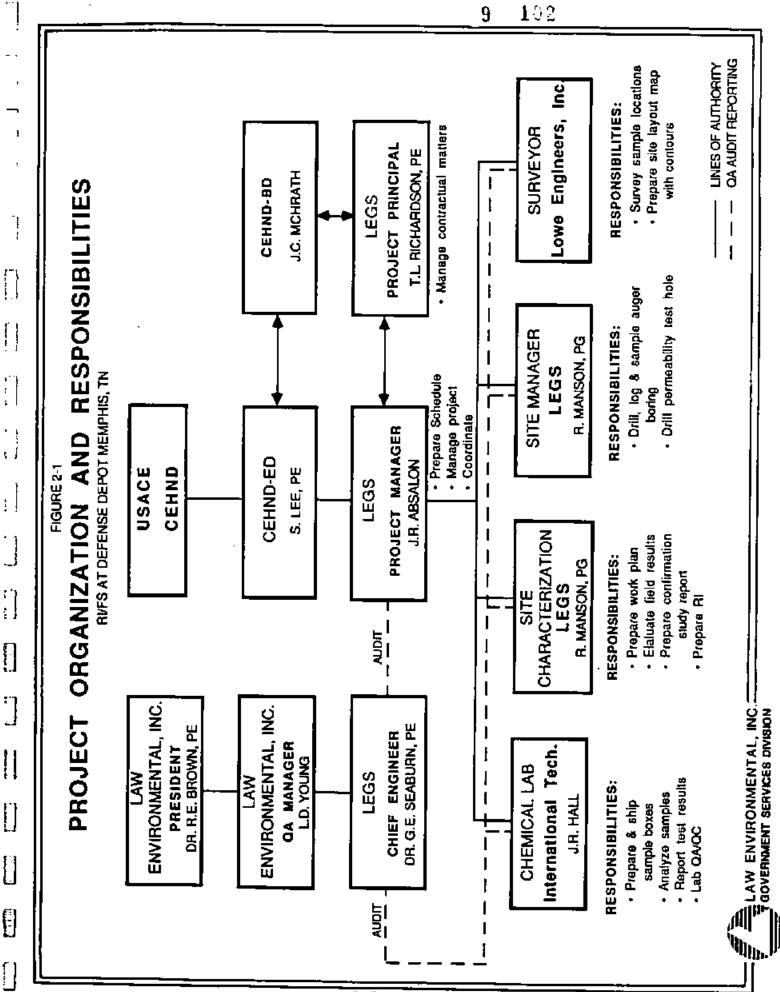
The work activities for this project will be organized into four primary work areas: drilling and sampling, surveying, chemical analysis, and site assessment (Figure 2-1). LEGS will perform the drilling and sampling, and site assessment activities. LEGS has subcontracted with International Technology Corporation to perform the chemical analysis of the soil and water samples. A local surveying firm will be selected to survey the monitoring well and soil boring locations and prepare a site map. The Remedial Investigation Report (RI) and a Feasibility Study Report (FS) will be prepared by LEGS.

2.1.1 <u>Law Environmental, Inc.</u>

LEGS will provide the project management, engineering and analysis, and drilling and sampling through its in-house resources. Law Engineering, our parent company, was founded in 1946 as an Atlanta chemical testing laboratory, which then evolved into geotechnical and construction materials testing. Law has an excellent reputation in these basic engineering and testing areas. Law Engineering added environmental testing and analysis to its expertise in 1976. Law Environmental, Inc. became a wholly owned subsidiary of Law Engineering on January 1, 1987. LEGS will manage all of the field, laboratory, and office work related to the DDMT RI/FS.

2.1.2 International Technology Corporation

International Technology (IT) is a full service laboratory plus a high hazard limited access facility located in Knoxville, Tennessee. The high hazard facility is operated for the analysis of extremely hazardous components such as dioxins and dibenzofurans. Specialties include: EPA Contract Laboratory Program (CLP) projects, analyses for dioxin/dibenzofurans and



PCBs, metals, and hazardous waste incineration by products and mixed waste analyses. A list of ITs certifications can be found in Table 2-1. International Technology will be responsible for providing sample shipping containers, chain of custody documents, chemical analysis, report generation and laboratory quality assurance/quality control (QA/QC). IT will report directly to the Project Manager during all phases of the project.

All laboratory work is performed in accordance with approved USEPA, American Society for Testing and Materials and/or US Army protocols. In addition, QA/QC programs are maintained for both instruments and analytical procedures.

2.2 KEY INDIVIDUALS

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Key project participants for the site investigation include the project manager, project principal, site manager, project chemist, health and safety officer, laboratory manager, and the field work parties. Described in the following paragraphs are the proposed project assignments and responsibilities, a list of individuals expected to serve in each capacity, and a brief synopsis of the participants related experience. Detailed resumes of the key individuals are presented in Appendix A.

PROJECT MANAGER - Is responsible for overall management of the DDMT investigation. Coordinates between office and field personnel, manages administrative requirements, schedules, technical approach, implementation, and report preparation. Mr. John R. Absalon will serve as the Project Manager. He is a registered Professional Geologist in nine states, including Tennessee, with approximately 16 years experience in project management and hazardous waste site investigations. With LEGS, Mr. Absalon is a Senior Geologist.

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TABLE 2-1

CERTIFICATIONS ITAS - KNOXVILLE

National Approvals/Accreditations

American Industrial Hygiene Association American Association for Laboratory Accreditation

State Certifications

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California Department of Health Services Florida Department of Health and Rehabilitative Services South Carolina Department of Health and Environmental Control New York State Department of Health North Carolina Department of Public Health Tennessee Department of Public Health Utah Department of Health

Qualified by/Suitability Status by

New Jersey Superfund Program New York State Superfund Program U.S. Environmental Protection Agency Contract Lab Program (Organics, Inorganics, Dioxins) Minnesota Superfund Program Virginia Superfund Program Tennessee Superfund Program National Bureau of Standards U.S. Army Corps of Engineers, Waterways Experiment Station U.S. Army Corps of Engineers, Huntsville, Alabama Tennessee Valley Authority

<u>Memberships</u>

American Council of Independent Laboratories American Society for Testing and Materials PROJECT PRINCIPAL - Provides technical quality control, oversight and direction for all aspects of the site investigation and data evaluation. He serves as the senior reviewer of the engineering reports on the DDMT investigation. Mr. Thomas L. Richardson will serve in this capacity. He is a registered Professional Engineer in Tennessee with 15 years experience in geotechnical engineering and hazardous waste investigation. Mr. Richardson reports to the Chief Engineer of Law Environmental's Government Services Division, Dr. Gerald E. Seaburn.

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- SITE MANAGER Is responsible for implementation of Safety Program Plan, Soil Boring and Monitoring Well Installation Plan, and this Sampling and Analysis Plan during the field investigation phase. He reports directly to the Project Manager. Mr. Robert Manson will serve as the Site Manager for the investigation. Mr. Manson is a Professional Geologist with eleven years of experience as a Professional Geologist and three years of experience as a hydrogeologist.
- PROJECT CHEMIST Is responsible for preparing and implementing the field sampling, preservation, chain-ofcustody, and shipping activities. Mr. Vincent Tersegno is a chemist with five years experience in hazardous materials handling programs with LEGS. He has experience on RCRA and Superfund sites throughout the country. Specific experience includes preparation of sampling plans and coordination of sampling activities for several USACE site assessments.
 - HEALTH AND SAFETY OFFICER Oversees the Safety Program Plan for DDMT. He conducts personnel training, administers company hazard assessment and surveillance medical program, and coordinates with Site Manager for site safety. He is available for consultation during the actual investigation. Dr. Jack Peng is the Law Environmental Safety Officer. He is a registered Professional Engineer and a certified

Industrial Hygienist. Dr. Peng has approximately 13 years experience in hazardous waste investigations.

- LABORATORY PROJECT MANAGER Is responsible for handling and analysis of water and soil samples received by the laboratory. This person also oversees sample travel through the lab, analytical procedures, quality control, reporting and sample disposal. Ms. Robyn M. Wagner is the Project Manager for this project. She is a biologist with over 9 years of technical and laboratory experience.
- WORK PARTY Performs on-site tasks contained in this plan, including the soil borings, surveying and monitoring well installation under the direction of the Field Manager. The work parties include drilling crews and the surveying team.

2.3 PROJECT OA RESPONSIBILITIES

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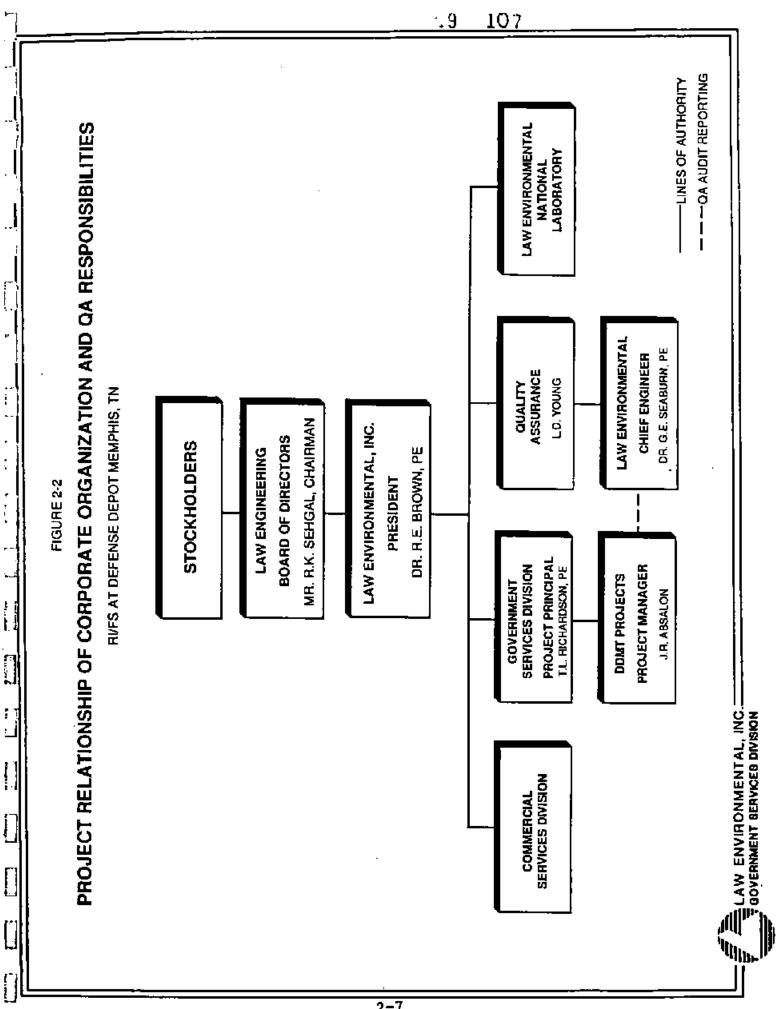
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Law Environmental, Inc. has established a strong internal QA program with an associated QA manual, engineering procedures manual, equipment calibration procedures manual, and specialty manuals for hazardous waste site investigations and software documentation. Law Environmental employees use these manuals as the basis for conducting all company work within the QA program.

Dr. R.E. Brown is the President of Law Environmental, Inc. Dr. Brown is ultimately responsible for Corporate QA. The Corporate QA Office is managed by Mr. Larry Young, who is responsible for daily management and auditing Law Environmental's QA Program (Figure 2-2). Each Law Environmental branch office and subsidiary has a Chief Engineer and/or Scientist, who is the primary QA officer of that group. Dr. Gerald Seaburn is the Chief Engineer for this project. Thus the Law Environmental lines of QA responsibility and audit flow from Corporate QA (Dr. Brown and Mr. Young) through Dr. Gerald Seaburn to the Division level (Mr. Richardson) where project level audits occur. This line of QA is outside of the operational lines of authority.



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2.4 ANALYTICAL LABORATORY QUALIFICATIONS

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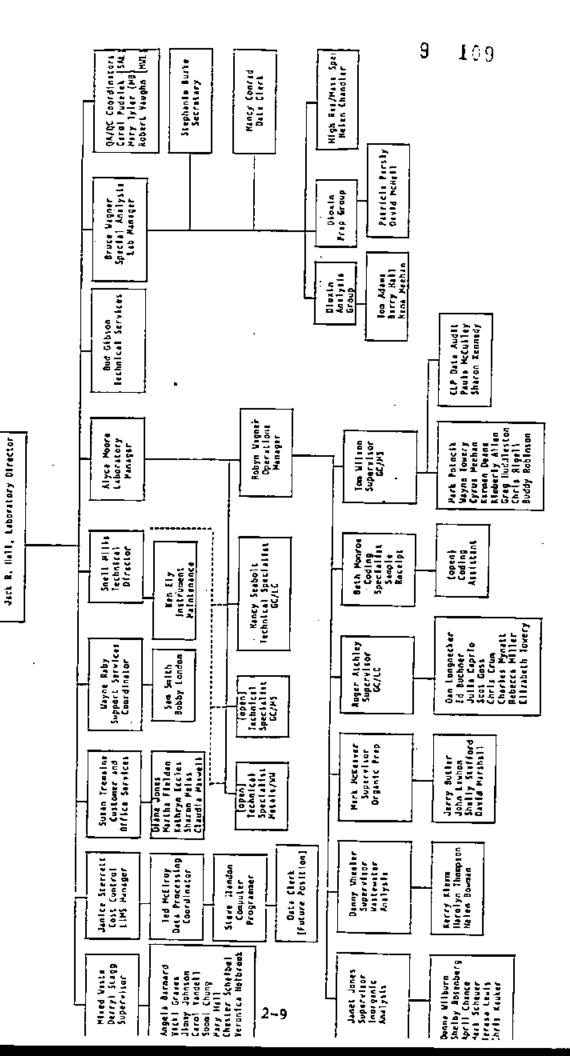
IT was selected by LEGS to perform the chemical analysis on the field samples. The IT laboratory in Knoxville was founded in 1962 to provide high quality, fully documented analytical data for industry. Quality assurance and quality control were built into the design of the laboratory and its operations. IT's comprehensive technical reports, with their fully integrated QA data, demonstrate the laboratory's commitment to provide credible and defensible data.

2.4.1 Laboratory Organization and Personnel

The overall organization of IT is shown in Figure 2-3. Specific personnel have been identified who are responsible for implementing the QA aspects of this project. IT designed this management organization and its management systems based on the many years of experience of the principals in the commercial laboratory business and believes it is the best system for efficiently managing the analysis of large volumes of samples the same time, maintaining high quality while. at and responsiveness to the specialized needs of individual clients. The elements of the overall IT management structure are presented in Appendix A.

2.4.2 Facilities and Equipment

IT Analytical Services (ITAS) consists of ten laboratories with a total area of over 130,000 square feet, including more than 90,000 feet of multi-functional, diversified laboratory work space. These laboratories employ the latest state-of-the-art designs in independent controls and operational isolation. They are zoned to provide safeguards against cross-contamination and arranged by work function to increase the efficiency of analytical operations. Since work functions or projects may vary, the laboratory areas are designed for flexibility. Several aspects of the laboratories worth noting are:



DAGANIZALIDNAL CHART II Analyticat Services - Knarvilla

FIGURE 2-3

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- Large sample storage areas with isolation, refrigeration, and storage
- . Isolated chemical and standard storage areas
- . Large dedicated sample preparation areas
- . Separate instrumentation areas

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 Diversity of available hood systems to meet a variety of project needs

A key portion of the IT Special Analysis Laboratory is a limited access laboratory located in Knoxville, Tennessee, designed and equipped to provide total containment and isolation of hazardous materials to protect the laboratory

ITAS laboratories are fully equipped with manual and automated state-of-the-art instrumentation. The addition of autosamplers and data integrators to the majority of our instrumentation has enhanced our laboratory capacity while maintaining cost controls.

Instrumentation includes gas chromatograph/mass spectrometers and gas chromatographs with a wide range of detectors for the determination of trace organics, graphite furnace and hydride generator atomic absorption spectrophotometers and inductively coupled argon plasma spectrometers for the analysis of trace metals and additional instrumentation for wet chemical applications.

Instruments are calibrated prior to the analysis of each set of samples. In addition, routine maintenance is scheduled and performed by on-site instrument repair specialists. The ITAS program for calibration and maintenance is designed and implemented to ensure compliance with applicable EPA, NRC, and NQ-1 guidelines.

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The total number of key instruments currently at the IT Knoxville laboratory is shown in the instrument summary presented as Table 2-2.

New instrumentation and equipment are regularly reviewed for consideration to achieve new analytical capabilities, improve precision and accuracy of current techniques, and reduce analytical costs while maintaining or improving quality.

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Each IT laboratory utilizes state-of-the-art information management systems and analytical instrumentation for sample tracking, scheduling and reporting. These systems utilize both commercially available and customized software. They are used to track the course of a sample through the laboratory, from sample receipt to analysis to final report to archiving. The information systems in the individual IT laboratories are electronically linked to each other, to field stations and to central management.

In addition to laboratory reports consisting of Certificates of Analysis and/or EPA CLP data packages, IT Analytical Services has the capability of producing custom report summaries in clientspecified formats. These reports can be delivered hard-copied and bound or in computer formats such as ASCII text, Dbase, or Lotus 123 files on floppy diskettes.

Analytical test results from GC, HPLC, GC/MS, AA, ICAP, IC, or Wet Chemistry are produced using a variety of instrumentation. Data from these analyses can be combined with the project/sample information in a relational database to provide sample/analysis data in a highly flexible format. ITAS can couple the database containing field and lab data with an assortment of proprietary and off-the-shelf software to perform statistical and trend analyses, to generate detailed graphical presentations of the data, and for sophisticated modeling and predictive analyses.

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MANUFACTURER/MODEL

TABLE 2-2

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LABORATORY EQUIPMENT 1TAS - KNOXVILLE (MIDDLEBROOK PIKE LAB)

INSTRUMENT/EQUIPMENT

Α. <u>Metals</u> 2 AA/Emission Spectrophotometers Instrumentation Labs/Model 151 AA/Emission Spectrophotometer Instrumentation Labs/Model 951 AA/Emission Spectrophotometer Thermal Jarrell Ash/Video 12E Atomic Vapor Accessory Instrumentation Labs/Model 440 Autosampler (for AA) Instrumentation Labs/Plasma 254 Graphite Furnace Atomizer Instrumentation Labs/Model 655 Graphite Furnace Atomizer Thermal Jarrell Ash/188 ICAP Emission Spectrometer Thermal Jarrell Ash/1100 ₿. <u>Inorganics and Wet Chemistry</u> Total Organic Carbon Analyzer **OI/Model** 7000 TOC Autosampler 01/Model 168-402 Ultraviolet Visible Spectrometer Perkin-Elmer/Model 552 2 Sonicators Tekmar/Model 500 С. Chromatography Gas Chromatograph Perkin-Elmer/Sigma 28 Gas Chromatograph Varian/Model 3740 Dual EC Gas Chromatograph VG/Model Trio-2 Gas Chromatograph Perkin-Elmer/Sigma 3 2 Gas Chromatographs Tracor/Model 222 2 Gas Chromatographs Tracor/Model T-560 2 Gas Chromatographs Tracor/Model T-565 2 Gas Chromatographs Varian/Model 3700 2 Gas Chromatograph Data Stations Perkin-Elmer/Sigma 15 Autosampler (GC) Perkin-Elmer/Model AS100B 2 Autosamplers (GC) Tracor/Model 770 6 Autosamplers (GC) Varian/Autosampler Aerographs 8000 2 Intergrators (GC) Perkin-Elmer/LCI-100 3 Purge & Traps Tekmar/LSC-2 High Performance Liquid Chromatograph Perkin-Elmer/Series 4-10 High Performance Liquid Chromatograph Perkin-Elmer/Series 3-B Ion Chromatograph Dionex/Model 2000i Integrator (IC) Dionex/Model 4270

TABLE 2-2

LABORATORY EQUIPMENT ITAS - KNOXVILLE (MIDDLEBROOK PIKE LAB)

(Continued)

INSTRUMENT/EQUIPMENT

MANUFACTURER/MODEL

D. Mass Spectrometry

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2 Gas Chromatograph-Mass Spectrometers/ DS Gas Chromatograph-Mass Spectrometer/	Finnigan/4000
DS 3 Gas Chromatograph Hass Spectrometers/	Finnigan/4500
DS	Finnigan/OWA 20/30
3 Autosamplers (VOA) Dynamic Headspace Analyzer,	Tekmar/ALS
Goncentrator	Tekmar/4000, 4100
<u>Computer Equipment</u>	
Laboratory Computer	Perkin-Elmer/7500 Professional Computer
Laboratory Computer	Perkin-Elmer/Model 3600
Laboratory Computer	Perkin-Elmer/3230
22 CRTs	Perkin-Elmer
4 Personal Computer	IBM/AT
Color Graphic Terminal	Perkin-Elmer
7 Dot-Matrix Printers	Perkin-Elmer
2 Letter-Quality Printers	Perkin-Elmer
Color Plotter	Perkin-Elmer

The ITAS laboratory data management systems assure confidentiality of the client and all data collected and allows rapid access to sample status at client or management request. These systems provide more efficient sample tracking while minimizing sample turnaround and assuring data integrity.

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3.0 SAMPLING

The objective of the DDMT field investigation is to determine the nature and extent of soil and groundwater contamination resulting from past operations at the facility. LEGS will then determine the potential risks to public health and the environment due to any constituent release and recommend appropriate remedial actions. To accomplish these objectives LEGS will collect representative samples of the site media for analysis.

3.1 SELECTION OF SAMPLING LOCATIONS

3.1.1 Introduction

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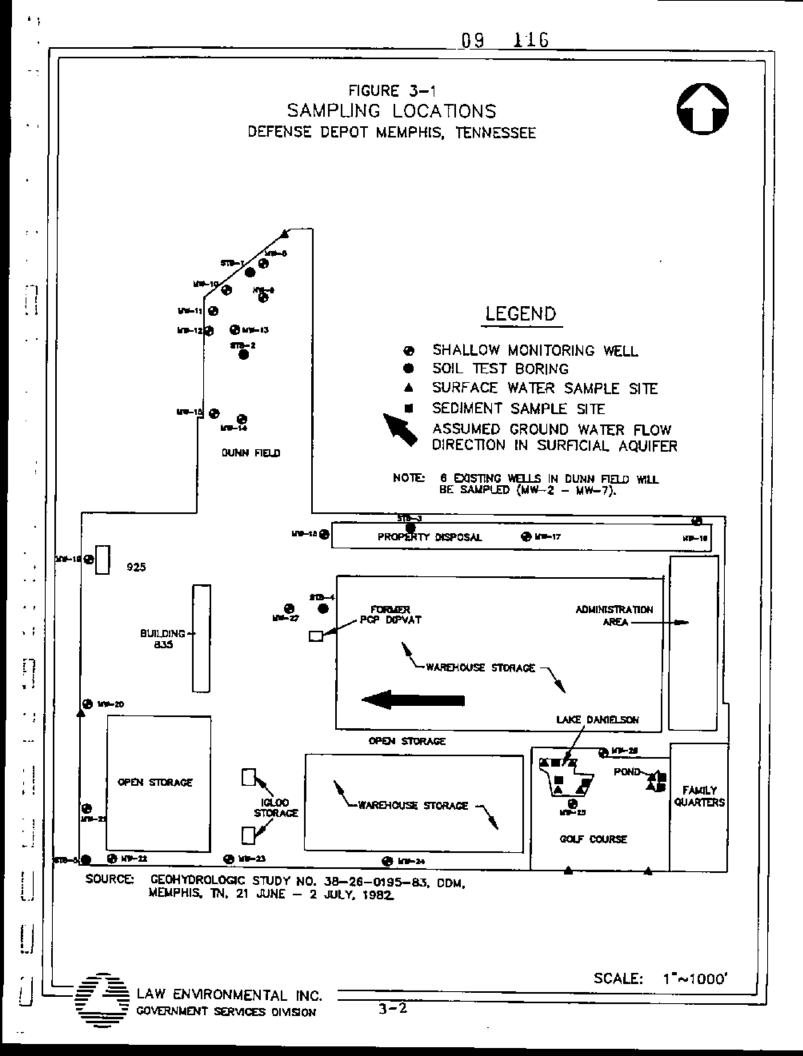
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Samples for chemical analysis at DDMT will include ground water, surface water, sediments, surface soils, and soils at depth. To accomplish the goals of the field investigation, extensive research on the part of the project team has gone into the selection of the sampling locations. The following sections discuss the rationale for the selection of specific sampling locations as well as figures depicting the proposed sampling locations. Additional discussion on this subject can be found in the Soil Boring and Monitoring Well Installation Plan Vol. II.

3.1.2 Soil Test Boring Locations

The purpose of the soil test borings will be to characterize the subsurface geology and to collect soil samples for chemical analysis. The soil test borings have been located to optimize both objectives. Figure 3-1 shows the proposed sampling locations for the main installation and Dunn Field. As shown on the figure the five borings form a north-south transect of the entire site. Two borings will be on the main part of the installation and three will be in Dunn Field. These locations will provide chemical samples and geologic data for the installation.



3.1.3 Monitoring Well Locations

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A total of six ground water monitoring wells currently exist in the Dunn Field Area. These wells will be utilized in the LEGS sampling effort. As specified in the Scope of Work an additional 20 wells will be drilled. Twelve wells are proposed for the main installation and eight wells at Dunn Field. The proposed locations are shown in Figure 3-1. These locations have been selected based upon reviews of background data regarding geology, geohydrology, and past waste management practices at DDMT. Each location is near a potential waste source or is downgradient of waste sources.

3.1.4 <u>Surface Soil Sample Locations</u>

A total of 40 shallow (less than 18 inches in depth) surface soil samples will be collected by the LEGS staff. Past waste management practices and hazardous materials handling locations will be the guiding factors in choosing locations for the samples (Figure 3-1). The following table lists areas where samples will be obtained.

- Dunn Field Area
- Property Disposal Area
- PCP Dipvat Area
- Open Storage Area
- Lake Danielson/Pond Area
- Format Recoupment Area.
- Paint Shop/Sand Blast Area

The exact locations of the sample points will be determined in the field by the Field Manager based upon visual inspection of the area and using best engineering judgment.

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3.1.5 <u>Surface Water Sample Locations</u>

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A total of ten surface water samples will be collected during this investigation. In an investigation such as this, surface water sample sites are influenced strongly by the relatively small amount of surface water present. Surface water is sampled where it is found (Figure 3-1). Lake Danielson which has experienced two documented fish kills possibly due to pesticide use, will be looked at closely. The following lists the samples by area and number:

-	Lake Danielson	4	samples
-	Golf course pond	2	samples
-	South perimeter	2	samples
-	West perimeter	1	sample

- North perimeter 1 sample

3.1.6 Sediment Sample Locations

A total of ten sediment samples will be collected from five locations at DDMT. Sediment samples will be concentrated in the golf course area because of past pesticide use practices (Figure 3-1). Each location will generate two samples; one from the sediment surface and a second from the nine inch depth. Three separate locations will be from Lake Danielson and two separate locations will be from the adjacent small pond.

3.2 <u>SAMPLES TO BE COLLECTED</u>

LEGS intends to collect twenty-six groundwater samples, ten surface water samples, ten sediment samples and fifty-five soil samples at the DDMT. In addition field control samples (i.e., duplicate samples, split samples, trip blanks and equipment blanks) will be collected. The breakdown of samples by sample type, sample location and analyte to be analyzed for is discussed in the following sections. 3.2.1 Soil/Sediment Samples

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A total of 55 soil samples will be obtained from DDMT consisting of 15 soil samples collected from the five stratigraphic test borings and 40 shallow soil samples collected from various locations around the installation (Figure 3-1). No shallow soil sample shall exceed 18 inches in depth.

There will be a total of 10 sediment samples collected from five locations. Each location will generate two samples; one from the sediment surface and a second from the nine inch depth. Three separate locations will be from Lake Danielson and two separate locations will be from the adjacent small pond.

The QA/QC requirements for soil and sediment sampling will be met by collecting 13 QC samples. These will consist of 1 travel blank (water), 1 equipment blank (water), 5 field duplicates, 3 samples for matrix spikes (MS) and 3 samples for matrix spike duplicate (MSD). The QA/QC breakdown is shown in Table 3-1.

3.2.2 <u>Ground-Water Samples</u>

There will be a total of 34 samples collected for ground-water analysis. This includes 26 samples from shallow ground-water monitoring wells and 8 QC samples consisting of 1 travel blank, 1 equipment blank, 2 field duplicates and a total of 4 MS/MSD samples. Refer to Table 3-1 for the QA/QC breakdown.

3.2.3 Surface Water Samples

There will be a total of 15 samples collected for surface water analysis. This includes 10 surface water samples and 5 QC samples which include 1 travel blank, 1 equipment blank, 1 field duplicate and a total of 2 MS/MSD samples. Refer to Table 3-1 for the QA/QC breakdown.

Task	Matri x Type	Number of Samples	Travel Blanks	Equipment Blanks	Field Duplicate	Total MS/MSD	Total QC
7	Ground Water	26	1	1	2	2/2	8
8	Surface Water	10	1	1	1	1/1	5
9	Sediment	10		•	1	1/1	3
	Shallow Soil	40	1	1	2	2/2	8
	Strati. graphic Soil	15	-	-	2	-	2

REQUIRED QUALITY CONTROL/QUALITY ASSURANCE SAMPLES

TABLE 3-1

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3.2.4 <u>QC Samples</u>

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The distribution of QA/QC samples have been outlined in the above section on a per matrix basis. Field controls for soil, sediment and groundwater samples shall consist of at least one duplicate, one travel blank and one equipment blank for every twenty samples collected. Field controls for surface water will be collected at a one in ten frequency. Table 3-1 contains the complete QA/QC sample breakdown.

3.3 SAMPLE COLLECTION METHODS

Different sample types (i.e., grab vs composite, soil vs. ground water) require specific sampling procedures, as described herein. Care has been taken to determine the best practical sampling procedure that will result in obtaining representative samples. The samples must maintain the integrity of the original medium through collection, transportation and delivery to the analyst. The site samples will be collected and containerized (if necessary) as described in the following paragraphs.

3.3.1 Ground Water Samples

The subsurface is a unique heterogeneous environment. Gas exchange, biological and other chemical reactions and conditions are different from the surface environment. Ground water is somewhat insulated from surface temperature and pressure variations. Rapid and significant changes can occur in ground water samples upon exposure to the surface (i.e., sunlight, temperature and pressure). Therefore, ground water sampling is conducted in a manner to minimize interaction of the sample and the surface environment. The equipment and protocol for collecting ground water samples at DDMT is discussed in the following paragraphs.

3.3.1.1 Sampling Equipment

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Many variations of ground water sampling equipment are available depending upon the objective of the sampling program. The DDMT ground water samples will be obtained with pre-cleaned PVC bailers. Pre-cleaning will be performed in the laboratory and in the field in accordance with recommended EPA procedures. Precleaning shall consist of the following steps: (1) remove gross contamination using scrapers, (2) wash with a brush in a bucket filled with an Alconox soap solution, (3) rinse in a second bucket containing tap water and a brush, (4) spray with a 10% nitric acid rinse, (5) repeat Step 3, (6) spray with methanol, (7) rinse with deionized water, and (8) air dry.

3.3.1.2 Sampling Protocol

The sampling protocol at the DDMT will be as follows:

- a. <u>Measure Water Level</u> Using clean, non-contaminating equipment (i.e., an electronic level indicator or a fiberglass tape) determine the water level in the well and calculate fluid volume in the casing and screen.
- b. <u>Purge Well</u> Remove at least five well volumes with a PVC bailer or by pumping. If the well does not recharge fast enough to allow five well volumes to be removed, the well will be pumped or bailed dry and sampled as soon as sufficient recharge has occurred to allow collection of a sample.
- c. <u>Collect Sample</u> Lower the PVC bailer slowly until it contacts the water surface and allow the bailer to sink to the desired depth and fill with a minimum of surface disturbance. Care will be taken so that the sample is collected from the screened portion of the well and not from the overlying riser section or the underlying sand-sump section of the well. Slowly withdraw the bailer, being

careful to prevent contact of the bailer line with the Tip the bailer and slowly discharge the contents ground. into the appropriate container. The process will be repeated as necessary to fill each container to the required volume. Samples to be analyzed for volatile organics will be collected first to minimize the effects of disturbance of the water surface in the well on the volatiles analysis. Sample containers will be filled completely leaving no air space above the liquid portion to minimize volatilization. Ground-water samples to be analyzed for dissolved metals will be filtered in the field through a filter membrane with 0.45 micron pore size. Sample containers and sample preservation are discussed in Sections 3.4 and 3.5, respectively.

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- Label Sample Once the sample is collected, label each d. container providing the following data: sample identification number, project number, date, time, person sampling, intended chemical analysis, and preservative(s) added. Record the information in the bound field notebook and complete all chain-of-custody and request for analysis documents as discussed in Sections 3.6 and 3.7. The bound field notebook will have prenumbered pages and entries will be made in indelible ink. Data from the sampling episode will also be recorded on the Law Field Sampling Report form shown in Figure 3-2.
- e. <u>Custody, Handling and Shipping</u> Place the properly labeled sample bottle in the appropriate carrying container and maintain the sample at 4° C throughout the sampling and transportation periods. The shipping container will be an IT "Sample Shuttle" cooler. The lid of the cooler will be taped shut with the custody seals provided with each Sample Shuttle. Samples are shipped on the day collected from the site directly to the laboratory by overnight courier. Chain-of-custody and request for analysis documents are shipped in air-tight plastic bags in each container (taped

		ONMENTAL INC.	JOB ND.	· ·
FIELD SAMPLII REPORT		ENT SERVICES IVISION GAW, GEORGIA	JOB NAME DATE SAMPLING POINT (LDCATION)	TINE
SAMPLE INFORMAT	ION SAMPLE I.D. NO WATER SOIL COMPOSITE	.: SLUDCE	OTHER (LIS	ST)
HAZARDOUS?:YES	NO UNKNOWN		HER (LIST)	
	VOLUME NUMBER	PRESERVATIVE/ PREPARATION	COMMENTS	s
<u></u>				
COMMENTS: (WELL PURGIN	C VOLUME: SAMPLE APPEARA	NCE; ODOR; COLOR, E	ETC. }	
COMMENTS: (WELL PURGIN		NCE; ODOR; COLOR, E	ETC. }	
		NCE; ODOR; COLOR, E) COMMENTS	
FIELD MEASUREMEN	TS			
FIELD MEASUREMEN	TS) COMMENTS	
FIELD MEASUREMEN	EQUIPMENT I.D.	RESULTS (UNITS) COMMENTS	
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FIELD MEASUREMEN PARANETER COMMENTS: (CALIBRATIONS SENERAL INFORMATIC SAMPLES SHIPPED TO:	EQUIPMENT I.D.	RESULTS (UNITS) COMMENTS	
FIELD MEASUREMEN PARANETER OMMENTS: (CALIBRATIONS ENERAL INFORMATIC AMPLES SHIPPED TO: PECIAL HANDLING:	TS EQUIPMENT 1.D. 	RESULTS (UNITS) COMMENTS	

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to the inside of the lid) with applicable samples. The laboratory is notified by phone of the sample shipment. This process is discussed in detail in Sections 3.6 and 3.7.

3.3.2 <u>Soil Samples</u>

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split-spoon sampling, continuous sampling, and hand auger sampling techniques will be used to collect grab samples at 40 different shallow soil sampling locations around the site and at five soil test boring locations as described in Section 3.1. The depth of each sample from the soil test borings will based on photoionization detector (PID) readings during drilling. If there are no significant PID readings the samples will be obtained at depths judged by the Field Manager to represent the greatest potential for contamination (i.e., low permeability layers in the unsaturated zone, at the water table, etc.). The following sections present a discussion of equipment, procedures, and protocol for soil sampling at the site.

Grab samples for chemical analysis will be collected from soil sampling locations in borings drilled with a hollow stem auger. The Soil Borings and Monitoring Well Installation Plan discusses the soil sampling protocols that will be followed. Each piece of sampling equipment will be steam-cleaned before use to minimize potential cross-contamination.

<u>Split Spoon or Continuous Sampling Protocol</u> - The procedures for collecting soil samples with the hollow-stem auger and split-spoon sampler or continuous sampler will be as follows:

a. <u>Collect Sample</u> - Hollow-stem auger from the ground surface to the specified sampling depth. Obtain soil samples from the boring using a split-spoon sampler or continuous CME sampler at the specified depth intervals (see Section 3.2.1). The split spoons will be decontaminated between each sample for chemical analysis using the procedures described in Section 3.3.1.1. Transfer the sample into an appropriate

. 9 126 sample container. After the boring is completed, steamclean all of the sampling equipment to prevent crosscontamination. Samples to be analyzed for volatile organic compounds will be removed from the sampler first. The sample will be disturbed as little as possible to minimize volatilization of organic compounds in the sample. The remainder of the sample will be placed in a stainless steel mixing bowl. It will be mixed thoroughly before containerizing other samples (i.e., metals, duplicate/split samples, etc.).

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- b. <u>Label Sample</u> Once the sample is collected, label the sample bottle with the appropriate sample tag providing the following data: sample identification number, project number, data, time, person sampling, analysis requested and preservative(s) added. Seal the sample containers with custody tape (for volatiles vials, tape the custody seal to the bottle cap). Complete all chain-of-custody documents and record the sampling event in the bound field notebook in indelible ink.
- Custody, Handling and Shipping Place the properly labeled с. and sealed containers in a plastic "ziplock" type bag and seal it. Place about three inches of inert cushioning and absorbing material (i.e., vermiculite) in the bottom of the cooler and arrange the sample bags in the cooler so that they do not touch. Pack the samples in ice (also in bags) and styrofoam packing beads or bubble wrap. Samples will be packed so as to maintain a temperature of 4⁰ C. Seal chainof-custody and request for analysis documents in air-tight plastic bags and tape them to the inside of the cooler lid. Tape the lid of the cooler shut with the provided custody Samples will be shipped to the laboratory via seals. overnight courier on the day they are collected. The laboratory will be notified by phone of the sample shipment.

3.3.3 <u>Sediment Samples</u> 09 127

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A Wildco stainless steel Hand Corer will be used to collect the sediment samples from Lake Danielson and the adjacent pond.

- <u>Collect Sample</u> Stabilize the boat or work platform to a. assure as nearly as possible a vertical drop and recovery of the core sampler. Position the core sampler over the drop point and steady momentarily. With the line arranged to run freely, release the sampler. When the corer has stopped, take up the slack in the line and begin to retrieve. Lift the corer above the water surface and, keeping it as vertical as possible, bring it aboard the work station. Cap the end of the cellulose butyl acetate (CBA) core liner tube, (label bottom) release the valve, free the core liner, slide it from the core tube and cap the other end (label There will be one sediment sample collected from the top). sediment surface and one sediment sample collected at the 9 inch depth from each sediment core. Uncap both ends of the CBA core liner containing the sediment sample. Insert a stainless steel or teflon plunger into the CBA core liner end marked "bottom". Push the plunger gently so that the "top" sediment is being deposited into a stainless steel mixing bowl, cut the first six inches of this sediment thoroughly before containerizing the sample. Each sample will require two VOA vials and one 250 ml. glass wide mouth container. This sediment portion will be labeled surface. Following this procedure cut the next six inch sediment portion. (6 inch - 12 inch section) for the nine inch sample.
- b. <u>Label Samples</u> Same as previous protocol.
- c. <u>Custody, Handling, and Shipping</u> Same as previous protocol.

3.4 <u>SAMPLE CONTAINERS</u>

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Samples for chemical analysis will be collected and placed in IT provided containers. Appropriate containers for the media and constituents under investigation at the site are identified in Table 3-2. All container caps will have Teflon liners. Vials for VOA samples will have Teflon-lined septa. Each container will be labeled giving the sample identification number, date, time, analysis requested, name of sampler, project number and preservative(s) added.

Prior to use at DDMT the sample containers and caps will be cleaned by the following procedures: hand-wash in Alconox or equivalent detergent solution at 150°, rinse in hot tap water, rinse with cold tap water, rinse with distilled water. In addition, containers used for collection of samples to be analyzed for EPA organic priority pollutants will be cleaned in a manner appropriate to the test procedure. All sample containers and caps will either be purchased pre-cleaned by IT or will be cleaned at the IT laboratory and shipped to the site in a readyto-use condition.

3.5 <u>SAMPLE PRESERVATION METHODS</u>

All of the samples will be stored and shipped on ice to maintain the temperature at approximately 4° C. Additional sample preservation methods required by specific analyses are identified in Table 3-2. Water samples to be analyzed for metals will be checked to ensure that a pH<2 is attained.

3.6 <u>SAMPLE IDENTIFICATION</u>

Field sampling personnel must properly identify all samples taken in the field by using the sample tag attached to or affixed around the sample container (the samples will also have labels as specified in Sections 3.3.1 and 3.3.2). The sample tag must contain the site name; sample identification number; project

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TABLE 3-2 SAMPLE CONTAINERS, PRESERVATIVES AND HOLDING TIMES

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Parameter	Container ^a	Preservation	Holding Time				
SOIL SAMPLES							
Volatile Organics	40 ml glass VOA vials; teflon-lined septum, no head space	Cool, 4 ⁰ C	14 days				
Pesticides & PCBs	250 ml wide-mouth amber glass; at least 3/4 full	Cool, 4 ⁰ C	7 days for extraction; 40 days for analysis				
Extractable Organics	250 ml wide-mouth amber glass; at least 3/4 full	Cool, 4 ⁰ C	7 days for extraction; 40 days for analysis				
Metals	250 ml wide-mouth amber glass; at least 3/4 full	Cool, 4 ⁰ C	6 months; (mercury - 28 days)				
EP-Toxicity	250 ml wide-mouth amber glass; at least 3/4 full	Cool, 4 ⁰ C	7 days for extraction: 40 anlayze within 28 days for Hg and 40 days for other metals.				
	WATER SAM	PLES					
Volatile Organics	40 ml glass vials; teflon-lined septum, no head space	Cool, 4 ⁰ C store inverted	14 days				
Pesticides & PCBs	l liter glass bottle	Cool, 4 ⁰ C	7 days for extraction; 40 days for analysis				
Extractable Organics	l liter amber glass bottle	Cool, 4 ⁰ C	7 days for extraction; 40 days for analysis				
Metals, Total	l liter polyethylene bottle	HNO ³ to pH<2; Cool, 4 ^o C	6 months (Mercury-28 days)				

a All containers have teflon-lined lids

number; the date, time, and location of sample collection; designation of the sample as either grab or composite; notation of the type of sample (e.g., ground water, soil, surface water); identification of any preservative(s) added; and signature of the sampler. The sample tags are to be placed on the bottles so as not to obscure any QA/QC data on the bottles; sample identification information must be printed in a legible manner using indelible ink. Field identification information must be sufficient to enable cross-reference with the field notebook.

3.7 TRANSPORTATION AND CHAIN-OF-CUSTODY

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Chain-of-custody procedures are intended to document sample possession from the time of collection to disposal in accordance with state and federal guidelines. For the purpose of these procedures, a sample is considered in custody of it is:

- In one's actual possession;
- In view, after being in physical possession;
- Locked so that no one can tamper with it;
- In a secured area, restricted to authorized personnel.

3.7.1 Chain-of-Custody Records

IT will provide coolers to transport the samples from the site to their laboratory in Knoxville, TN. These coolers will be metal and in good condition. IT will provide properly cleaned sample containers in each cooler. The type of container will vary depending on the analysis required. Coolers will be shipped from the site to the laboratory via overnight courier on the day of sampling whenever possible.

Chain-of-custody records are provided in each sample cooler. The custody record will be fully completed in duplicate, using black carbon paper where possible, by the field technician who has been designated by the Project Manager as being responsible for sample shipment to the laboratory for analysis. The information

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- name of person collecting samples
- date and time samples were collected
- type of sampling conducted (composite/grab)
- location of sampling station

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- number and type of containers used
- signature of LEGS field technician relinquishing samples to non-LEGS person such as Federal Express agent
- date and time of custody transfer to overnight courier

In addition, if samples are known to require rapid turnaround in the laboratory because of project time constraints or analytical concerns (e.g., extraction time or sample retention period limitations, etc.) the person completing the chain-of-custody record will note these constraints in the remarks section of the custody record.

If it is not practicable to seal all containers at a Federal Express office, they should be sealed beforehand. The duplicate custody record will therefore have the signature of the relinquishing field technician and a statement of intent such as "To Federal Express (Memphis Office), p.m. 01/31/89". The duplicate custody record is placed in a plastic bag, taped to the underside of the box lid, and the box closed. The container is then tightly bound with filament tape and, if required, may be padlocked at the discretion of the Project Manager. Finally, at least two custody seals are to be signed by the individual relinquishing custody and affixed in such a way so that the box cannot be opened without breaking them. At the shipping agent's office, the relinquishing individual will put all the specific shipping data (airway bill number, office, time, date) on the original custody record which is to be transmitted to the laboratory. It is the Project Manager's responsibility to ensure that all are consistent and they are made part of the permanent job file maintained at IT.

At the laboratory, the sample custodian (hereinafter referred to as "custodian") will open the package, retrieve the duplicate record, and complete the "Received by Laboratory by" hox by affixing his signature. The custodian will also fill in the "Method of Shipment:" box with the shipper's name (e.g., Federal Express) and airway bill number.

3.7.2 <u>Custody Seals</u>

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Custody seals are preprinted adhesive-backed seals with security slots designed to break if they are disturbed. With the exception of VOA vials, individual sample bottles are sealed over the cap by the sampling technician. Sample shipping containers are sealed in as many places as necessary to ensure security. Seals are signed and dated before use. On receipt at the laboratory, the custodian will check (and certify by completing logbook entries) that seals on boxes and bottles are intact.

3.7.3 Laboratory Custody

Laboratory chain-of-custody procedures are intended to document sample possession from the time of sample receipt to disposal in accordance with state and federal guidelines.

All samples received at IT have chain-of-custody initiated at the time of receipt. All samples are logged into the master sample log and assigned an internal sample number. All pertinent sample information is recorded in the master sample log. Once samples have been logged in and the chain-of-custody is complete, copies of the chain-of-custody are distributed to all individuals that

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will be handling the samples as well as to the project and operations management personnel.

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Details regarding IT standard chain-of-custody operating procedures are provided in the IT Standard Operating Procedures (SOP) for DDMT which have been provided, in their entirety, to the USACE Project Manager and Contracting officer at USACE's Huntsville Division (CEHND).

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4.0 ANALYSES

4.1 <u>PARAMETERS</u>

Tables 4-1 and 4-2 illustrate the water and soil/sediment samples to be collected and the analyses to be performed respectively. The required analyses are all EPA approved methods.

4.2 ANALYTICAL METHODS

A11 chemical analyses will be performed by the LEGS subcontractor, IT. IT will perform all analyses using established EPA and/or USATHAMA methods. The analytical methods that will be used for this investigation are listed in Table 4-3. The complete text of the appropriate analytical methodologies are provided in the IT SOP and are available upon request from CEHND. The anticipated analytical method detection limits are provided in Appendix B.

4.3 LABORATORY OC/OA

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Environmental measurements have inherent limitations arising from equipment problems, procedural deviations, and changes in ambient conditions. Most of these measurements are analyses made for extremely low concentrations of constituents and are subject to chemical interferences, instrument limitations and uncertainties that affect the accuracy of the determination. It is essential to minimize these factors so that the measurements accurately reflect the character of the sample collected.

All data gathered by LEGS during the course of this investigation or processed by the laboratory will meet objectives of accuracy, precision, sensitivity, completeness, representativeness, and comparability. These characteristics are defined in the following paragraphs.

9 135 TABLE 4-1

CROUND	WATER ANI) នហ	RFACE	WATER	R SA	MPLES
	BASI	(C C(ONTRAC	Т		
REQUIRED	ANALYSES	AND	APPRO	VED B	EPA	METHODS

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			TASK 7 Ground Water Analysis		TASK 8 Surface Wate Analysis	
PARAMETERS	EPA NETHOD		FIELD	QA/QC	FIELD	QA/QC
GC/MS for Volatile Organics	EPA	8240	28	8	10	5
GC/MS for Semi- Volatile Organics	EPA	8250	26	8	10	5
PCBs/Pesticides	EPA	8080	26	8	10	5
Metals*	EPA	6010	26	8	10	5
Mercury (Hg)	EPA	7470	26	8	10	5
pH, temp, and conductance	Dete: in f:	rmined ield	Field	NA	FIELD	NA

Metals by Method 6010 shall include: Antimony, Arsenic, Barium, Cadium, Chromium, Copper, Lead, Silver, Selenium, Nickel, and Zinc.

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Number of volatile organic analyses for Task 7 includes travel and equipment blanks from Task 9.

TABLE 4-2

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SOLL AND SEDIMENT SAMPLES BASIC CONTRACT REQUIRED ANALYSES AND APPROVED EPA NETHODS

PARAMETERS	EPA	METHOD	Shallow Soil	Totai QC	Sediment	Total QC	P****!	Tete
?			3010			46	Stretigraphic Soils	QC
GC/MS for Volatile Organics	EPA	8240	40	8	10	3	15	2
GC/NS for Semi- Volatile Organics	EPA	8250	40	8	10	3	15	2
PCBs/Pesticides	EPA	8080	40	8	10	3	15	Z
Notals*	EPA	3050+ 6010	40	8	10	3		2
Mercury (Hg)	EPA	7471	4 D	8	10	3	15	2
EP Toxicity	ÉPA	1310					15	2
pH, temp, and conductance		ermined Hield	NA		NA		NA	

TABLE 4-3

APPROVED ANALYTICAL METHODS

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Analytical Methods

Water Samples:	
Volatile Halocarbons	EPA 8240
Volatile Aromatics	EPA 8240
Pesticides & PCBs	EPA 8080
Semi-Volatile Organics	EPA 8250
Metals:	
Antimony	EPA 6010
Arsenic	EPA 6010
Barium	EPA 6010
Cadmium	EPA 6010
Chromium	EPA 6010
Copper	EPA 6010
Lead	EPA 6010
Nickel	EPA 6010
Silver	EPA 6010
Selenium	EPA 6010
Zinc	EPA 6010
Mercury	EPA 7470
Soil Samples:	
Volatile Halocarbons	EPA 8240
Volatile Aromatics	EPA 8240
Pesticides & PCBs	EPA 8080
Semi Volatile Organics	EPA 850
Metals:	
Antimony	EPA 3050 + 6010
Arsenic	EPA 3050 + 6010
Barium	EPA 3050 + 6010
Cadmium	EPA 3050 + 6010
Chromium	EPA 3050 + 6010
Copper	EPA 3050 + 6010
Lead	EPA 3050 + 6010
Nickel	EPA 3050 + 6010
Silver	EPA 3050 + 6010
Selenium	EPA 3050 + 6010
Zinc	EPA 3050 + 6010
Mercury	EPA 7471
EP- Toxicity	EPA 1310

Accuracy - Accuracy is a measure of the bias in a system. Accuracy is defined as the degree of agreement of a measurement with an accepted reference or true value. To determine the accuracy of an analytical method, a sample spiking program will be conducted. The results of sample spiking will be used to calculate the quality control parameter for accuracy evaluation, the Percent Recovery (%R). The Percent Recovery is defined as 100 times the observed concentration, minus the sample

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concentration, divided by the true concentration of the spike.

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where: X = Analytical result from the spiked sample T = Analytical result from the unspiked aliquot K = Known value of the spike %R = Percent Recovery

<u>Precision</u> - Precision is the measure of the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of standard deviation or Relative Percent Difference (RPD). Precision is inferred through the use of duplicate samples. RPD for each component is calculated using the following equation:

$$A - B$$

 $RPD = ----- \times 100$
 $(A + B)/2$

where: A = Replicate Value 1
B = Replicate Value 2
RPD = Relative Percent Difference

The calculated Percent Recovery and RPD will be summarized. The RPD data will be used to evaluate the long term precision of the analytical method.

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<u>Completeness</u> - Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct or normal conditions. Over 90 percent of all data obtained on this project should be valid based upon evaluation of the quality control data.

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<u>Representativeness</u> - Representativeness is the degree to which data accurately and precisely represent a characteristic population, a process control, or an environmental condition. Appropriate sampling procedures will be implemented so that the samples are representative of the environmental matrices from which they were obtained.

<u>Comparability</u> - Comparability refers to the degree to which one data set can be compared to another. Appropriate sampling, analytical and reporting processes will be standardized so that the samples of similar matrices may be compared. Data reporting procedures and standardized analytical methods are discussed in another section of this plan.

<u>Sensitivity</u> - The anticipated detection limits for each of the methods to be employed on this program are summarized in Appendix B. Actual method detection limits for each analysis will be calculated and reported in accordance with the procedures outlined in the IT SOP. All of the anticipated method detection limits meet the sensitivity requirements for the end use of the data.

<u>QC Check and Corrective Action Procedures</u> - The types and number of QC checks that will be inserted into the sample sets are summarized in the method-specific SOPs which are available upon request. These IT methods are consistent with the USEPA methods provided in SW-846. Corrective action procedures to be employed when results fall outside control limits are detailed in the IT laboratory QC procedures provided in the IT SOP. In general, the

analytical QC procedures (e.g., numbers and types of QC samples, QC charts, etc.) are consistent with those described in the appropriate EPA methods in SW-846.

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5.0 DATA ANALYSIS AND REPORTING

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The procedures employed by IT to assure the validity and accuracy of data analysis and reporting are discussed in detail in the IT-SOP. The topics covered are described briefly below with reference to the appropriate sections of the IT-SOP:

<u>Data Analysis Scheme</u> - Procedure required to evaluate analytical results for individual analytes including units and equations required to calculate concentrations are discussed in the method specific SOPs.

<u>Limits of Data Acceptability</u> - Feedback systems used to identify potential problems and corrective actions measures taken when the limits of acceptability are exceeded, personnel responsible for initiating and carrying out corrective actions, and the demonstration of the re-establishment of control (Section 6.0 of the IT-SOP).

<u>Data Management Systems</u> - Procedures for the collection of raw data, data storage, data QA documentation and data security (Section 12.0 of the IT-SOP).

<u>Responsible Individuals</u> - Individuals involved in the reporting sequence are identified in Section 16.0 of the IT-SOP.

<u>Data Reporting Formats</u> - Data reporting procedures are described in Section 11.0 of the IT-SOP. IT will report all analytical results (including non-quantified concentrations) to LEGS. In the RI and the FS Engineering Reports, LEGS will only report the quantified concentrations.

<u>Data Review Procedures</u> - The standard data review procedures utilized by IT to insure the precision, accuracy and completeness of the analytical data are summarized in Section 10.0 of the IT-SOP.

6.0 PROGRAM CONTROLS

The following sections briefly describe the internal program controls that are incorporated into IT's SOP and will be followed in their entirety during this program.

6.1 CALIBRATION PROCEDURES AND FREQUENCY

Table 2-1 provided a complete listing of the appropriate laboratory instrumentation. IT's program for instrument calibration and maintenance is described in detail in the SOP-DDMT.

6.2 INTERNAL OC CHECKS

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As discussed in section 5.0, IT's SOPs for internal QC checks are provided in their SOP.

6.3 PREVENTATIVE MAINTENANCE

Preventative maintenance is discussed in the IT SOP.

6.4 EXTERNAL CERTIFICATION

IT is currently certified by the State of Tennessee, Department of Public Health for the analysis of drinking water and wastewater, and the analysis of hazardous wastes associated with state-sponsored Superfund sites. It has numerous other certifications and qualifications listed in Table 2-1. The State Certifications are issued as a result of successful analysis of proficiency samples (including trace metals and organics) followed by an inspection of the IT laboratory to assess custody and documentation procedures.

IT is a qualified U.S. Environmental Protection Agency Contract Lab (CLP) in organics, inorganics and dioxins.

APPENDIX A

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RESUMES

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- 7. Brief resume of Key Persons, Specialists and Individual Consultants anticipated for this project.
- a. Name & Title: Gerald E. Seaburn, Ph.D., PE. Corporate Consultant/Vice President Principal Hydrologist
- b. Project Assignment: Principal-In-Charge
- c. Name of Firm with which associated: Law Environmental, Inc.
- d. Years experience: With This Firm <u>12</u> With other Firms <u>10</u>
- e. Education: Degree(s)/Year/Specialization PHD/1976/Water Resources Planning & Management MSCE/1965/Hydraulic Engineering BSCE/1964/Civil Engineering BB/1962/Engineering
- f. Active Registration: Year First Registered/Discipline 1968/Civil Engineering/FL/NY
- Other Experience and Qualifications relevant to the proposed q. project: Dr. Seaburn has 15 years of wide ranging experience with projects involving groundwater/surface water interaction throughout the State of Florida. Dr. Seaburn is an expert in computer modeling of flow and contaminant movement. Many of his projects have considered potential or actual groundwater contamination form municipal waste sites and industrial facilities. Dr. Seaburn has managed numerous hazardous waste assessments throughout Florida, including preparations of remediation plans and clean-up designs. Others have dealt with storm-water and other surface water control facilities. He has been active in both design and permitting phases of projects and has extensive experience in dealing with regulatory agencies.

7. Brief resume of Key Persons, **Bpecialists** and Individual Consultants anticipated for this project. Name & Title: a. Jack Peng, Ph.D., CIH Project Assignment: ь. Health and Safety Officer Name of Firm with which associated: Ç. Law Environmental, Inc. Atlanta, Georgia Years experience: With This Firm _ 1 With other Firms _ đ. 14 e. Education: Degree(s)/Year/Specialization Ph.D/Environmental Health Science/Industrial Hygiene MS/Environmental Health Science BS/Forestry f. Active Registration: Year First Registered/Discipline 1979/Certified Occupational Hearing Conservationist 1983/Certified Industrial Hygienist

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g. Other Experience and Qualifications relevant to the proposed project:

Peng is the Director of Occupational Health and Dr. Industrial Hygiene. In this capacity he is responsible for matters concerning Health and Safety all for Law Environmental Inc. Dr. Peng and his staff provide training in accordance with EPA and OSHA for all personnel involved in the investigation of hazardous waste sites. In addition, training is provided to both our industrial and government clients. Prior to coming with Law Environmental, Dr. Peng was Industrial Hygiene Manager for the International Paper He was responsible for all aspects of Industrial Company. hygiene for the corporation and provided technical direction and supervision to the staff of Industrial Hygienists. Dr. Peng and his staff were responsible for all 110 facilities in the United States. Prior to his IP experience, he taught graduate and undergraduate courses in Environmental Sciences and Environmental Law and Policy.

Dr. Peng and his staff at Law Environmental develops 40-hr Health and Safety training course for hazardous waste operation to comply with OSHA 29CIR1910-120 which is part of Superfund Amendment Reauthorization Act of 1986. This course is being taught at ten cities nationwide.

- Brief resume of Key Persons, Specialists and Individual Consultants anticipated for this project.
- a. Name & Title: Thomas L. Richardson
- b. Project Assignment: Principal Engineer

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- c. Name of Firm with which associated: Law Engineering
- d. Years experience: With This Firm 12 With other Firms 3
- e. Education: Degree(s)/Year/Specialization MSCE/GEORGIA Institute of Technology BSCE/DUKE University
- Active Registration: Year First Registered/Discipline 1980/Civil Engineering
- g. Other Experience and Qualifications relevant to the proposed project:

Mr. Richardson has directed a variety of confirmation and remedial investigations on RCRA, CERCLA, and DERA hazardous waste sites. He has a wide variety of experience within the hazardous waste field. He has provided direct project coordination for well installation, soil and water sampling, and laboratory testing. He has also been involved in evaluation of existing waste isolation facilities. He has managed the field work, sampling and analysis at an oil recycling facility, and he has directed confirmation studies adjacent to an existing chemical plant in Georgia. He was the principal investigator of the integrity of existing slurry walls surrounding a landfill. He also participated in the design of a new landfill facility. Mr. Richardson routinely prepares plans and conducts senior-level reviews for studies at DOD sites on active and abandoned facilities. He has directed the evaluation of groundwater impact on design and construction, including recommendations for groundwater control methods such as drains, dewatering systems, recharge systems, and waterproofing. He has also been involved in a wide range of geotechnical activities, including assessment for siting and preliminary design, investigations for final design, design consultation, and construction related activities. He has a wide range of geotechnical investigation experience including in-situ evaluation of modulus, strength, and premeability characteristics. His geotechnical construction experience includes inspection, quality control, and instrumentation.

- Brief resume of Key Persons, Specialists and Individual Consultants anticipated for this project.
- a. Name & Title: John R. Absalon

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b. Project Assignment: Project Manager

c. Name of Firm with which associated: Law Environmental, Inc. Atlanta, Georgia

d. Years experience: With This Firm 4 With other Firms 12

- e. Education: Degree(s)/Year/Specialization BS/1973/Geology
- f. Active Registration: Year First Registered/Discipline 1980/Professional Geologist
- g. Other Experience and Qualifications relevant to the proposed project:

Mr. Absalon has sixteen years of waste management, environmental geology, hydrogeology and geotechnical engineering experience. He has obtained significant regulatory compliance experience with USEPA, USACE, DOE, regional, state and local environmental water resource agencies. Mr. Absalon has managed Installation Restoration Program (IRP) projects for over seven years at a wide variety of DOD installations. He has performed 40 IRP studies at USAF AND DOD facilities located at installations in 30 states and one territory. He has proposed, planned, conducted, and reported the complete range of USAF IRP projects including PA/SI, Confirmation, Pre-RI, Remedial Investigations and Feasibility Studies (RI/FS), Remedial Action Plan (RAP), Closure and Post-Closure studies. He has experience in leading assessments (PA/SI), RI/FS, RAPS, and Environmental Impact Studies (EIS). Mr. Absalon has had direct "hands on" experience on the USAF IRP, USACE Defense Environmental Restoration Program (DERP), and such USEPA programs as CERCLA, SARA, RCRA, FIFRA, TSCA, and CWA. То date, he has completed seven RI/FS projects under CERCLA. Army Corps of Engineers Defense Environmental Restoration Program (DERP) and such USEPA programs as CERCLA, SARA, RCRA, FIFRA, TSCA and CWA. To date, he has completed seven RI/FS projects under He has personally managed and conducted IRP studies at CERCLA. experimental herbicide test grids, aerial weapon impact sites, nuclear accident sites, a reactor inactivation, low level radiation waste sites, experimental chemical laboratory waste sites (two AFLCs), POL depots, FPTAs, solvent spills, fuel spills, UST, sludge drying beds, lagoons, landfills, PCB spills, and EOD zones. He also performed ground-water quality studies at US Army chemical warfare sites, US Army and US Navy munitions loading facilities, and an ordnance manufacturing plant.

- 7. Brief resume of Key Persons, Specialists and Individual Consultants anticipated for this project.
- a. Name & Title: Robert D. Manson, PG Project Geologist

. Project Assignment:

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Site Manager

- c. Name of Firm with which associated: Law Environmental, Inc. Atlanta, Georgia
- d. Years experience: With This Firm 1 With other Firms 12
- e. Education: Degree(s)/Year/Specialization BS/1976/Geology
- f. Active Registration: Year First Registered/Discipline 1988/Professional Geologist
- g. Other Experience and Qualifications relevant to the proposed project:

Mr. Manson has 12 years experience as a professional geologist/hydrogeologist. He has supervised numerous geoologic projects and prepared written reports and support materials, such as geologic maps, cross-sections, tabular geologic analysis and geophysical exhibits. He has been responsible for site evaluation, selection, inspection, permitting, and compliance with regulations of E.P.A., U.S. Fish and Wildlife, National Park Service, and numerous state regulatory agencies. Mr. Manson has been responsible for all geologic aspects of drilling operations including logging, sampling, coring, sample description, fresh water aquifer protection and site safety. Mr. Manson has hydrogeologic experience in six states: Texas, Arkansas, Florida, Georgia, Kentucky and Tennessee. He has had experience on USEPA programs such as CERCLA, SARA, RCRA, FIFRA, TSCA, and CWA. Before coming to Law Environmental, Mr. Manson was in charge of all environmental compliance sampling and monitoring for the Kennedy Space Center, Florida.

- Brief resume of Key Persons, Specialists and Individual Consultants anticipated for this project.
- a. Name & Title: Frank W. Thomas

b. Project Assignment:

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Site Geologist

- c. Name of Firm with which associated: Law Environmental, Inc. Atlanta, Georgia
- d. Years experience: With This Firm <u>0</u> With other Firms <u>4</u>
- e. Education: Degree(s)/Year/Specialization MS/1989/Geophysics BS equiv/1986/Geology BA/1978/Biology
- f. Active Registration: Year First Registered/Discipline

g. Other Experience and Qualifications relevant to the proposed project:

Mr. Thomas has 4 years of geophysical and geological field experience. He has been a consultant on numerous projects where he was responsible for geophysical/geological data acquisition, analysis, and interpretion. This included written and oral reports, surface and subsuface mapping, preparation of cross sections, and stratigraphic interpretations. Mr. Thomas also has 2 years experience involving inverse and forward modeling techniques. JACK R. HALL

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Professional Qualifications

Mr. Hall is a professional chemist with 23 years of experience in the collection and chemical analysis of environmental samples. His experience ranges from analysis of air, water, and milk for radiological constituents to analysis of a wide variety of chemical wastes, including experience in coordinating the analytical analyses and monitoring needs for the startup of coal liquification and chemical pilot plants. Currently, he has responsibility for the four IT analytical laboratories in the South. Mr. Hall has worked in a personnel supervisory and project management capacity for more than 16 years. The current projects and laboratories he is actively involved with are: method development for organic pollutants; compliance testing for specific CLP organics; testing of vents for treatment equipment design; analysis of hazardous pollutants in waste materials and environmental media for EPA and several industrial clients; testing of specific emissions from test burns for a variety of wastes; and Resource Conservation and Recovery Act analysis. Mr. Hall has been involved in the design of IT's Special Analysis, Mixed Waste, and Austin Environmental laboratories and is currently locating and designing a laboratory in Florida.

Education

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B.S., Chemistry, Pennsylvania State University, University Park, Pennsylvania; 1962

Experience and Background

- 1984 <u>Director, Southern Analytical Operations, IT Corporation, Knoxville</u> Present <u>Tennessee</u>. Responsible for four analytical services laboratories that:
 - Provide consulting and analytical services to industrial and governmental clients.
 - Have full-service capabilities for analyzing environmental media and hazardous materials for inorganic and organic constituents at the parts-per-trillion through percent levels.
 - Responsible for negotiating and managing large analytical services contracts, introduction of new technologies into the laboratories, budgeting, and quality assurance of the laboratories.
- 1982 <u>Manager, Proposal Administration, IT Corporation, Knoxville, Tennes-</u> 1984 <u>see.</u> Was responsible for the evaluation of requests for proposals and managing the preparation of proposals for analytical, engineering, and technical services. Managed special analytical chemistry projects (EPA Interlaboratory Study for Priority Pollutants).

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Jack R. Hall

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- 1980 <u>Vice-President and Manager of Analytical and Technical Services, IT</u>
 1982 <u>Enviroscience, Division of IT Corporation, Knoxville, Tennessee</u>. Managed the IT Enviroscience analytical laboratory and oversaw conceptual design through construction of a state-of-the art, limitedaccess analytical laboratory for analyzing extremely hazardous materials as an addition to the Knoxville laboratory and a 40-foot mobile laboratory with similar capabilities.
- 1975 <u>Manager, Analytical Services Department, Hydroscience, Inc., Knox-</u>
 1980 <u>ville, Tennessee</u>. Was responsible for maintaining the analytical technology of Hydroscience at a high level of the state of the art. Utilizing extensive experience in chromatograpy, managed the Knoxville Laboratory Analytical Services Group, which specializes in the analysis of trace organic compounds in environmental matrices.
- 1968 <u>Senior Analytical Chemist, Michigan Division Analytical Laborator</u> 1975 <u>les, Dow Chemical Company, Midland, Michigan</u>. Was responsible for the analysis of environmental samples in the Michigan Division Analytical Laboratory. Functions included development of procedures for in-plant monitoring of all discharges. Plants thoroughly studied included chlorinated benzene, 2-4 dichlorophenoxy acetic acid, 0,0 dimethyl-o(3.5.6-trichloro-2-pridyl phosphate), salicylic acid, glycol ethers, and polyethylene glycols.

Senior Analytical Chemist, Analytical Laboratories. Was responsible for research and method development for specific compound analysis of environmental samples (air, water, and solid wastes). Coordinated air- and water-sampling programs in production processes of phenol, alkyl phenols, chlorinated phenolics, chlorinated benzenes, and herbicides.

<u>Analytical Chemist, Waste Control Department</u>. Was responsible for analysis of samples from waste control research projects and waste water treatment plants. Involved in implementation of new analytical instrumentation in laboratory and on-stream at WWTP.

 1964 <u>Supervisor, Radiological Health Analytical Section, Pennsylvania</u>
 1968 <u>Department of Health, Harrisburg, Pennsylvania</u>. Primary function of group was the analysis of air, water, and milk for radiological constituents.

> <u>Supervisor</u>, <u>Public Waters Analysis Section</u>, <u>Division of Sanitary</u> <u>Engineering</u>. Section was responsible for sampling and analysis of all public and drinking waters of Pennsylvania for compliance with federal and state regulations.

> <u>Chemist, Division of Sanitary Engineering, Industrial Wastewater</u> <u>Section</u>. Was responsible for sampling and analysis of industrial wastewaters of Pennsylvania for compliance with state and federal discharge permits. Worked with other regulatory agencies on analytical method development and training programs. Experience included reviewing process chemistry of chemical, pharmaceutical, and formulating plants and requesting discharge permits. Evaluated potential of air and water discharges.

Jack R. Hall

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Publications

Hall, J. R., D. Stagg, and S. Clark, 1987, "Guidelines and Precautions in Collecting and Analyzing for Mixed Wastes," presented at the 1987 Winter Meeting of the American Nuclear Society.

Hall, J. R., 1983, "Quality Assurance in Environmental Trace Analysis," <u>Liquid Chromatography in Environmental Analysis</u>, edited by James F. Lawrence, Humana Press.

Hall, J. R., J. R. Florance, and D. L. Strother, 1981a, <u>EPA Method</u> <u>Study, Method 604-Phenols</u>, Contract No. 68-03-2625, submitted to Quality Assurance Branch, EMSL, EPA - Cincinnati, Ohio, for publication.

Hall, J. R., J. R. Florance, and D. L. Strother, 1981b, <u>EPA Method</u> <u>Study 22, Method 612-Chlorinated Hydrocarbons</u>, Contract No. 68-03-2625, submitted to Quality Assurance Branch, EMSL, EPA - Cincinnati, Ohio, for publication.

Hall, J. R., J. R. Florance, 1980, "Implementation of a Quality Assurance Program for the Determination of Trace Organics in Environmental Samples," presented at the 1980 Pittsburgh Conference.

Hall, J. R., C. W. Stuewe, R. C. Wilmolth, and J. L. Kennedy, 1979, <u>Removal of Trace Elements from Acid Mine Drainage</u>, EPA-600/7-79-101.

Hall, J. R., M. N. Wass, and R. A. Solomon, 1978, "Problems Encountered with the EPA Protocol Procedures for Screening of Industrial Waste Effluents for Priority Pollutants," presented at the 176th National Meeting, ACS.

Hall, J. R., 1977a, "Effect of New Effluent Guidelines on the Industrial Waste Treatment Laboratory," presented at Mid-Atlantic Industrial Waste Conference.

Hall, J. R., 1977b, "The Effect of Recent Legislation on the Industrial Wastewater Laboratory", presented at the New York Water Pollution Control Federation Meeting.

Hall, J. R., J. R. Florance, and R. D. Fox, 1976, "Role of New Techniques in Wastewater Analysis," presented at the 31st Purdue Industrial Waste Conference.

Hall, J. R., 1970, "Determination of Select Phthalates in Wastewater," presented at the 166th National Meeting ACS.

Hall, J. R., R. T. Richards, and D. T. Donovan, 1967, "A Preliminary Report on the Use of Silver Metal Membrane Filters in Sampling for Coal Tar Pitch Volatiles," <u>Amer. Ind. Hyg. Assoc. J.</u>

JANET M. JONES

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Professional Qualifications

Ms. Jones is a chemist experienced in the collection and analysis of environmental samples. Her recent experience includes management of a laboratory in Florida with responsibilities ranging from sales and marketing through sample collection, analysis, report and invoice preparation. Instrumental experience includes atomic absorption spectrophotometry (flame and flameless techniques), inductively coupled argon plasma, gas chromatography and total organic carbon analysis. She has experience with wet chemical techniques and environmental microbiology. As Sales and Customer Services Representative, she acted as liaison between customers and laboratory personnel, as well as promoting new business through telephone inquiries from potential customers. She is experienced in laboratory Quality Assurance/Quality Control (QA/QC) procedures and data review. Her writing experience includes data reports, Standard Operating Procedures, proposals, and QA project plans.

Education

- B.A. (with honors), Chemistry, University of Tennessee, Knoxville, Tennessee; 1980
- Flameless Atomic Absorption Analysis, Instrumentation Laboratories, Atlanta, Georgia; 1981

1982 Winter Conference on Plasma Spectrochemistry, Orlando, Florida; January 1982

American Management Association course, "The Basics of Telephone Selling Techniques"; April 1986

Experience and Background

1987 - <u>Inorganic Analyses Coordinator, IT Corporation, Knoxville, Tennessee</u>. Present Responsible for the following:

- Supervising the AA/ICP laboratory.
- Providing technical support to the Water/Wastewater laboratory.
- Supervising and/or performing sample preparation, analysis, data reporting, and departmental QC review for the metals laboratory.
- Analysis techniques include atomic absorption, atomic emission, graphite furnace AA, cold vapor AA for mercury, and inductively coupled plasma.
- 1986 <u>OA/QC Coordinator, IT Corporation, Knoxville, Tennessee</u>. Responsible
 1987 for all quality assurance functions pertaining to laboratory operations. Specific job duties include: initiating and supervising on-going QA
 programs; entering intralaboratory and external OC samples into the
 sample stream; determining and maintaining accuracy and precision data;
 writing and reviewing OA/OC programs, project plans, proposals, reports

Janet M. Jones

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and Standard Operating Procedures; initiating, establishing, and maintaining preventive maintenance programs, corrective actions, method R&D, new employee QC training programs, and sample receipt and preservation protocols; handling matters pertaining to ITAS accreditations, certifications, and outside QA audits and inspections; and supervising inventory and quality control of reagents, calibration standards, and Standard Reference Materials.

1984 - <u>Sales and Customer Services Representative, IT Corporation, Knoxville,</u> 1986 <u>Tennessee</u>. Responsible for normal telephone inquiries from potential clients, including intercompany requests, quoting prices and answering client requests on sample status. Works with sales and marketing on proposals.

- 1983 Laboratory Manager, Envirolab, Briley, Wild & Associates, Ormond Beach, 1984 Florida. Responsible for marketing and client relations, sample collection, sample analysis, report and invoice preparation. Analytical departments included atomic absorption, gas chromatography, total organic carbon, wet chemistry, and microbiology.
- 1980 Group Leader, Atomic Absorption, IT Corporation, Knoxville, Tennessee. 1983 Responsible for scheduling technicians, sample preparation and all analyses by atomic absorption (flame and flameless) and inductively coupled argon plasma.
- 1979- <u>Accounting Clerk, Plasma Alliance, Production Statistics, Xnoxville.</u>
 1980 <u>Tennessee</u>. Responsible for plasma inventory control. Also prepared expense reports and cash reports.
- 1977 Office Assistant, University of Tennessee, Knoxville, Tennessee.
 1979 Responsible for general office duties including typing, filing and reception for two U.T. departments math and athletics.
- 1976 <u>Assistant Bookkeeper, Frank Wylie Realty, Knoxville, Tennessee</u>.
 1977 Responsible for maintaining and balancing the books for all departments including rental properties. Also worked as backup receptionist.

Professional Affiliations

American Chemical Society Florida Society for Environmental Analysts

KERRY A. KLEMM

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Professional Qualifications

Mr. Klemm's education includes organic chemistry, inorganic chemistry, environmental chemistry, as well as zoology, microbiology, botany, anatomy and physiology, and genetics. He has taught science courses at the high school level.

Education

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B.S., Biology, Environmental Studies, and Secondary Education, Manchester College, North Manchester, Indiana; 1981

Experience and Background

1985 - Lab Technician, IT Corporation, Knoxville, Tennessee. Responsible for Present the following:

- Measuring the quantity of the following parameters in water and soil samples: cyanides, pH, phenols, orthophosphates, total phosphorus, biochemical oxygen demand (BOD), chemical oxygen demand (COD), chloride, carbon tetrachloride, oil and grease, fluoride, sulfate, nitrate, nitrite, total dissolved solids, total suspended solids, total settleable solids, ammonia, total kjeldahl nitrogen, surfactants, hexavalent chromium.
- Assisted with setup of wet chemistry department for mixed waste radiological lab.
- 1984 <u>Salesman/Manager Trainee, Color Tile Incorporated, Knoxville, Tennessee</u>.
 1985 Assisted manager in the daily operations of a retail store. Responsible for pricing merchandise, unloading warehouse trucks, stocking merchandise, taking physical inventories, and selling merchan-dise to customers.
- 1982 Dorm-Master/Teacher/Coach, The Harvey School, Katonah, New York.
 1984 Responsible for teaching seventh grade life science, eighth grade physical science, ninth grade earth science, and tenth grade biology.
 Dormitory duties included supervising ten to thirteen seventh, eighth, and ninth grade boys. Coached seventh grade soccer, seventh and eighth grade ice hockey, and high school tennis.
- 1982 <u>Substitute Biology Teacher, Lake Ridge Academy, North Ridgeville, Ohio.</u> (Replaced full-time teacher who was on maternity leave). Taught seventh grade general science, ninth grade biology, and tenth grade ecology.
- 1981 Chain O'Lakes State Park, Albion, Indiana. Responsible for the state
 1982 parks interpretive activities, such as nature hikes, animal displays
 and talks. Also designed and built display cases for nature center.

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ALYCE R. MOORE

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Professional Qualifications

Ms. Moore has fourteen years of experience in analytical operations, supervision and management, and extensive experience in all aspects of sample preparation and analysis of environmental samples for metals, anions, classical parameters and organic analysis, as well as experience in microbiology, biological and aquatic samples and EP Toxicity extraction techniques for waste disposal. She has extensive experience in laboratory scheduling, writing and evaluating reports. In addition, she possesses background in screening applicants and handling personnel problems.

Education

- Gas Chromatography Course, Southern Analytical, Knoxville, Tennessee; January 1978
- Perkin-Elmer One Day Seminar, Infrared, Knoxville, Tennessee; April 1976
- "Instrumentation and Application of Liquid and Gas Chromatography", Perkin-Elmer Seminar, Knoxville, Tennessee; 1975
- "Atomic Absorption Seminar", Varian Instrument Division, Knoxville, Tennessee; 1973
- "Techniques of Solid Waste Management", Knoxville, Tennessee; January 1972
- "Microbiological Analysis of Water and Wastewater", Millipore Workshop, Chattanooga, Tennessee; September 1972
- "Society for Applied Spectroscopy", Eleventh National Meeting, Dallas, Texas; September 1972

Experience and Background

1971 - <u>Laboratory Manager, IT Corporation, Knoxville, Tennessee</u>. Former Lab Present Manager at Stewart Laboratories, Inc., which was acquired by IT Corporation in July 1981. Responsible for supervision of all analytical groups, covering a two-shift operation and involving:

- Scheduling projects, shifting laboratory personnel to meet changes in work loads, evaluating data and writing reports, expansion and changes in laboratory facilities, instructing new employees and coordinating all day-to-day operations.
- Handles client calls dealing with technical questions and sales and customer service.
- Works closely with quality control coordinator to assure continued excellent quality of laboratory operations.
- Assists IT Field operations where possible and as needed.

(Alyce R. Moore)

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- Provides support to field operations, evaluates data and compiles reports.
- Assists analytical groups by actual "hands on" analytical testing. Trains new personnel and assists in interviewing and hiring of personnel.
- Schedules and coordinates large government projects.

1961 - <u>Assistant Manager and Bookkeeper, Cashier, Robert Hall Clothes,</u>
 1968 <u>Knoxville, Tennessee</u>. Handled all bookkeeping duties and managed store operations in manager's absence.

SNELL A. MILLS, III

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Professional Qualifications

Mr. Mills is an experienced analytical chemist in gas chromatography (GC) and gas chromatography/mass spectrometry (GC/MS) methods and equipment. He has performed analyses of waste materials and environmental samples in laboratory and field laboratory operations. Mr. Mills also has experience in computer services and maintenance, including programming and development of several custom programs and specialized libraries for the quantitative analysis of priority pollutants by GC/MS/DS.

Education

B.A., Chemistry, Maryville College, Maryville, Tennessee; 1979

Experience and Background

1986 - <u>Technical Director, IT Corporation, Knoxville, Tennessee</u>. Responsible Present for current laboratory technology growth and the introduction of new techniques for analysis of complex environmental matrices. Responsibilities include:

- Technical review of operations.
- Project management large multimatrix and multiparameter projects.
- Review and recommend capital expenditures.
- Methodology and Standard Operating Procedure approval.
- Troubleshooting in technical areas requiring assistance with project unique analytical chemistry problems.

1979 - Group Leader, IT Corporation, Knoxville, Tennessee. Responsible for 1986 all GC/MS analytical services at IT Analytical Services. Schedules work load, supervises analytical chemists and instrument maintenance of the GC/MS/DS systems. Responsible for:

- Ambient air analysis on EPA contracts and for coordination and preparation of all sampling container kits sent out to clients.
- Involved extensively in confirmation of polychlorinated biphenyls (PCBs) by GC/MS involving transformer oil; environmentally degraded PCBs in biological tissues, soil, sediment, and sludge; PCBs and products of incomplete combustion from incinerator test burns; and has developed a number of custom GC/MS methods for this purpose.
- Project Manager for Environmental Protection Agency-Contract Laboratory Program (EPA-CLP) for government contracts.

NANCY D. SEABOLT

69 159

Professional Qualifications

Nancy Seabolt has over ten years' experience in sample preparation and chemical analysis of environmental samples, including analysis of air, soil, water, biological tissues and miscellaneous types of waste samples for pesticides, polychlorinated biphenyls (PCB's) and trace organic compounds. She also has experience with gas chromatography using various detectors, high performance liquid chromatography, total organic halogen and other organic analysis techniques, as well as some experience with Atomic Absorption (AA) and gas chromatography/mass spectrometry (GC/MS).

Education

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M.S., Chemistry, University of Georgia, Athens, Georgia; 1977 B.S., Chemistry, North Georgia College, Dahlonega, Georgia; 1973

Experience and Background

1986 - <u>Technical Specialist for Gas and Liquid Chromatography, IT Corporation</u>, Present <u>Knoxville, Tennessee</u>. Responsible for:

- Method development for GC and HPLC, as well as troubleshooting instrument and project problems.
- Evaluating new instruments and techniques in addition to reviewing and updating current methodology.
- Bringing new instruments on-line and training technicians in their use.
- Assisting in technical proposals and project design.
- 1985 Technical Manager for Gas and Liquid Chromatography, IT Corporation, 1986 Knoxville, Tennessee. Responsibilities included scheduling of analyses and supervision of both chemists and technicians; method development for GC and HPLC, as well as, troubleshooting instrument and project problems; evaluating new instruments and techniques in addition to reviewing and updating current methodology; bringing new instruments on-line and training technicians in their use; and assisting in technical proposals and project design.
- 1978 <u>Analysis Coordinator, Chromatography and Absorption, IT Corporation,</u>
 1985 <u>Knoxville, Tennessee</u>. Direct supervision of all organic analyses at
 ITAS with the exception of GC/MS. Areas of responsibility included
 organic sample preparation, GC, HPLC, Total Organic Carbon (TOC), Total
 Organic Halogens (TOX), Ultraviolet (UV)-visible, infrared, and special
 applications. Intermittant experience with GC/MS, both running samples
 and interpreting data. In addition, conducted method development in
 organic analysis. Supervised three chemists and two technicians.

(Nancy D. Seabolt)

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- 1976 <u>Pesticide Residue Analyst, University of Georgia Cooperative Extension,</u>
 1978 <u>Athens, Georgia.</u> Conducted pesticide residue and trace metal analysis
 in feed ingredients, biological tissues, and soil and water samples.
 Techniques included gas chromatography, HPLC, and flame and flameless
 atomic absorption. Developed method for analysis of arsenic in chicken
 parts.
- 1973 <u>Graduate Research Assistant in Organic Photochemistry</u>, <u>University of</u>
 1975 <u>Georgia</u>. Involved in organic photochemistry. Participated in study of photodegradation products of 2,4-0.

Publications

Seabolt, N. D., P. B. Bush., R. S. Halbrooks, and J. H. Jenkins, 1980, "Mercury Accumulation in Georgia Otters", presented at the River Otter Research Workshop, Florida State Museum, March 27-29, 1980, Gainesville, Florida.

Seabolt, N. D., 1977, "An Investigation of the Segmental Mobility of 8-Ketobexadecyltrimethylammonium Bromide," Master's Thesis, University of Georgia, Athens, Georgia.

MARY E. TYLER

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Professional Qualifications

Mary Tyler is experienced in collecting chemical and biological samples for analyses of water and wastewater, and has done extensive work and study involved in anaerobic waste treatment systems and the gas chromatographic analyses of such systems - influents, effluents and by-products. She has been responsible for coordinating the commercial GC analyses in her group. She also did calculations and QC review of data. Currently, she is Quality Control Coordinator.

Education

M.S., Environmental Engineering, University of Notre Dame, Notre Dame, Indiana; 1984
B.A., Biology, Indiana University, Bloomington, Indiana; 1980

Experience and Background

1987 - <u>OA/OC Coordinator, IT Corporation, Knoxville, Tennessee</u>. Responsible Present for all quality assurance functions pertaining to laboratory operations. Specific job duties include:

- Initiating and supervising on-going DA programs.
- Entering intralaboratory and external QC samples into the sample stream.
- Determining and maintaining accuracy and precision data.
- Initiating, establishing, and maintaining preventive maintenance programs, corrective actions, method R & D, new employee training programs, and sample receipt and preservation protocols.
- Handling matters pertaining to ITAS accreditations, certifications, and outside QA audits and inspections.
- Supervising inventory and quality control of reagents, calibration standards, and Standard Reference Materials.

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- 1984 Chemist, IT Corporation, Knoxville, Tennessee. Experienced in analyzing extracts for PCBs, priority pollutant pesticides, city water pesticides and herbicides. Experienced also in total organic halide and total organic carbon, gasoline and diesel fuel analysis. Responsible for the commercial gas chromatography analysis and calculations and miscellaneous organics sections of the GC Department.
- 1982 Engineering Assistant, Elkhart Wastewater Treatment Plant, Elkhart, 1984 Indiana. Conducted solids balance and routine calculations of daily operating data, supervised and managed pilot tests for plant expansion, assisted in operator and laboratory technician training programs and prepared monthly operating reports.

(Mary E. Tyler)

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- 1980 Engineering Assistant and Laboratory Technician, TenEch Environmental 1982 Enginners, Inc., South Bend, Indiana. Conducted chemical and microbiological analyses of water and wastewater, trained laboratory technicians, managed and operated an anaerobic wastewater treatment project, participated in aerobic treatability study, prepared equipment and trained personnel for field sampling projects, performed engineering support activities such as data calculating, report preparation and drafting.
- 1979 Laboratory Technician, Indiana University, Bloomington, Indiana.
 1980 Worked part-time in the microbiology laboratory of the Environmental Health and Safety Department. Collected and analyzed campus milk, drinking water and stream water. Prepared weekly laboratory reports and maintained lab.

ROBYN M. WAGNER

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Professional Qualifications

Robyn Wagner has eight years of experience in laboratory operations management, analytical laboratory supervision, project design, project management, analytical chemistry, and biology/chemistry research. She is experienced in the supervision of analytical, mobile, and biological/toxicological laboratories and competent in the use of gas chromatography, high performance liquid chromatography, DC argon plasma emission spectroscopy, infrared spectroscopy, classical wet methods, and programming in BASIC.

Education

B.S., Biology, Rutgers University, New Brunswick, New Jersey; 1981

ACS Short Courses: Capillary Gas Chromatography: Techniques and Problem Solving; 1983 Effective Management Techniques; 1984 Effective Management Techniques for Chemical Analysis Laboratories; 1985

Experience and Background

- 1986 Operations Manager, IT Corporation, Knoxville, Tennessee. Present Responsible for management of daily laboratory operations; review all analytical data and report to Laboratory Manager for approval; handle client calls dealing with technical questions, sales, and customer service; supervise quality control activities performed as part of routine analytical operations; schedule projects and set priorities; responsible for supervision of group supervisors.
- 1985 <u>(On special assignment), IT Corporation, Knoxville, Tennessee</u>.
 1986 Assigned to the Knoxville analytical laboratories to expand technical expertise and develop working knowledge of all laboratory areas including laboratory information and data management, water and wastewater analyses, metals analyses, organic preparation, GC/LC, GC/MS and dioxin/furan analyses.
- 1981 Laboratory Supervisor, IT Corporation, Edison, New Jersey. Supervised a group of seven chemists and two technicians to provide analytical support to the USEPA under EERU Contract No. 68-03-3069. Established work plans, budgets and manpower forecasts for both R+D and emergency response activities, and was responsible for sampling and analytical expenditures of \$1,000,000. covering more than 100 different EERU projects. Directed research projects to evaluate equipment and develop rapid methodology for use onboard EPA's mobile laboratory. Supervised and performed analysis of hazardous materials in complex environmental

THOMAS W. WILSON

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Professional Qualifications

Thomas Wilson has been a gas chromatography/mass spectrometry (GC/MS) chemist since 1978. He worked in GC/MS pollutant analysis for nine years, and has recently served as Group Leader for major effluent guidelines isotope dilution contract, and now is the GC/MS Group Supervisor. Chemistry, electronics, and computer programming background qualify him for problem solving associated with interpretation and evaluation of raw analytical data and development of programs specifically designed to perform those functions. He has extensive experience in electronics and computer programming, having programmed in machine, assembly, and higher languages for several minicomputers, such as TI 980, PNP, and NOVA series. He was listed in <u>Journal of Analytical Chemistry</u> at the University of Tennessee in 1972 as its outstanding undergraduate analytical chemistry student.

Education

A.B.D., Chemistry, University of Tennessee, Knoxville, Tennessee; 1976 8.A., Biology, Vanderbilt University, Nashville, Tennessee; 1968

Experience and Background

	GC/MS Group Supervisor, IT Corporation, Knoxville, Tennessee.
Present	Responsible for:

- Coordinating and prioritizing projects.
- Reviewing and overseeing QC on all analyses.
- Training personnel.
- Purchasing for GC/MS meeds.
- Expediting and improving procedures in GC/MS group as a whole.
- Commercial and CLP analyses, including special projects, to cover all phases of GC/MS work.
- 1978 Group Leader for Special EPA Projects, IT Corporation, Knoxville,
 1986 Tennessee. Responsible for effluent guidelines work, and for GC/MS extractables analyses for hazardous waste contracts and all phases of GC/MS priority pollutant analysis, including development and optimization of procedures. Also responsible for Finnigan 4000 operation;
 GC/MS analysis including priority pollutant VOA's, base neutrals, and acid extractables, as assigned; application of GC/MS and GC techniques to wastewater analysis.
- 1972 Department of Chemistry, University of Tennessee, Knoxville, 1976 Tennessee. Conducted recitation classes and laboratories for various freshman courses, administered and proctored tests and exams, graded tests and laboratory papers.

(Robyn M. Wagner)

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matrices using standard, as well as, non-standard methodology, and a variety of analytical techniques (GC/MS, GC, MPLC, IR, TOC, DCP emission spectroscopy). Designed and directed extent of contamination studies. Responsible for the development and implementation of internal quality control procedures to ensure reliable and statistically sound data generation. Designed and managed an external quality assurance program to assure the validity of environmental measurements made during the testing of EPA prototypical hardware, including the mobile incinerator and the carbon regenerator. Responsible for the daily operation of EPA's central and mobile laboratories.

- 1980 Laboratory Technician, USEPA-OHMSB, Edison, New Jersey. Performed 1981 methods development research and environmental sample analyses. Preparation of rapid analytical methods for publication. Performed sample analyses onboard mobile laboratories during emergency response activations. Experience in repair and maintenance of analytical instruments.
- 1979 Laboratory Technician, USEPA-Region II, Edison, New Jersey. Performed
 1980 acute and chronic aquatic toxicology tests in support of the National Pollution Discharge Elimination Program. Assisted in the design of a flow-through aquatic bioassay system for the Surveillance and Analysis Division, Biology/Toxicology Laboratory. Maintained and cultured bioassay test organisms. Responsible for the daily operation of the laboratory. Conducted independent research of the life cycle of Daphnia magna.
- 1979 <u>US Forest Service, Camptonville, California</u>. Participated in the biology intern program.

Professional Affiliations

Member of the American Chemical Society Member of the ACS Environmental Chemistry Division Member of the American Institute of Chemists

Publications

Wagner, R., et. al., March 1984, "A Comprehensive Strategy for On-Site Analysis of Hazardous Waste," presented at the <u>1984 Pittsburgh Conference</u> <u>on Analytical Chemistry and Applied Spectroscopy</u>, Atlantic City, New Jersey.

Wagner, R., D. Remeta, and M. Gruenfeld, March 1985, "Rapid On-Site Methods of Chemical Analysis," <u>CONTAMINATED LAND: Reclamation and</u> <u>Treatment,</u> R. E. Montgomery ed., Plenum Publishing Corp., New York, pp. 257-310.

(Thomas W. Wilson)

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 1972 - Research Worker, University of Tennessee, Department of Chemistry, 1976 Knoxville, Tennessee. Conducted research under Dr. W. A. Van Hook. Involved osmotic pressure-free energy relationships between heavy and "natural" waters. Also did work for Dr. J. W. Larsen on research and development analysis of protein in hamburger meat.

APPENDIX B

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ANTICIPATED METHOD

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DETECTION LIMITS

ANTICIPATED METHOD DETECTION LIMITS

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METHOD/ANALYTE	Water Detection Limit (ug/l)	Limit
EPA 6010:		
Antimony	32	32
Arsenic	53	53
Barium	2	2
Cadmium Chromium	4	4
	7	.7
Copper Lead	6	6
Nickel	42	42
Selenium	15 75	15
Silver	75	75 7
Zinc	2	2
EPA 7470/7471:		
Mercury	0.2	0.2
EPA 8240:		
Acetone	100	100
Benzene	5	5
Bromodichloromethane	5	5
Bromoform	5	5
Bromomethane	10	10
2-Butanone	100	100
Carbon Disulfide Carbon Tetrachloride	5	5
Chlorobenzene	5	5
Chloroethane	5 10	5
2-Chloroethyl Vinyl Ether	10	10 10
Chloroform	5	5
Chloromethane	10	10
Dibromochloromethane	· 5	10
1,1-Dichloroethane	5	5
1,2-Dichloroethane	5	5
1,1-Dichloroethylene	5	5
t-1,2-Dichloroethylene	5	5
1,2-Dichloropropane	5	5
c-1,3-Dichloropropene	5	5
t-1, 3-Dichloropropene	5	5
Ethylbenzene 2-Hexanone	5	. 5
2-nexanone 4-Methyl-2-pentanone	50	50
Methylene Chloride	50	50
WeenArene curotide	5	5

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Styrene	5	5
Tetrachloroethylene	5	5
1,1,2,2-Tetrachloroethane	5	5
Toluene	5	
1,1,1-Trichloroethane	5	5 5
1,1,2-Trichloroethane	5	5
Trichloroethylene	5	5
Vinyl Acetate		
	50	50
Vinyl Chloride	10	10
Total Xylenes	5	5
EPA METHOD 8080:		
Aldrin	0.04	2.68
a-BHC	0.03	2.01
b-BHC	0.06	4.02
d-BHC	0.09	6.03
g-BHC (Lindane)	0.04	2.68
Chlordane	0.04	2.68
4,4'-DDD	0.11	7.37
4,4'-DDE	0.12	8.04
4,4'-DDT	0.12	
Dieldrin		8.04
	0.02	1.34
Endosulfan I	0.14	9.38
Endosulfan II	0.04	2.68
Endosulfan Sulfate	0.66	44.2
Endrin	0.06	4.02
Endrin aldehyde	0.23	15.4
Heptachlor	0.03	2.01
Heptachlor epoxide	0.83	55.6
Methoxychlor	1.76	118
Toxaphene	2.4	
PCB-1016	2.4	161
PCB-1221		
PCB-1232		
PCB-1242	0.65	43.6
PCB-1248		
PCB-1254		
PCB-1260		
EPA METHOD 8250:		
Acenapthene	19	1,273
Acenapthylene	35	2,345
Acetophenone		
Alddrin	19	1,273
Aniline		.,0/3
Anthracene	19	1 272
4-Aminobiphenyl	17	1,273
Aroclor-1016		
Aroclor-1221		
	300	20,100
Aroclor-1232		

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Aroclor-1242	-	
Aroclor-1248		
Aroclor-1254	360	24,120
Aroclor-1260		
Benzidine	440	29,480
Benzoic acid		
Benzo(a) anthracene	78	5,226
Benzo(b) fluoranthene	48	3,216
Benzo(k) fluoranthene	25	1,675
Benzo(g,h,i)perylene	41	2,747
Benzo(a) pyrene	25	1,675
Benzyl alcohol		_,
a-BHC		
b-BHC	. 42	2,814
d-BHC	31	2,077
g-BHC		2,017
Bis(2-chloroethoxy)methane	53	3,551
Bis(2-chloroethyl)ether	57	3,819
Bis (2-chloroisopropyl)ether	57	3,819
Bis (2-ethylhexyl) phthalate	25	1,675
	19	
4-Bromophenyl phenyl ether		1,273
Butyl benzyl phthalate Chlordane	25	1,675
4-Chloroaniline		
1-Chloronapthalene		
2-Chloronapthalene	19	1,273
4-Chlorophenyl phenyl ether	42	2,814
Chrysene	25	1,675
4,4'-DDD	28	1,876
4,4'-DDE	56	3,752
4,4'-DDT	47	3,149
Dibenzo(a,j)acridine		
Dibenzo(a,h)anthracene	25	1,675
Dibenzofuran		
Di-n-butylphthalate	25	1,675
1,3-Dichlorobenzene	19	1,273
1,4-Dichlorobenzene	44	2,948
1,2-Dichlorobenzene	19	1,273
3,3'-Dichlorobenzidine	165	11,055
2,4-Dichlorophenol	27	1,809
2,6-Dichlorophenol		
Dieldrin	25	1,675
Diethylphthalate	19	1,273
p-Dimethylaminobenzene		
7,12-Dimethylbenzo(a)anthracene		
a,a-Dimethylphenylamine		
2,4-Dimethylphenol	27	1,809
Dimethylphthalate	16	1,072
4,6-Dinitro-2-methylphenol	240	16,080
2,4-Dinitrophenol	420	28,140
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2,4-Dinitrotoluene	57	3,819
2,6-Dinitroltoluene	19	1,273
Diphenylamine		
1,2-Diphenylhydrazine		
Di-n-octylphthalate	25	1,675
Endosulfan I		
Endosulfan II		
Endosulfan sulfate	56	3,752
Endrin		·
Endrin aldehyde		
Endrin ketone		
Ethyl methanesulfonate		
Fluoranthene	22	1,474
Fluorene	19	1,273
2-Fluorobiphenyl	<u> </u>	_,
2-Fluorophenol		
Heptachlor	19	1,273
Heptachlor epoxide	22	1,474
Hexachlorobenzene	19	1,273
Hexachlorobutadiene	9	603
Hexachlorocyclopentadiene		
Hexachloroethane	16	1,072
Indeno(1,2,3-cd)pyrene	37	2,479
Isophorone	22	1,474
Methoxychlor		
3-Methoxychloranthene		~ _
Methyl methansulfonate		
2-Methylnapthalene		
2-Methylphenol		
4-Methylphenol		
Napthalene	16	1,072
1-Napthylamine		
2-Napthylamine	- -	
2-Nitroaniline		
3-Nitroaniline		
4-Nitroaniline		
Nitrobenzene	19	1,273
2-Nitrophenol	36	2,412
4-Nitrophenol	24	1,608
N-Nitroso-di-n-butylamine		1,000
N-Nitrosodimethylamine		
N-Nitrosodiphenylamine	19	1,273
N-Nitroso-di-n-propylamine		
N-Nitrosopiperidine		
Pentachlorobenzene		
Pentachloronitrobenzene		
Pentachlorophenol	36	2,412
Perylene		-,
Phenacetin		
Phenanthrene	54	3,618

Line I

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Phenol	15	1,005
2-Picoline		·
Pronamide		
Pyrene	19	1,273
Terphenyl		
1,2,4,5-Tetrachlorobenzene		
2,3,4,6-Tetrachlorophenol	-	
2,4,6-Tribromophenol		
1,2,4-Trichlorobenzene	19	1,273
2,4,5-Trichlorophenol		·
2,4,6-Trichlorophenol	27	1,809
Toxaphene		·

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SOURCE: USEPA. 1986. Test Methods for Evaluating Solid Waste. SW-846, Third Edition. Washington, DC: US Environmental Protection Agency.

DDMT WORK PLAN - VOLUME IV

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FINAL SAFETY HEALTH AND EMERGENCY RESPONSE PLAN (SHERP)

For

REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)

At

DEFENSE DEPOT MEMPHIS, TENNESSEE (DDMT) CONTRACT NO. DACA87-88-C-0092

Prepared for:

U.S. Army Corps of Engineers Huntsville Division P. O. Box 1600 Huntsville, Alabama 35807

Prepared by:

Law Environmental, Incorporated Government Services Division 112 TownPark Drive Kennesaw, Georgia 30144-5599

January 1989

1.0 INTRODUCTION

1.1 <u>PLAN_OBJECTIVE</u>

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The health and safety of site workers and the public is a primary concern and goal during hazardous materials investigations. Thus, a comprehensive, carefully managed, and thoroughly documented Safety, Health and Emergency Response Plan (SHERP) is crucial for successful project completion.

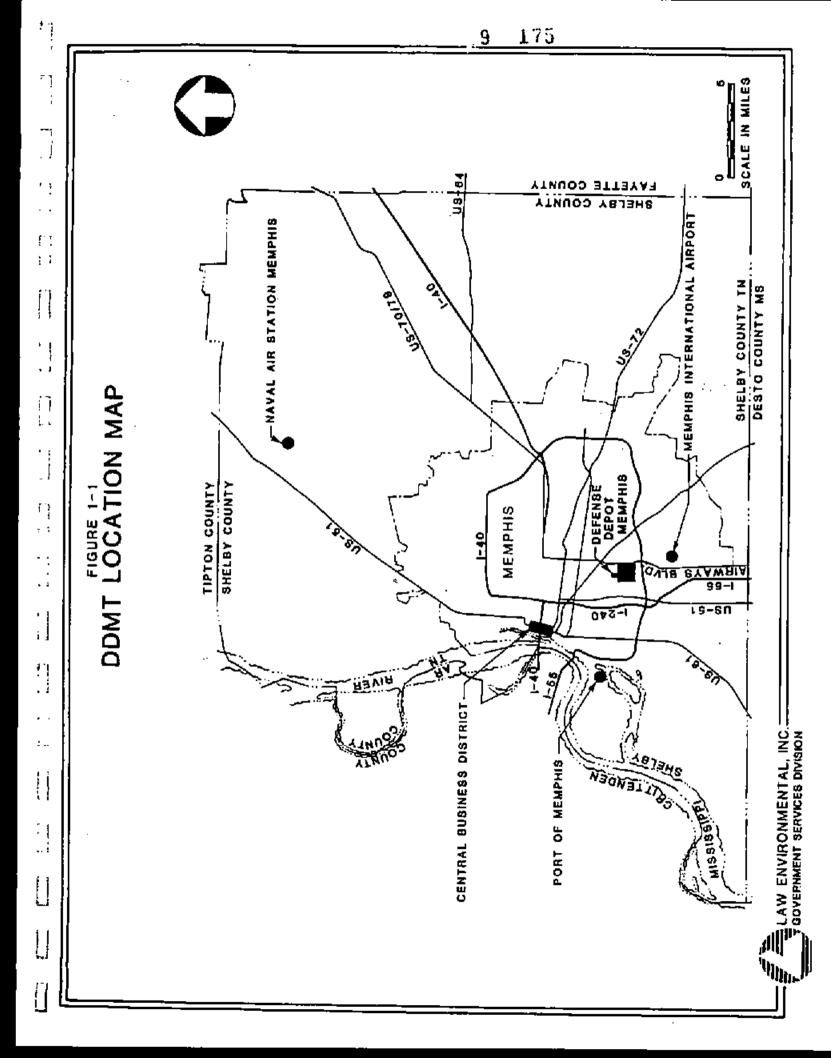
The plan describes field implementation of the SHERP, specific responsibilities, training requirements, protective equipment, and operating procedures that have been adapted to meet sitespecific requirements, emergency procedures and medical Its flexibility allows unanticipated site-specific monitoring. problems to be addressed while assuring adequate and suitable worker protection. This site specific plan is based on actual site inspections. The SHERP will be bound with other pertinent information, and given to the Site Manager as a field reference manual for safety, health and emergency responses. The complete SHERP will be discussed with all site personnel and will be made available for review through the Site Manager to ensure sufficient awareness of potential hazardous conditions and safety procedures on the site.

Appendix A presents additional field work requirements by the Technical Escort Unit for subsurface investigations at suspected chemical burial sites at Dunn Field.

1.2 SITE DESCRIPTION

The Defense Depot at Memphis, Tennessee (DDMT) is located in Memphis, Shelby County, Tennessee (see Figure 1-1). DDMT is currently managed by the Defense Logistic Agency (DLA). DDMT consists of 642 acres and has been in operation since 1942. The Depot stockpiles and distributes material goods for the

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Department of Defense throughout the south-central United States. Some of these materials included hazardous materials such as pesticides, cleaning solvents, and petroleum products. A more detailed description for DDMT is presented in Volume I of the Work Plan.

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1.3 <u>HAZARD_ASSESSMENT</u>

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A site inspection visit to DDMT, was performed by Law Environmental personnel, prior to the preparation of this SHERP. The purpose of the visit was to evaluate potentially hazardous conditions that might be encountered during the field investigation. The following hazard assessment data have been developed for potential hazardous substances that may be present at the site. The hazardous constituent list is based upon background information provided by the U.S. Army Corps of Engineers (USACE), and data gathered during the initial site inspection.

1.3.1 Suspected Constituents

According to documents provided by the USACE, operations at DDMT disposed of wastes consisting of the following compounds:

	Potential Source		Contaminants of Concern
0	Mustard/Lewisite	0	Thiodiglycol
0	Solvents	0	Acetone
			n-Butyl Acetate
			Carbon Tetrachloride
			Chloroform
			1,1-Dichloroethane
			1,2-Dichloroethylene
			1,1-Dichloroethylene
			Isooctanol
			Methyl ethyl ketone (MEK)
			Morpholine

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			1,1,2,2-Tetrachloroethane Tetrachloroethylene 1,1,1-Trichloroethane 1,1,2-trichloroethane Trichloroethylene Toluene
0	Pesticides/Herbicides		o DDD, DDT, DDE, Chlordane, Aldrin, Malathion, 2,4-D, Zinc Chromate, Dieldrin
o	PCP Dip Tank	o	Pentachlorophenol (PCP) Dioxin/Furan
o	Transformers	o	РСВ
o	Spills	o	Hydrofluoric Acid, Naptha,
O	Paints	o	Cadmium, Chromium, Lead
o	Burials at Dunn Field	o	Trichloroacetic Acid ortho-Tolidine dihydrochloride

1.3.2 <u>Characteristics of Suspected Constituents</u>

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Table 1-1 contains a list of the chemical contaminants of concern which are suspected to be present at DDMT. The table also lists the physical characteristics, odor threshold, regulatory exposure limits, respirator breakthrough times, and resistant material. The following is a brief discussion of each constituent. The complete Chemical Hazard Response Information System (CHRIS) files for all constituents except mustard gas are presented in Appendix A in the form of Chapter 2, Agent Information from Safety Regulations for chemical agents H, HD, and HT (DARCOM-R 385-31).

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			DEFENS	ie depot -	MEMPHIS, TENNESSEE	TENNESS	Ë			
INDICATOR CHEMICAL	SPECIFIC GRAVITY	AED VAPOR PRESSURE (psia)	WATER ⁽¹⁾ SOLUBILITY (Ros/bs H2O)	LELAJEL(2) (%)	EXPOSURE LIMITS TLV ⁽³⁾ DLH ⁽⁴⁾ ACGH (ppm)	LIMITS DLH(4) (ppm)	ODOR THRESHOLD (ppm)	RESPIRATOR ⁽⁵⁾ CARTRIDGE BREAKTHROUGH Time (minutes)	CHEMICAL RESISTANT MATERIAL	
SOLVENTS: Acetane	167.	£.7	miscible	2.6/12.8	750	20,000	ŝ	37	Nylan, rubber	
n-Butyl Acetate	0.86	0.5	0.1	1.7/7.6	150	10,000	10	11	Nylon; Delrin	
Carbon Tetrachloride	1,59	3.8	90.	Not fammable	5, skûn	300	>10	77	Viton	
Chloratorm	1.49	6.4	.80	Noi flammable	10	1000	205-307	ß	Vltan	
1,1-Dichloroethane	ө 1.17	17.4	.50	5,6/11,4	200	4000	¥	23	Viton	
1,1-Dichloroethylene	ne 1.21	18.3	.50	7,3/16	ŝ	20	NA	ı	I	
1,2-Dichloroethylene	ne 1.27	M	<u>8</u> .	9.7/12.8	200	4000	¥	30	Viton	
Isooctanol (6)	829.	M	.60	¥	M	NA	v	I	ı	
Methyl ethyl Ketone	ы ,806	3.5	27	1.8/11.5	200	NA	10	82	Polypropylene nylon	ç
Morpholine	0.1	0.5	miscible	1.8/10.8	20,skin	AN N	ţ	ı	Rubber	
1,1,2,2 Tetra- chloroethane	1.60	0.5	.25	Not flammable	1, skin	150	0.5	104	Viton	
Tetrachioroethylene (perchioroethane)	e 1.63	M	.02	Noi flammable	50	500	ŝ	107	Vitan Vitan	^
1,1,1-Trichloroethane	1.31 an	4.0	.07	2//6	350	450	100	I	173 voji	1 +
1,1,2 Trichloroethane	ne 1.31	M	NA	2/16	10, skin	1000	100	72	Viton	
Trichloroethylene	1.46	2.5	1.	B/10.5	50	1000	50	55	Viton	
Toluene	.867	1.1	.05	1.3/7	100	2,000	2	94	Nykon, Vitan	

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TABLE 1-1

CHARACTERISTICS OF SUSPECTED CONTAMINANTS

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			CHARACT	TABLE 1-1 (CONTINUED) CHARACTERISTICS OF SUSPECTED CONTAMINANTS	Table 1-1 (Continued) Tics of Suspected of	NTAMINANT	ø			
			DEFENSE	E DEPOT -	MEMPHIS, T	TENNESSEE)			
INDICATOR SPE CHEMICAL CER	SPECIFIC	REID VAPOR PRESSURE (psia)	WATER ⁽¹⁾ SOLUBLITY (Ibs/bs H2O)	(%) (%)	EXPOSURE LIMITS TLV ⁽³⁾ DLH ⁽ ACGIH (ppm)	Ŧ	ODOR THRESHOLD (ppm)	RESPIRATOR ⁽⁵⁾ CARTRIDGE BREAKTHROUGH Time (minutas)	CHEMICAL RESISTANT MATERIAL	
PESTICIDES/HEABICIDES:	IICIDES:									
Aktin	1.6	¥	o '	ı	.25 mg/m ³ , skin	100 ന്യ/ന ³	¥	ı	ı	
Chlordane	1.60	MA	insoluble	0.7/5	0.5 mg/m3, skin	500 mg/m ³	NA	NA	NA	
2,4 D	1.563	Å	Ą	W	10 mg/m ³	500mg/m ³	3.13mg/m ³	ı		
000	¥,	22	22	N N		I	, , ,		I	
DOT	1.56	NA	insoluble	Not flammable	1 mg/m ³	¥1	NA	W	A	
Diektrin	167.	7.25	insoluble	NA	0.25 mg/m ³	450 mg/m ³	~		ı	
Malethion	1.23	M	.014	NA	10 mg/m ³ , skin	5000 mg/m ³	,	I	,	09
Melhyl Bromide	1.68	45	060'	10/15	5.skin	2.000	Odortess		Kynar/Viton	1
Zinc Chromate	3.43	M	.100	¥	.01 mg/m ³	500 mg/m ³	Odortess	ı	'a	73
MISCELLANEOUS										
PCP (Pentachtorophenol)	1.98	NA	.100	Not flammable	0.5 mg/m, ³ skin	150 mg/m ³	. VN	NA	•	
DiaxIn	M	7	⊽	2/22	100	NA	NA	NA	¥	
Furan	0.94	7	NA	2.3/14.3	10	¥N	NA	NA	M	
PCB	1.3 - 1.8	NA	insoluble	Not Ilammable	0.5 -1.0 тg/m ³	5-10 пд/п ³	NA	NA	NA	

TABLE 1-1 (CONTINUED)

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				CHARACTE	TABLE 1- ERISTICS OF E DEPOT -	TABLE 1-1 (CONTINUED) HARACTERISTICS OF SUSPECTED CONTAMINANTS DEFENSE DEPOT - MEMPHIS, TENNESSEF	D) CONTAMINA TENNESSE	NTS TE		
INDICATOR	-	SPECIFIC GRAVITY	HELD VAPOR PRESSURE (ps#a)	WATER ⁽¹⁾ SOLUBILITY (Ibs/Ibs H2O)	LEL/JEL ⁽²⁾ (%)	EXPOSURE LIMITS TLV ⁽³⁾ DUH ⁽¹ AOGH (ppm) (ppm)	-IMITS DUH(⁴⁾ (ppm)	CDOR THRESHOLD (ppm)	RESPIRATOR ⁽⁵⁾ CARTRIDGE BREAKTHROUGH Time (minutes)	CHEMICAL RESISTANT MATERIAL
Naptha (7)		88. - 88.	0.13	insolub l a	¥	100	10,000	4.7		Kynar, Viton
Hydrofluorie Acid	ic Acid	1.26	Varies	miscable	¥	ŋ	20	NA		Neoprene niirte NBR
Trichloroacetic Acid	etic Acid	1.6	lmm. at 51oC	.13	NA	-	N	1.6-2,5 тg/т ³		
o-Tolidine (Dihydrochloride)	(bride)	1.0	0.1 mm at 20 ⁰ C	miscible	¥	A2 skin	M	M	NA1	
Thlodiglycol	-	1.19	¥	Misc in water	N	¥	۲	NA	NA	(Thiodiethylanel) glyco
	Pounds/Pounds of Water Lower Explosive Limit (LE Threshold Limit Value (TL Immediately Dangerous to Time to reach one percei	of Water Limit (LEL)/I falue (TLV) e genous to Life ne percent b	Pounds/Pounds of Water Lower Explosive Limit (LEL)/Upper Explosive Limit (UEL) Threshold Limit Value (TLV) established by American Conference of Governmental Industrial Hygienist (ACGIH) Immediately Dangerous to Life or Heatth (IDLH) Time to reach one percent breakthrough at concentration of 1000 pom.	t (UEL) tan Conference tartation of 100	of Governments 0 pom.	al Indusirial Hygix	misi (ACGIH)			, g

Inner to react one percent breakthrough at concentration of 1000 ppm.
 Data for this compound is for Octanol
 Coal Tar
 NA - Not Available

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1.3.2.1 Chlorinated Hydrocarbons

Specific chlorinated hydrocarbons that may potentially be present at the site include: Carbon Tetrachloride, Chloroform, 1,1-Dichloroethane, 1,2-Dichloroethane, 1,2-Dichloroethylene, 1,1,2,2-Tetrachloroethane, Tetrachloroethylene, 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, and Trichloroethylene. These compounds are characteristically colorless, volatile, highly flammable liquids with a chloroform-like odor. The chlorinated hydrocarbons have high vapor pressure and higher specific gravities than water. Exposure may occur by inhalation of vapors, supplemented by skin adsorption. Exposure to the liquid and vapor may produce irritation to eyes, skin, and upper respiratory tract. Liquid aspirated into the lungs can cause serious pulmonary damage. Acute exposure results in central nervous system depression, headache, dizziness, nausea, and deterioration of the liver and kidneys. The threshold limit values for the chlorinated hydrocarbons listed range from 1 ppm (1,1,2,2-Tetrachloroethane) to 350 ppm (1,1,1-Trichloroethane).

1.3.2.2 Other Solvents

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Other solvents which may be potentially on the site are acetone, n-butyl acetate, isooctanol, MEX and toluene. As a class, these solvents are colorless, volatile and flammable with characteristic odors. Their vapors irritate the eyes and upper respiratory tract. Acute exposures cause dizziness, headache, anesthesia and respiratory arrest. Contact with liquid solvent irritates the eyes and dries the skin. Aspiration into the lungs causes gagging and pulmonary edema, while ingestion causes vomiting, diarrhea and depressed respiration. Liver and kidney damage can follow ingestion. The threshold limit values for these solvents range from 100 ppm (toluene) to 750 ppm (acetone).

1.3.2.3 <u>Pentachlorophenol (PCP)</u> 09 182

PCP has been used as a wood-preservative, herbicide, defoliant, and antimicrobial agent. Exposure may occur through inhalation of contaminated soils and skin adsorption. Exposure may cause local irritation and systemic effects- characterized by profuse sweating, fever, and gastrointestinal pains- eventually effecting the liver and kidneys. There is some evidence that PCPs are carcinogenic in laboratory animals.

1.3.2.4 <u>Metal Contaminants</u>

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Metals that might potentially be present on the site include chromium, cadmium, and lead. <u>Chromium</u> compounds may act as allergens in some workers, causing dermatitis to exposed skin. Acute exposure, which is unlikely at the site, may cause coughing, wheezing, and headaches. Hexavalent chromium is a known carcinogenic substance with a TLV of 0.05 mg/m3. The early effects of <u>lead</u> poisoning are non-specific. Later symptoms (usually reversible) include fatique, headaches, aching bones, and decreased appetite. <u>Cadmium</u>, although potentially toxic, should not present exposure problems with the precautions being taken to reduce exposure to other materials present. The TLV's for lead and cadmium are 0.15 mg/m3 and 0.05 mg/m3 respectively.

1.3.2.5 <u>Pesticides</u>

A wide variety of pesticides has been used at DDMT. Pesticides, in general, are not readily volatized into air. Investigative activities such as drilling and sampling do not generate significant amounts of dust. Therefore, workers should not experience potentially hazardous exposure to pesticides via inhalation. Proper skin protection will be provided with the use of Tyvek coveralls, gloves, boots, and goggles. Commonly used pesticides include:

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<u>Dioxin (TCDD) / Furan</u>

Dioxin is a colorless, needlelike crystal that has been used as a herbicide. It is carcinogenic. Exposure may occur via oral or dermal contact. It is a mild irritant to eyes. Exposure may cause severe problems to the liver, and chloracne.

Furan is a clear-white liquid. Exposure may occur via inhalation or dermal contact. Exposure may produce a narcotic effect in affected humans.

<u>Chlordane</u>

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Chlordane is a amber liquid with a chlorine-like odor that has been used as an insecticide. It is a suspected human carcinogen. Exposure may occur through inhalation or skin adsorption. Exposure may cause hyperexcitability and convulsions. Chronic exposure can cause liver damage.

DDT

DDT is a colorless-white crystal with a slight aromatic odor. It is a common air contaminant and exposure via inhalation, oral or dermal contact. Acute exposure causes tremors in the head/neck muscles, mild convulsions, cardiac/respiratory failure, and death. Chronic exposure causes dermatitis, convulsions, central nervous system degeneration, coma, and death.

<u>Aldrin</u>

Aldrin is a light to dark brown solid or solution used as an insecticide or fumigant. Ingestion, inhalation or dermal absorption of an acutely toxic dose will cause nausea, vomiting, hyperexcitability, tremors, convulsions and ventricular fibrillation. Kidney and liver damage is reversible to an extent. Ingestion of 25 gr. has caused death in children. The threshold limit value is 0.25 mg/m^3 for aldrin.

<u>2.4-D</u>

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2,4-Dichlorophenoxyacetic acid is a systemic herbicide which is an odorless, white or solid. Exposure to 2,4-D dust may irritate the eyes. Ingestion produces gastroenteric distress, diarrhea, mild CNS depression, difficulty in swallowing and transient liver and kidney injury. The threshold limit value is 10 mg/m³.

<u>Malathion</u>

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Malathion (Cythion) is a liquid insecticide with a strong "skunklike" odor. Exposure to malathion fumes causes headache, blurred vision, constriction of the pupils, weakness, nausea, cramps, diarrhea and chest tightness. Muscle twitching and convulsions may follow. These symptoms develop over a period of eight hours. The threshold limit value is 10 mg/m³ with 5000 mg/m³ being immediately dangerous to life and health.

<u>Zinc Chromate</u>

Zinc chromate is a yellow, odorless solid used as a fungicide. Inhalation of the dust causes irritation of the nose and throat. Ingestion of zinc chromate can cause irritation or corrosion of the alimentary tract, circulatory collapse, and toxic nephritis. Skin or eye contact causes irritation. Chronic inhalation exposure to zinc chromate is associated with lung cancer. The threshold limit value is 0.05 mg/m^3 .

<u>Methyl Bromide</u>

Methyl bromide is a colorless liquefied gas with a weak, chloroform-like odor. Methyl bromide is used as a fumigant. Inhalation of vapors produces lung congestion and pulmonary edema. Higher concentrations cause rapid narcosis and death. Methyl bromide liquid irritates the eyes and skin on contact. Methyl bromide has a threshold limit value of 5 ppm and is easily absorbed via the skin.

<u>Dieldrin</u>

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Dieldrin is a light brown solid insecticide with a mild chemical odor. Inhalation, ingestion or dermal contact causes irritability, nauseas, vomiting, fainting, convulsions and coma. The threshold limit value is 0.25 mg/m^3 and is absorbed via the skin. The NIOSH time-weighted average PEL is 0.15 mg/m^3 .

1.3.2.6 <u>Miscellaneous Constituents</u>

Miscellaneous constituents include:

<u>Morpholine</u>

Morpholine is a colorless, oily liquid solvent with a fishy, ammonia odor which is used as a rubber accelerator, and as an ingredient in boiler water, waxes, polishes, detergents and as a corrosion inhibitor. Contact with liquid morpholine causes skin and eye burns. Inhalation or dermal absorption may produce nausea and headache. The threshold limit value is 20 ppm with a short-term inhalation limit of 20 ppm for 15 minutes. The odor threshold is 0.01 ppm.

Hydrofluoric Acid

Hydrofluoric acid is a watery liquid with an irritating odor. It is a non-oxidizing mineral acid which causes serious and painful burns of the eyes and skin. The threshold limit value is 3 ppm. Although hydrofluoric acid was previously spilled on the DDMT site, no remnants of the spills are expected to remain to the present time as hydrofluoric acid is quickly degraded in the environment.

<u>Naphtha</u>

Naphtha (Coal Tar) is a mixture of benzene, toluene and xylenes which is the active ingredient in moth balls. Naphtha is

primarily a narcotic and causes unconsciousness with high concentration inhalation exposures. Chronic exposure are associated with leukemia.

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Trichloroacetic Acid

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Trichloroacetic acid is a colorless, crystalline solid with a sharp, pungent odor. It is used in organic synthesis, medicine, pharmacy and in herbicides. The TLV is 1 ppm. Small bottles of trichloroacetic acid were buried at Dunn Field in 1965. In aqueous conditions, trichloroacetic acid decomposes at room temperature to chloroform and carbon dioxide (Kearney, 1975). The persistence of trichloroacetic acid in soil varies from 14 to 90 days and is dependent on soil type, moisture, and temperature (Worthing, 1979).

<u>O-Tolidine (dihydrochloride)</u>

O-Tolidine is absorbed through the skin and is an assumed human carcinogen. No specific threshold limit value is given by ACGIH. This material was buried at Dunn Field in 1955. O-Tolidine has a high melting point and is not volatile. Also, this constituent is only slightly soluble in water. The potential hazard to field workers from inhalation or skin exposures is low (HSDB, 1988).

1.3.3 <u>Hazard Assessment Summary</u>

Based on the initial site inspection, the potential for healththreatening contamination exists and warrants increased personal protection for the Field Work Team. Intrusive activities, such as soil boring, monitoring well installation, and sampling increase the potential for exposure to hazardous substances.

Requirements for personal protective equipment and safety protocol will be discussed in Section 4.0.

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2.0 RESPONSIBILITIES

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The Project Manager, Site Manager, and Health and Safety Officer are responsible for formulating and enforcing health and safety requirements. These responsibilities include:

- Assuring that all site team members have received the required 40-hour health, safety and emergency response training;
- . Assuring that all team members have completed the required medical examination and have met the qualification criteria for site work;
- . Assuring that all equipment used on site is suitable and adequate;
- . Assuring that site standard operating procedures are followed at all times; and
- Addressing any unusual problems or conditions that may be encountered.

The Site Manager, Mr. Robert Manson, will also serve as the Field Safety Coordinator. He will have direct responsibility for administering the SHERP relative to all site activities, and will be in the field full-time while site activities are in progress. His primary operational responsibilities will be environmental monitoring, including air and soil monitoring. Mr. Manson has completed his 40-hour course titled "Health and Safety for Hazardous Waste Operations" as required by OSHA (29 CFR 1910.120), Red Cross first aid and CPR training. In addition, Mr. Manson has received the required eight hours of training for on-site management and supervisor personnel in accordance with OSHA (29 CFR 1910.120(e)(3)]. This training and his experience on other hazardous waste sites qualify him as the Field Safety

Coordinator. Mr. Greg Myers will serve as the Alternate Field Safety Coordinator. Mr. Myers has successfully completed the same training programs as Mr. Manson.

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The Project Manager, Mr. Steven Shugart, has overall responsibility for the the project and will visit the site during field operations. He will direct the Site Manager and will confirm that the SHERP is properly implemented. The Project Manager reports to the Principal Engineer, Mr. Thomas L. Richardson, who has ultimate responsibility for the project.

The Health and Safety Officer, Dr. Jack Peng, has responsibility for reviewing and approving the SHERP and responding to any nonroutine matters that relate to health, safety, and emergency response during the project life. The Health and Safety Officer provides an independent check on the implementation of the SHERP at the site. The Health and Safety officer may visit the site at any time to monitor compliance with the provisions of the SHERP. Field Personnel will report directly to the Site Manager. Subcontract Personnel will also report directly to the Site Manager. A brief description of each individual's experience and capabilities is presented in Section 2.2 of the DDMT Work Plan.

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3.0 PERSONNEL HAZARD TRAINING

3.1 <u>COMPREHENSIVE TRAINING</u>

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A thorough understanding of the types of hazards most likely to be encountered at hazardous waste sites and personal protection measures needed to protect on-site personnel are the first requirements of a complete SHERP. As a result, Law Environmental requires that each project team member participate at a minimum in a 40-hour comprehensive training course which complies with OSHA 29 CFR 1910.120. Annual refresher training is also an integral part of overall hazardous waste awareness.

Table 3-1 provides an outline of Law Environmental, Inc.'s comprehensive training course. The training courses are conducted by the company Health and Safety Officer, and representatives from outside companies who manufacture and distribute safety equipment. The course includes a hands-on training session to familiarize the participants with safety equipment and field situations.

Subcontractors and visitors entering designated work areas will be subject to all applicable health and safety requirements during field operations at the site. The Site Manager is responsible for briefing the subcontractor's personnel on potential contamination that may be encountered on the site, site safety, and the emergency response plan. Potential subcontractors that may work on the project include the drilling crew and the survey crew. Each of the subcontractors and visitors will be under the direct supervision of the Site Manager or his representative.

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Table 3-1

LAW ENVIRONMENTAL TRAINING COURSE

HEALTH AND SAFETY PROCEDURES

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HAZARDOUS WASTE SITES

I. HEALTH AND SAFETY

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- A. Introduction/Background
- B. Attitude and Behavior
- C. General Safety Practices
 - 1. Overview of personnel protection equipment
 - 2. EPA levels of protection
 - 3. Procedures for site investigation
 - a. Planning before departure
 - b. At the site
 - c. Decontamination and site exit
 - 4. Environmental monitoring equipment
 - a. Detector tubes (Draeger)
 - b. Organic vapor analyzers (OVA)
 - c. Photoionization Detectors (Photovac TIP, HNU)
- D. General Occupational Health
 - 1. Common classes of chemicals
 - 2. Exposure routes
 - 3. Physical, chemical properties, toxicity
 - 4. Medical monitoring
 - 5. Pulmonary function tests
- E. DOT Labeling Regulations
- F. Safety Regulations

II.	PER	SONAL	PROTECTION		09	191
	Α.	EPA	Levels of Protecti	ion		
		1.	Selection criteri	ia		
		2.	Equipment			
	в.	Resp	iratory Protection	1		
		1.	Types of respirat	ors		
		2.	Fit testing			
	-	3.	Cartridge selecti	on		
		4.	Cleaning, mainten	ance, s	storag	e
	c.	Prot	ective Clothing			
		1.	Types, materials			
		2.	Selection			
		3.	Protection from v	arious	chemi	cals
	D.	Self	-contained Breathi	ng Appa	aratus	
III.	RESI	PIRATO	R FIT TESTING			
	A.	Qual	itative Fit Testin	g of En	nploye	es
		1.	Personal safety d	ata she	ets	
		2.	Cleaning, repairi			nce
IV.	EQUI	PMENT	DEMONSTRATION AND	PRACTI	CE SES	SSIONS
	Α.	Drae	ger Detector Tube :	Samplin	ıg	
	в.		nic Vapor Analyzer:			
	c.	SCBA				

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V. HAZARDOUS WASTE FUNDAMENTALS

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- A. Determination of a Hazardous Waste
- B. Labeling, Manifests, Placarding
- C. Proper Shipping Names, Transportation
- D. Material Safety Data Sheets

VI. QA/QC CONSIDERATIONS

- A. Requirements
- B. Standard Forms
- C. Chain of Custody

VII. SITE OPERATIONS

- A. Work Zones
- B. Sampling Techniques
- C. Equipment Decontamination
- D. Sample Handling

VIII. REVIEW OF SITE-SPECIFIC STANDARD OPERATION PROCEDURES

- A. SHERP for the Site
- B. QC Plan for the Site

3.2 <u>PRE-INVESTIGATIVE HEALTH AND SAFETY BRIEFING</u>

Prior to the start of any field activity the Site Manager and Project Manager will meet with all workers and subcontractors. These meetings will discuss in detail the hazards specific to the site and will specify the proper work uniform for each work area. As part of this meeting the Standard Operating Procedures (SOPs) will be outlined. It is the responsibility of the Site Manager to ensure that all workers are thoroughly familiar with each specific SOP and the overall chain of command at the site.

3.3 MORNING SAFETY MEETINGS

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Morning safety meetings help in the safe execution of the field work. These meetings are the responsibility of the Site Manager. The Site Manager will inform field personnel of any changes from the previous day activities. Responsible individuals will be identified and routes for emergency corrective actions will be shown.

3.4 POST-INVESTIGATION SAFETY MEETING

Immediately following completion of field work, a meeting will be held to review the implementation of the SHERP. The objective of this meeting is to provide a basis for future SHERP's.

4.0 FIELD IMPLEMENTATION

The SHERP addresses all phases of field operations at the site, including:

- Names of key personnel responsible for site safety and health
- . Work practices

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- . Hazard identification and assessment
- Established work zones
- . Level of personal protective equipment required in each zone
- . Sampling procedures
- . Entry and exit routes
- . Decontamination procedures
- . Accident/emergency response
- . Medical surveillance
- . Training
- . Record keeping

A review of the history and conditions of the study area indicated the extent and nature of the hazardous conditions. Based on the information obtained, the primary exposure to workers by hazardous constituents will be through contact with contaminated soil or water. The inhalation of vapors during intrusive activities also appears to be an important source of contact. As a result, the site investigation will be performed primarily under Level D personnel protection with the additional requirement for nitrile gloves and Tyvek coveralls (levels of protection A through D are described in Appendix A). Provisions are made to further upgrade levels of protection if necessary. Level C protective equipment will be available on-site.

4.1 PERSONAL PROTECTIVE EQUIPMENT

It is well established that worker efficiency decreases in direct proportion to the amount of protective gear required. Thus, it is desirable to use as little equipment as possible while

providing adequate protection. Anything less than maximum protection (Levels A or B) cannot be specified without (1) carefully defining site conditions, (2) allowing extra safety margins, (3) having higher level equipment readily available, and (4) anticipating worst-case conditions. In the event of conflicting requirements, the most protective level shall apply. It cannot be emphasized too strongly, that these requirements are subject to change at any time by the Health and Safety Officer or the Site Manager based on contaminant monitoring, visual observations, or changes in work or site conditions.

This SHERP recognizes four levels of personal protection (levels A, B, C, and D). Personal protective equipment selection is based on three separate criteria: EPA Levels of Protection as defined in Standard Operating Safety Guides; Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, provisions of OSHA 29 CFR 1910 and 1926; and, the U.S. Army Corps of Engineers Safety and Health Requirements Manual EM 385-1-1. The required protective equipment and selection criteria for all levels of protection are summarized in Appendix A. Based on these criteria, and the results of our site inspection, we have chosen to initially use a modified Level D protection (described in Appendix A) for various site activities. The following levels of protection are those that may be utilized at the site for the proposed field investigations. Section 4.6 presents additional safety equipment required for field work.

<u>LEVEL D</u>

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Level D is defined as the basic work uniform. Based on the initial site reconnaissance, the field investigations at DDMT will be conducted in the modified Level D work uniform with the additional requirement of nitrile gloves and coated Tyvek coveralls. However, safety equipment will be available on-site to upgrade protection to Level C if necessary. The Level D safety equipment includes:

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- . Distinct field work clothes
- . Coated tyvek or disposable chemical resistant coveralls
- . Viton or mitrile rubber boots, with steel toe and shank
- . Disposable outer boots (optional)
- . Hard-hats
- . Face shield (optional)
- Viton gloves with optional cotton liners . Gloves are required when any contact with soil or water on-site is necessary.

LEVEL C

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Level C (as defined in Appendix A) equipment includes the following:

- Half-face, air-purifying respirator, with cartridges for organic vapors, dusts and mists.
- . Tyvek coveralls or disposable chemical-resistant coveralls
- . Viton gloves, with optional cotton liners
- . Cotton gloves as liners if needed
- . Neoprene or nitrile rubber boots, with steel toe and shank
- Disposable outer boots (optional)
- Hard-hats
- Safety glasses or goggles

LEVEL B

If Level B conditions are encountered, site work will be terminated, the USACE will be notified, and the contract will be modified to allow upgrades necessary to operate at this level. Level B (as defined in Appendix A) equipment includes the following:

- Pressure-demand (Positive Pressure) SCBA, NIOSH/MSHA approved
- . Polylaminated chemical-resistant coveralls

- . Inner chemically resistant gloves (Viton)
- . Outer chemically resistant gloves (Viton)
- . Hard hat

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- . Inner boots with steel toe and shank
- . Disposable outer boots (optional), taped to cuff
- . Two-way radio communication

4.2 MONITORING

4.2.1 Environmental Monitoring

The primary health and safety concerns during field activities are physical contact with contaminated soil and the inhalation of vapors. Frequent photoionization detector (PID) measurements will be conducted with a Photovac TIP or HNU PID during all drilling and sampling activities. During drilling, a measurement will be obtained each time the drill stem is removed from the auger flights to take a soil sample. During well development and all sampling activities, a PID measurement will be taken each time a sample is taken, and not less than each half-hour. The photoionization detectors will be calibrated each day using the appropriate calibration gas.

In addition, certain constituents have action levels near the reasonable detection limits of the PID units (approximately 1 For this reason, a flame-ionization detector (FID) with ppm). gas chromatagraph (GC) attachment, or other method of determining specific organic constituents, will be used to supplement the PID The FID-GC unit will be used to identify if readings. constituents with low action levels are present (specifically 1,1,2,2-Tetrachloroethane). An FID-GC reading will be made each time the PID instrument indicates even low levels of constituents. FID-GC readings will be made a minimum of every two hours during drilling, well installation, and sampling activities. The FID-GC unit will be regularly calibrated according to the manufacturers recommendations.

An explosimeter (MSA Model 2A) will be used to check for explosive atmospheres in the boreholes at the same intervals as the PID. The explosimeter measures from 0 to 100 percent of the Lower Explosive Limit (LEL). The LEL is the minimum concentration of vapors in the air forming a mixture elevated enough to burn or explode, given a source of ignition. If the explosimeter reading is greater than 20 percent of the LEL, then work will be stopped and the situation evaluated. Section 4.5 provides a discussion of the specific gear required for each specific work task and the action levels for each task.

Environmental monitoring will be performed frequently during drilling and sampling. Each time the auger is advanced five feet during drilling, the borehole headspace will be monitored using the PID and explosimeter. The soil contained in each sampler removed from the boring will be monitored with the PID and the reading will be recorded in the lithologic log. During sampling, well headspace measurements will be taken with the PID when the well is initially opened and during sample collection.

4.2.2 Personnel Monitoring

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Cold weather is expected during the field investigation. To minimize health problems when the outside temperature is below freezing, at least one 15 - minute break will be allowed every two hours for workers to warm up. If work continues into the summer months, heat stress may become a health related problem especially when wearing protective equipment. During warm weather, workers will be continually observed (through the buddy system and by on-site managers) for signs of heat stress, elevated body temperature, and other adverse health effects. Monitoring of personnel wearing impervious clothing will commence when the ambient temperature is 72.5°F or above. Monitoring frequency will increase as the ambient temperature increases or as slow recovery rates are observed. When temperatures exceed 72.5⁰F, workers will be monitored for heat stress at the

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intervals described in Table 4-1. Monitoring will be performed by the Site Manager.

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The following techniques will be used to monitor the body's recuperative abilities. Heart rate (HR) will be measured by the pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats per minute. If the HR is higher, the next work period will be shortened by 10 percent while the length of the rest period remains the same. If the pulse rate is 100 beats per minute at the beginning of the next rest period, the following work cycle will be shortened by 33 percent.

4.3 ACTION LEVELS OF PERSONAL PROTECTION

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When predetermined constituent levels are indicated by field instrumentation, action is dictated to preclude exposing personnel to hazardous conditions. The action may be either engineering controls to reduce constituent levels, or personal protection.

Airborne contamination with both PID and FID units will be monitored as described previously. A review of Table 1-1 indicates that the threshold limit values (TLV's) for volatile compounds range as low as 1 ppm (1,1,2,2 Tetrachloroethane) and 5 ppm (Carbon tetrachloride, 1,1,1-Dichloroethylene, and Methyl Bromide). The remaining compounds have TLV values of 10 ppm or higher. Based on this, an action level of 5 ppm is applicable for all compounds except the two discussed above. The FID-GC unit will be used to determine if those specific constituents are present, and in what concentration. If they are present, the action limit will be one-half the TLV for each constituent. If not present, the general action level will apply.

If action levels are exceeded, four options can be exercised to reduce worker exposure. High volume fans may be employed to vent volatile constituents away from the work area. The fans will be

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TABLE 4-1

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Heat/Rest Table

Adjusted [*] <u>Temperature(</u> ^O F)	Normal Work <u>Conditions (min)</u>	Tyvek Suit Work <u>Conditions (min)</u>
90.0 +	45	15
87.5 +	60	30
82.5 +	90	60
77.5 +	120	90
72.5 +	150	120

* Adjusted Temperature = Air Temperature (^OF) + [13 x % Sunshine]

placed away from work area to minimize any electrical hazard. The efficiency of this method will be monitored by frequent PID measurements. If the fan is not employed, or is not effective in reducing breathing-zone PID measurements below the action level, Level C personal protection will be instituted. Upgrading to Level C requires the addition of a half-faced respirator with a cartridge for organic vapors, dusts, and mists, to the modified Level D protection initially used at the site. PID measurements will continue after addition of respirators to the work uniforms. The concentration of breathed air will then be calculated using the following relationship.

Breathed Air = Ambient Air

Respirator Protection Factor

where:

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- 1) Ambient air measured by PID
- Respirator Protection Factor is 10 for half-face respirators and 50 for full face respirators.

If the calculated breathed air is not below the stated action levels, either a different respirator will be used or the work site will be evacuated. The work site will be evacuated immediately if PID measurements in the breathing zone is greater than 250 ppm, in general, or less for specific constituents as shown in Table 4-2.

If respirators are required, cartridges will be replaced at onehalf the calculated respirator break through time. The calculated respirator break through time shall be based on the values presented in Table 1-1, adjusted for the ratio of actual airborne concentrations to the 1000 ppm stated. The FID-GC will be used to identify the air-borne constituents present, and the lowest respirator break through time will be used in the calculation.

TABLE 4-2 Action Levels for Personnal Protection

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AIRBORNE VO	LATILE CONSTITUENTS
PID/FID READINGS IN THE BREATHING ZONE	ACTION
0-5 ppm above background 5-250 ppm above background >250 ppm above background	Level D Level C Evacuate the site immediately
If Carbon Tetrachloride, Bromide is present	1,1,1-Dichloroethylene, or Methyl
FID-GC READING	ACTION
< 2.5 PPM	Level D Level C
2.5 - 30 ppm > 30 ppm	Ever t Evacuate site
	Evacuate site
> 30 ppm	Evacuate site
<pre>> 30 ppm If 1,1,2,2-Tetrachloroethane</pre>	Evacuate site
<pre>> 30 ppm If 1,1,2,2-Tetrachloroethane FID-GC READING < 0.5 ppm 0.5 - 15 ppm</pre>	Evacuate site is present ACTION Level D Engineering techniques or Level C
<pre>> 30 ppm If 1,1,2,2-Tetrachloroethane FID-GC READING < 0.5 ppm 0.5 - 15 ppm > 15 ppm</pre>	Evacuate site is present ACTION Level D Engineering techniques or Level C Evacuate site ACTION ⁽¹⁾ Continue work, monitor every 5
<pre>> 30 ppm If 1,1,2,2-Tetrachloroethane FID-GC READING < 0.5 ppm 0.5 - 15 ppm > 15 ppm EXPLOSIMETER READINGS</pre>	Evacuate site is present ACTION Level D Engineering techniques or Level C Evacuate site ACTION ⁽¹⁾

(1) Modified from standard operating Safety Guides, USEPA, November, 1984. Listed levels are more stringent than EPA guidelines.

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(2) LEL - Lower Explosive Limit

Explosimeter readings will be taken at frequent intervals. All work will stop and the work area will be evacuated if the explosimeter readings indicate flammable vapor concentrations greater than 20% of the Lower Explosive Limit (LEL).

The explosimeter action levels were modified from Standard Operating Safety Guides, USEPA, November, 1984. Listed levels are more stringent than EPA guidelines. Task specific action levels (i.e., site surveying, soil boring, and soil sampling) are discussed in Section 4.5.

4.4 WORK ZONES

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For Safety purposes, a hazardous waste site is generally divided into three specific zones on the basis of contamination potential: Zone 1 - Exclusion Zone; Zone 2 - Contamination Reduction Zone; and Zone 3 - Support Zone.

of The <u>Exclusion</u> Zone is the suspected area greatest environmental contamination and presents the greatest potential for worker exposure. Personnel entering the area must wear the mandated level of protection. In certain instances, different levels of protection will be required depending on the tasks to be performed within that zone. The Support Zone serves as a clean, control area. The Contamination Reduction Zone serves as a transition area between the Exclusion Zone and the Support Zone. Decontamination facilities are located in the Contamination Reduction Zone. All areas will be defined and marked as appropriate.

At the DDMT site, the establishment of these three specific zones will be based on the location of intrusive activities. If hazardous conditions develop during site operations, work will be stopped and the three zones and any necessary additional zones will be developed. The Exclusion Zone will be designated as an area within a 15 foot radius of the boring. The Site Manager may extend this zone based on prevailing wind direction and ambient

concentrations encountered. The Support Zone will be considered any area outside the Exclusion Zone. The Contamination Reduction Zone will be established when appropriate. The zones will be marked by appropriate flags and stakes, and personnel will be briefed about activities and protective equipment for each zone.

4.5 TASK SPECIFIC LEVELS OF PROTECTION/WORK ZONES

Based on experience at similar sites, it appears that the primary exposure to contaminants may occur through physical contact or through inhalation while handling potentially contaminated samples. It seems appropriate, therefore, to specify protective measures based on the work activity, rather than requiring a site-wide level of protection. All work zones located in Dunn Field will be approved by the US Army Technical Escort Unit prior to investigating suspected chemical burial sites.

4.5.1 <u>Topographic Survey</u>

All site surveying will be conducted after soil boring and sampling have been accomplished. The site will be in its original configuration and no specific Exclusion Zone is required. The surveying work will be non-intrusive and therefore the survey crew will be allowed to perform the site survey in a basic work uniform (Level D) unless significant contamination is discovered during the field investigations at the site. In the case where high levels were observed with the PID in the breathing zone, around the site, the survey crew would be required to perform its work with the appropriate up-graded protection which would include appropriate respirators equipped with suitable cartridges for organic vapors, dusts, and mists.

4.5.2 Soil Boring and Well Installation

For soil boring and well installation, including soil sampling, personal levels of protection will initially be the modified

Level D as designated previously. However, if contamination above action levels is encountered during the soil boring and sampling, the previously specified work zones will be established.

4.5.3 <u>Well Development and Water Sampling</u>

The modified Level D designated previously, will be used during well development and both ground water and surface water sampling. In addition, due to the increased potential for splashed water, face shields and taping of gloves and boots will be required. However, if contamination above action levels is encountered the previously described work zones will be established.

4.5.4 <u>Sediment Sampling</u>

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Sediment samples will be obtained from Lake Danielson. The sampling will be done from a small row boat available at the site. Strict boating rules will be enforced to minimize the potential for capsizing. The personal protection level for this sampling will be the modified level D previously described, with the addition of lifejackets, face shields, and taping of gloves and boots. In the event of capsize, the samplers will proceed as fast as possible to emergency shower locations.

4.6 EMERGENCY EQUIPMENT

The emergency equipment described below will be available on the site during field operations.

4.6.1 Fire Extinguishers

Because of the potential threat of fire at hazardous waste sites, fire extinguishers will be readily available and at hand throughout the investigation. All fire extinguishers will be

Class ABC. The fire extinguisher will be kept with the field crew during any subsurface activity such as drilling or backhoe excavations.

4.6.2 First Aid Kits

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An industrial first aid kit with sufficient supplies for five people will be kept in the support area. Smaller first aid kits will be kept in clean areas and with field crews. At least one individual at the site will be trained in First Aid and CPR.

4.6.3 <u>Eve Wash</u>

A portable eyewash (meeting the minimum requirements of ANSI 2358.1) and sufficient potable water for copious flushing will be readily available and at hand throughout the investigation. The eyewash unit is kept on-site in a support vehicle.

4.6.4 <u>Emergency Showers</u>

Emergency shower facilities will be located at DDMT. Coordination with the base will be obtained to use these facilities if necessary.

4.6.5 <u>Communications</u>

Emergency telephone numbers are provided in Section 6.1 of this SHERP, which will be readily available to any of the field crew. Emergency communication will be discussed in the safety briefings prior to initiating the field work. The location of the telephone closest to the site will be identified to each member to the field team. A telephone, for emergency use only, is located inside Building 230, in Section II of the Warehouse.

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5.0 SITE OPERATING PROCEDURES

5.1 SAFETY PLAN RESPONSIBILITIES

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The Project Manager is responsible for ensuring that each member of the field team is aware of all components of the safety plan. This plan covers all phases of operation at the site, including:

- Hazard identification and assessment
- Established work zones
- Level of personal protective equipment required in each zone
- Work practices
- Sampling procedures
- Entry and exit routes
- Decontamination procedures
- Accident/emergency response

5.2 ACCIDENT PREVENTION

The following items are requirements to protect the health and safety of field workers and will be discussed in the safety briefing prior to initiating work on the site.

5.2.1 General Safety Operating Procedures

- A buddy system will be used. Hand signals will be established, where necessary, to maintain communication.
- During site operations, each worker will consider himself as a safety backup to his partner. Off-site personnel provide emergency assistance. All personnel will be aware of dangerous situations that may develop.
- . Visual contact will be maintained between buddles onsite when performing hazardous duties.

Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of hazardous material is prohibited at the job site, and good hygiene is required before pursuing these activities away from the job site.

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- Prescription drugs will not be taken by personnel where the potential for contact with toxic substances exist, unless specifically approved by a qualified physician. Alcoholic beverage intake is prohibited during the work day at the site.
- No excessive facial hair which interferes with the face to face piece seal of the respirator will be permitted on personnel required to wear such equipment. Each staff member will be fit-tested for respirators. Level D initially specified at the site does not require the use of respirators. However, half-faced respirators equipped with suitable cartridges for organic vapors, dusts, and mists, will be available on-site in the event that upgrading to Level C is necessary. The respirators and spare cartridges will be available on-site in a support vehicle.
- . Work areas for various operational activities (equipment testing, decontamination) will be established if higher levels of protection are implemented at the site.
- Procedures for leaving any contaminated area will be planned and reviewed prior to going on-site.
- . Work areas and decontamination procedures have been established based on prevailing site conditions and are subject to change if site conditions change.
- . No personnel will be admitted to the site without the proper safety equipment and training.

Proper decontamination procedures must be followed before leaving the site. Decontamination in the Level D mode of operation will consist of good personal hygiene and cleaning boots and gloves before leaving the site.

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- . All personnel must comply with established safety procedures. Any staff member who does not comply with safety policy, as established by the Health and Safety Officer or the Project Manager, will be immediately dismissed from the site.
- Any medical emergency supersedes routine safety requirements.
- The Field Safety Coordinator will make regular safety inspections of the site to insure that operations are being conducted in accordance with established Standard Operating Procedures.

5.2.2 <u>Before Leaving Field Office</u>

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Review site information (see Site Manager).

- Expected hazards
- Special conditions
- Sampling procedures
- Location of telephones and emergency equipment
- Emergency medical information
- Level of personnel protection required

. Check safety gear and equipment. The following equipment will be used at the site, or will be available for issue, depending on site-specific conditions. The safety gear and equipment will be available on-site in a support vehicle.

Steel-toed chemical-resistant safety boots

Neoprene or Nitrile rubber boots

- Standard Tyvek coveralls [9 210]
- Hard-hat

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- Goggles or Safety Glasses
- Viton gloves
- Half-face, air-purifying respirator with cartridges suitable for organic vapor, dusts, and mists
- Ziplock baggies, quart and gallon size, to keep spare equipment clean
- Field standard operating procedures
- Eyewash
- First Aid Kit(s)
- Backup equipment and spares will be maintained, including:
 - Extra Tyvek suits and gloves
 - Duct tape
 - Trash barrel for return transportation of contaminated gear and equipment
 - Extra respirator cartridges

5.2.3 <u>Before Entering Site</u>

- No eating/drinking/smoking except away from the work area. Use good sanitary practices and wash hands and face thoroughly before eating/drinking/smoking.
- Drink replacement fluids, especially during hot weather conditions, and carry drinks for use in support area.
- Place sample containers in field sample carrier (backpacks or carrier). Do not place containers or equipment on potentially contaminated surfaces.
- . Check location of emergency eye wash supply and telephones.

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. Check alternate safety gear.
 Respirator (test even if you are not going to wear it immediately).
- Hard-hat
- Goggles or Safety Glasses
. Check gear for rips/tears/malfunctions.
. Set up buddy system prior to proceeding.
. Preliminary site survey.
 Characterize physical conditions of site
- Use as much <u>excess</u> caution as possible
. Use caution - go slowly.
5.2.4 <u>Sampling</u>
. No eating/drinking/smoking while sampling.
. Use standard, specified sampling techniques (see QC Plan or discuss with Site Manager).
. Use appropriate care in handling samples. If the sampling site is not accessible using your gear, don't take a sample. Confer with buddy and team leader about alternate sampling locations.
. Wipe off spills, dirt, and residue immediately.
. If any gear or equipment damage develops, immediately repair or replace.

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. If any physical discomfort occurs, such as lightheadedness, stop work, notify your buddy, and return to the designated Support Zone.

5.3 DECONTAMINATION PROCEDURES

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personnel must complete appropriate decontamination A11 procedures prior to leaving the site in a manner that is responsive to actual site conditions. A decontamination area will be set up at an appropriate site location. Receptacles will be provided for all disposable clothing. The receptacles will be conventional trash cans lined with heavy duty polyethylene trash Wash tubs containing a detergent-water solution or an bags. appropriate decon solution (see below) and soft-bristle brushes will be used to decontaminate reusable personal protective clothing and boots. Following the detergent-water washing, an intermediate rinse will be applied when necessary. Clean. potable water will be used for the final rinsing. Decontamination solutions will be disposed of on site in an area which allows the infiltration of the solutions into the soil. Each individual shall conduct proper personal hygiene which may include washing any exposed skin prior to eating, smoking, or leaving the site, consistent with site conditions. Initial decontamination procedures application at the site are for Level D., Decontamination procedures for higher levels of protection (i.e., Level C) are also discussed.

5.3.1 Level D Routine Decontamination

- Wash boots and gloves.
- Remove boots, gloves, and field clothes, and change into non-field clothes and street shoes.
- . Place boots, gloves, and field clothes in specified storage area. Dispose of disposable suits and any other disposable

and/or uncleanable equipment in the proper receptacle on site. Check with team leader if uncertain.

. All field personnel must wash their face and hands thoroughly before leaving the site.

5.3.2 Level C Routine Decontamination

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A proposed schematic for Level C decontamination is provided in Figure 5-2. The Site Manager may adjust the decontamination layout according to site conditions. Decontamination procedures for Level C will consist of the following:

- Field equipment should be placed at the first drop site. It will be appropriately decontaminated later.
- Boots and gloves should be washed with a detergent solution and rinsed in clear water.
- . Gloves, glasses and hard hats can be removed and left at the second drop site.
- Respirators can be removed, washed and swabbed down with alcohol, and bagged for storage. Exhausted respirator cartridges can be removed and thrown away at this point. Respirators should be left at the third drop site.
- . Boots and disposable clothing can now be removed. Boots are deposited at drop site number 2. Disposables are thrown away.
- Street shoes can be put on.
- . All field personnel must wash their face and hands thoroughly before leaving the site.

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5.3.3 <u>Heavy Equipment Decontamination</u>

If site conditions warrant, heavy equipment will be decontaminated prior to leaving the site. This will include manual removal of gross contamination with shovels, etc., followed by a steam or high pressure wash, paying particular attention to tracks, wheels, and undercarriages. If no significant contamination is encountered on site, then steam or high pressure wash is not required.

5.3.4 Decon Solutions

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Decon solutions are prepared to react with, neutralize, or physically remove specific contaminants on a site. All decon solutions and rinse waters are collected in wash tubs and will be disposed of on site in an area which allows for the infiltration of the solutions in the soil.

Decon Solution 1 - for light contamination; liquinox-based Decon Solution 2 - for organic contaminants; detergent-based Decon Solution 3 - for most acids and alkalines; trisodium phosphate based Decon Solution 4 - for organophosphates, cyanides; calcium hypochlorite based

It is anticipated (based on prior sampling results) that Decon Solution 1 will be sufficient for this site.

5.4 <u>PERSONAL HYGIENE</u>

A sufficient supply of clean, potable water and hand soap will be provided at the site for the personal hygiene of field personnel. Personal hygiene primarily entails washing and is not strictly considered decontamination.

6.0 EMERGENCY PROCEDURES

6.1 EMERGENCY TELEPHONE NUMBERS

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The first contact in an emergency should be security office, extension 6677. This number may be called from any phone on DDMT. Emergency Response Team will meet at gate and provide an escort.

Ambulance: Memphis	901/522-5252
Police: Memphis Police	901/528-2222
Fire Department: Memphis Fire Dept.	901/458-8281
Hospital: Baptist Central Hospital 899 Madison Avenue	901/522-5252
Law Field Office:	
LEI/Government Services Division	
404/421-3400	
Project Manager : John R. Absalon	
Office 404/421-3408	
Home 404/432-0767	
Site Manager : Robert Manson	
Office 404/421-3554	
Home 404/591-1547	
Health & Safety Officer : Jack Peng	
Office 404/421-3536	
Home 404/447-0544	

6.2 <u>HOSPITAL</u>

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Hospital emergency room personnel will be contacted and briefed regarding the scope of the study. The emergency route to the hospital will be discussed with all field investigation personnel prior to beginning any activities. The hospital is located approximately seven miles northwest of DDMT, at the intersection of Dunlapp and Union Avenue off from Highway 240 (as shown in Figure 6-1). Directions to the hospital and a route map will be available to all field personnel at the site.

6.3 <u>ACCIDENTS/INJURIES</u>

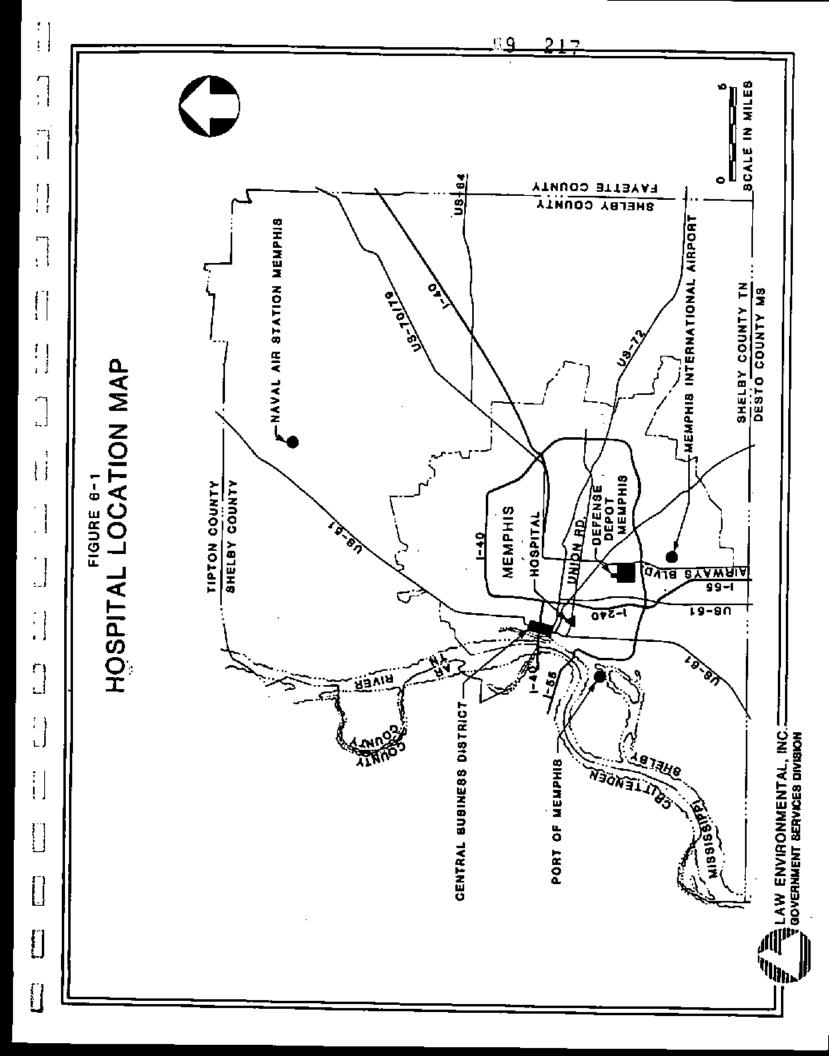
Depending on the severity of the injury, treatment may be given at the site by trained personnel, additional assistance may be required at the site (emergency medical technicians), or the victim may have to be transported to hospital.

In life threatening situations, care must begin WITHOUT considering decontamination. Outside protective clothing can be removed if it does not cause delays or aggravate the problem. Respirators must always be removed. Normal decontamination procedures should be followed when at all possible.

The Health and Safety Officer shall immediately notify the Contracting Office (CO) of any accident/incident. Within two working days of any reportable accident, the Health and Safety Officer shall complete and submit to the CO an Accident Report on ENG Form 3394 in accordance with USACE, EM 35-1-1, Appendix C and the USACE Supplement 1 to that regulation.

It will be the responsibility of the Health and Safety Officer to investigate thoroughly the details of any accident or injury. Based on his findings, he will recommend any corrective action relative to field procedures to prevent recurrence.

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6.4 <u>FIRE</u>

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The potential for fire is significant at many hazardous waste sites. During subsurface operations, explosimeters and photoionization detectors are used to monitor levels of potentially combustible gases and volatile organics. Fire extinguishers (Class ABC) will be kept on each drilling rig. The local fire department will also be alerted to the nature and location of any field investigation.

6.5 EXPLOSION

There is frequently the possibility of explosion during hazardous material investigations. Work will be stopped and the situation evaluated when readings in excess of 10% of the lower explosive limit are obtained on the MSA Explosimeter. Continuous monitoring will be performed as long as readings between 10% and 20% of the lower explosive limit are obtained. If measured readings are greater than 20%, the site will be evacuated until appropriate work procedures can be established.

6.6 SITE EVACUATION

Three stages of evacuation have been determined:

- . Withdrawal from immediate work area
- Evacuation of site
- Evacuation of nearby area facilities

6.6.1 Withdrawal from Work Area

Withdrawal to a safe upwind location will be required if any of the following occur:

If concentrations of volatile organics, combustible, or toxic gases exceed 10 ppm above background levels in the breathing zone or 10% of the lower explosive limit

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the work area will be temporarily evacuated for further assessment.

 If a minor accident occurs, Field operations will resume after first aid and/or decontamination procedures have been administered.
 Equipment malfunctions.

6.6.2 Evacuation of Site

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The Site will be evacuated in the following cases:

- Explosive levels of combustible gases exceed 20 percent LEL.
- A major accident or injury occurs.
- . Fire and/or explosion occurs.
- If measured organic levels of an unknown contaminant exceed 250 ppm as measured on a Photovac TIP photoionization detector (PID), the site will be evacuated, the USACE will be notified, and the contract will be modified to allow upgrades necessary to operate at the appropriate level.

6.6.3 Evacuation of Nearby Area Facilities

The Site Manager is responsible for determining if circumstances exist for area contamination, and should always assume worst-case conditions until proven otherwise. DDMT and local fire and police departments will be contacted. A list of their addresses and telephone numbers will be carried by the Site Manager.

6.7 <u>SAFETY OF THIRD PARTIES</u>

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Work area access will controlled at the site and only verified team members, and previously approved personnel will be allowed in work areas or areas containing potentially hazardous materials or conditions. Work zones will be staked and flagged to deter access by third parties. No unauthorized personnel will be allowed in the designated work zones.

7.0 MEDICAL MONITORING PROGRAM

Each individual will undergo and pass a comprehensive physical examination prior to going to any hazardous site. LEGS employees participate in the program described below, under the direction of the Occupational Medicine Associates Center. Subcontractor personnel are required to furnish documentation of equally comprehensive examinations. Subcontractors will also furnish certification of annual medical surveillance.

The tests included in the LEGS medical examination are described in Table 7-1. Other tests can be added if warranted by special needs or exposure history. Examples of the medical history forms are shown in Appendix B.

7.1 INITIAL EXAMINATION

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The initial examination is intended to determine each employee's complete medical history as well as the compatibility of the (bio)medical status with the job description. For example, minimum physical requirements must be met:

- <u>Vision</u> Binocular vision is required, and must be correctable to 20/40 (Snellen) in one eye and 20/20 in the other. Normal depth perception and basic color distinction are required.
- <u>Hearing</u> Hearing loss in either ear should be no more than
 30 dB at 500, 1000 and 2000 hertz.

<u>Smell</u> - Normal.

- <u>Speach</u> No conditions causing indistinct speech.
- <u>Other No disease or condition which would interfere with</u> the full performance of duties.

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TABLE 7-1

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Standard Biomedical Monitoring

Test	Initial Examination	Annual Examination
Full physical	x	x
EKG	x	(X)
Chest X-ray	x	(X)
Hematology evaluation (including complete blood count, differential and platelet count)	x	x
Hemoglobin and hematocrit	x	x
Urinalysis	x	x
Vision screen	x	x
Executive profile (SMA-22, CBC, thyroid profile)	x	x
Pulmonary function	x	x
Audiometry	х	(X)
Proctoscopic exam	(X)	(X)

(X) - Included at the discretion of the occupational medicine physician.

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An electrocardiogram and spirometry are performed. The electrocardiogram is recorded as optional for annual reexamination. Employees over 35 years of age and employees with cardiac risk factors (overweight, smoking) are required to have annual EKGs.

Chest x-rays have, for the most part, been eliminated from the physical examination except for the initial baseline exam. The physician gives the patient a complete examination of the chest. This chest exam coupled with pulmonary function studies, gives the medical staff sufficient information relative to any potential pulmonary problems. If chest x-rays are indicated from the results of later examinations, they are then performed. This decision is left to the discretion of the examining physician.

In addition, an extensive battery of hematological and serum chemistry determinations are performed. Hematological tests include a full blood count with differential and platelet count.

The standard serum-enzyme chemistry is also performed for the following parameters:

Alsanine aminotransferase (ALT, SGPT) Aspartate aminotransferase (AST, SGOT) Albumin Alkaline phosphatease Bilirubin (total) Blood Urea Nitrogen (BUN) BUN/Creatinine ratio Calcium CO₂ (Content) Cholesterol Chloride Creatinine Globulin Glucose Lactate dehydrogenase (LDH)

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Phosphorus (Inorganic) Potassium Protein Sodium Triglycerides Uric acid

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A routine urine analysis is performed, including observation of color, specific gravity, and microscopic examination of formed elements and pathologically significant elements not normally present such as glucose, protein, blood, ketones, and bile acids. The majority of these parameters are indicative of kidney dysfunction.

Audiometry (hearing examination) is often included in the examination cycle if significant noise exposure is anticipated (i.e., working in close proximity to heavy equipment for extended periods of time).

7.2 <u>QUARTERLY EXAMINATIONS</u>

Quarterly examinations consist of blood chemistry and enzyme tests, focused on the detection of preclinical signs and imminent adverse health effects. These tests require serum and urine analysis only and can be performed by licensed paramedical personnel. Quarterly exams can be performed on all site members, as deemed necessary by the Health and Safety Officer and Occupational Medicine Associates, depending on frequency and duration of field work.

7.3 ANNUAL EXAMINATION

Annual examinations are a repeat of the initial examination. A number of the recommended biomedical tests for the establishment of baseline and sensitivity parameters can sometimes be dispensed with at this time. All personnel included in the initial exam program are given annual exams.

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7.4 SPECIAL PARAMETERS

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If indicated by the medical history and/or initial laboratory results, the examining physician will order additional tests. In addition, a host of parameters can be added to the parameters mentioned to account for prior and expected exposure conditions. An example would be exposure of heavy metals. If lead is a primary agent, a blood lead evaluation would be performed, including a quantitative blood lead determination. Other heavy metals could be analyzed in either blood or urine samples.

Summary reports of the examinations are provided and reviewed with each employee. Complete records are kept at the Occupational Medicine Associates offices.

REFERENCES

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- HSDB, 1988. Hazardous Substances Data Base: 3,3',-Dimethylbenzidine, National Library of Medicine. Bethesda, MD.
- Kearney, 1975. <u>Herbicides</u>, 2nd ed. Sited in HSDB: Trichloroacetic acid. National Library of Medicine. Bethesda, MD.
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APPENDIX A

PERSONAL PROTECTIVE AND SAFETY EQUIPMENT

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APPENDIX A

A.1 PERSONAL PROTECTION AND SAFETY EQUIPMENT

The following levels of protection are recommended in Occupational Safety and Health Guidance Manual for Hazardous Waste Operations.

A.1.1 Protective Equipment and Selection Criteria

<u>Level A</u>

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Level A is worn when the highest level of respiratory, skin, and eye protection is required.

Protective Equipment Required

- . Pressure-demand (positive pressure) SCBA
- Fully encapsulating suit
- Gloves (inner)
- . Gloves (outer) chemical-resistant, Neoprene
- . Boots, chemical-resistant, steel toe and shank
- Hard-hat (optional)
- . Two-way radio communication
- . Disposable coverall chemical suit (optional)

Selection Criteria

Any of the following conditions warrants Level A protection:

 A chemical substance has been identified which requires the highest level of protection based on a measured (or potential) high concentration of atmospheric vapors, gases, or particulates; or work functions involve high potential for exposure to vapors, gases, or particulates.
 Extremely hazardous substances (e.g., dioxin, Department of Transportation (DOT) Class "A" poisons, concentrated pesticides) are known or suspected, and skin contact is possible.

- . The potential exists for contact with substances that destroy skin.
- . Reading on the organic vapor analyzer meter exceeds 500 ppm.
- . Operations are conducted in confined, poorly ventilated areas or unknown air quality hazards.

<u>Level B</u>

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Level B safety gear is worn when the highest level of respiratory protection is required, but a lesser degree of skin protection is required.

Protection Equipment

- . Pressure-demand (positive pressure) SCBA, NIOSH/OSHA approved
- . Chemical-resistant splash suit or polycoated disposable chemical-resistant coveralls
- . Gloves (inner)
- . Gloves (outer), chemical-resistant (taped to sleeves)
- . Boots, inner, chemical-resistant, steel toe and shank
- . Boots, outer, disposable (taped to cuffs), optional
- Hard-hat
- . Two-way radio communication

Selection Criteria

- Atmospheres with chemical concentrations considered Immediately Dangerous to Life and Health (IDLH) that do not represent a severe skin hazard.
- Atmospheres exceeding limits of protection afforded by a full-face, air-purifying respirator.
- Atmospheres containing substances with poor warning properties, substances for which air-purifying cartridges

do not exist, or have low removal efficiency.

- . Atmosphere containing <19.5 percent oxygen.
- Conditions are such that small exposed areas about the head and neck will not be contacted by hazardous substances.

<u>Level C</u>

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Level C safety equipment will be worn when the types and concentrations or airborne contaminants are known, and the criteria for using air-purifying respirators are met.

- Protective Equipment
- . Air-purifying respirator with suitable cartridges, fit tested
- . Chemical-resistant suit or polycoated disposable chemical-resistant coveralls
- Gloves (inner)
- . Gloves (outer), chemical-resistant
- . Boots (inner), steel toe and shank
- Boots (disposable, optional)
- . Hard-hat

Selection Criteria

- . Atmospheric contaminant concentrations do not exceed IDLH levels.
- Air concentrations of identified substances will be reduced by the respirator to below the substance(s) exposure limit.
- . Service limit of respirator cartridges will not be exceeded.
- . Conditions are such that small exposed areas about the head and neck will not be contacted by hazardous substances.
- Job functions do not require SCBAs.

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- . Atmospheres contain between 19.5 and 25 percent oxygen.
- . Individual has been successfully fit tested.

<u>Level D</u>

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Level D safety equipment is the basic work uniform.

Protective Equipment

- . Chemical-resistant suit or disposable chemical-resistant coveralls (optional)
- . Gloves required with any site soil or water contact
- . Boots (inner), steel toe and shank
- . Hard-hats
- . Safety goggles or glasses
- . Face shield (optional)
- . Disposal boot covers (optional)

Selection Criteria

. Contact with contaminated material is extremely unlikely, and no inhalable toxic substances are present.

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APPENDIX B

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MEDICAL FORMS

R. BURT FRATER, JR., M.D. PHILLIP R. ROGERS. M.D. SCOTT D. HENDERSON, M.D. MICHAEL P. SEYFRIED, M.D. STEPHEN K. THOMPSON, M.D. NEMBERS, AOMA

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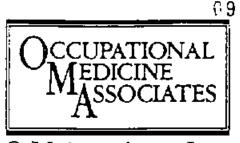
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O M Associates, Inc.

ecializing in Comprehensive Occupational Health Care Programs for Indexire and Business Sance 1969

To the Person Being Examined:

As part of your company sponsored occupational health program, this Periodic Medical Monitoring Examination is a continuation of the comprehensive Medical Monitoring Program that began with a Baseline Examination and continues with regular Periodic Examinations.

This examination was carefully designed so that comparisons can be made between this examination and your Bausline Examination, as well as other Periodic Examinations you may have taken. Only by such careful attention to every detail can your health and safety be properly monitored. When you leave your current position, or when you no longer require medical monitoring, you will take this examination as your Exit Examination.

Flease complete this questionnaire <u>before</u> your scheduled appointment time. If you are uncertain about a particular question, please ask your examiner during your appointment. The blood studies are an essential part of this examination, and require some preparation by you. On the night prior to having your blood drawn, you must not take any food or liquids (except water or black coffee) after 10:00 P.M. If you are a diabetic, you should omit this instruction and inform your examiner's staff at the beginning of your appointment. Excessive alcohol intake during the week prior to your examination may affect the results of your blood tests, so this is discouraged.

examination as you have in the past. You will be informed of any abnormalities, along with appropriate recommendations for information about your personal health, such as your blood pressure and cholesterol. This examination is not meant to take the place of your regular health examinations with your personal physician.

Please take the time to fill this form out carefully and completely, because your attention to detail will help us help you.

Sincerely,

Scott D. Henderson, M.D. Medical Director O M Associates, Inc.

CHAMBLEE/DUNWOODY 4553 N. Shallowford Rd. Suize 22-B Allanta, GA 30338 OM#16:45520081987

PEACHTREE CORNERS 4028 Holcomb Bridge Rd. Suite 200 Norcross, GA 30092 449-9014

You will receive a letter regarding the results of the retesting or job restrictions, if needed. You will also receive

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LYNN A. HENDERSON, DIRECTOR CHARNER BELLAMY, R.N., C.F.N.P. ROBERT J. MUNOZ, P.A.C. GINGER BOYKIN, R.N., C.F.N.P.

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R. BURT PRATER. JR., M.D. PHILLIP R. ROGERS. M.D. SCOTT D. HENDERSON, M.D. MICHAEL P. SEYFRIED. M.D. STEPHEN K. THOMPSON, M.D. MEMBERS, ADMA

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LYNN X. HENDERSON, DIRECTOR CHARNER BELLAMY, R.N., C.F.N.P. ROBERT J. MUNOZ, P.A.C. GINGER BOYKIN, R.N., C.F.N.P.

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O M Associates, Inc.

Softwalizing in Compensative Octoperional Health Com-Programs for Industry and Basiness Since (1969

NOTICE TO EMPLOYEE

(name)

You are scheduled for a () Baseline Exam, or a () Periodic Annual Exam, or a () Exit Exam

on	at	
	(date)	(time)
аt	the following location of OMA:	() Chamblee Du

at the following location of OMA: () Chamblee Dunwoody () Peachtree Corners

The new BASELINE QUESTIONNAIRE is necessary on all employees as a starting point for our computer data. Therefore, although you may be scheduled for a Periodic Annual, or an Exit Exam, you will be given the Baseline Questionnaire initially.

If you wear contact lenses or glasses, it is important that you bring them to your appointment (also bring your contact lens case and fluid). Without these items, we will be unable to test your uncorrected vision.

Thanks for your cooperation.

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CHAMBLEE/DUNWOODY 4553 N. Shallowford Rd. Suite 22-B Atlanta, GA 30338 455-7008

PEACHTREE CORNERS 4028 Holcomb Bridge Rd. Suite 200 Norcross. GA 30092 449-9014

PATIONAL ATES

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AUTHORIZATION FOR RELEASE OF INFORMATION TO PRIVATE PHYSICIAN

Do you have a private physician: Yes() No()

If yes, do you request that Occupational Medicine Associates send the results of your examination to him/her: Yes() No()

 PRIVATE PHYSICIAN NAME:

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NAME: _____ Phone

ADDRESS:_____

Your Name

Date

Company

f 1	BASELINE MEDICAL MONITORING QUESTIONNAIRE
, ' I, 	<pre>A. What is your marital status? 1. single 4. separated 7.9 237 2. married 5. divorced 3. widowed</pre>
• • • •	B. What is your race? White Hispanic Black American Indian Asian Other (specify)
• •	C. Is this a Pre - placement exam? YES NO
	D. If this is not a Pre - placement exam, how long have you worked for this company?
•.	(write in answer)
<u>.</u>	E. If this is not a Pre - placement exam, how long have you worked in your current position? (write in answer)
•	F. What is your current or proposed job title?
i	G. Please give a brief description of this job.
J	

In order to evaluate your health and safety at the worksite, information about your current or proposed job requirements is needed. Please circle all requirements listed in the section below that apply to your current or proposed job. If you are unaware of your job requirements, have your supervisor complete this section before your examination.

B. FUNCTIONAL REQUIREMENTS

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- 1. Heavy lifting, 45 pounds or over. 2. Moderate lifting, 15-44 pounds. 3. Light lifting, under 15 pounds. Heavy carrying, 45 pounds or over. 5. Moderate carrying, 15-44 pounds. Light carrying, under 15 pounds. 7. Straight pulling. 8. Pulling hand over hand. 9. Pushing. 10. Reaching above shoulder. 11. Use of fingers. 12. Both hands required. 13. Walking, greater than one hour. 14. Standing, greater than one hour. 15. Repeated crawling. 16. Repeated kneeling. 17. Repeated bencing. 18. Climbing, legs only. 19. Climbing, use of legs and arms. 20. Both legs required. 21. Operation of motor vehicle.
- 22. Ability for rapid mental and miscular coordination simultaneously.
- 23. Near vision correctable at 13 to 16 inches to Jaeger 1 to 4.
- 24. Far vision correctable one eye to 20/20 and to 20/40 in the other.
- 25. Far vision correctable in both eyes to 20/40
- 26. Both eyes required.
- 27. Depth perception.
- 28. Ability to distinguish basic colors.
- 29. Ability to distinguish shades of œlors.
- 30. Hearing (aid permitted).
- 31. Hearing without aid.
- 32. Use of respirator for more than 30 days per year.
- 33. Use of respirator for less than 30 days per year.
- 34. Other (Specify)

K. Are you required to wear a respirator in the performance of your job? YES NO If you are required to wear a respirator, please answer the following. 4 N 1. Indicate level of work while wearing a respirator. a. Light. ק Moderate. ъ. • • Heavy. c. Strenuous. đ. 2. Indicate type of respirator(s) to be used. Air Purifying with mechanical filter for removing particulates. a. Air Purifying with canister or cartridge for removing gas and vapor. ъ. 1 Air Purifying with combination of mechanical filter and canister or cartridge. C. Supplied Air pressure demand. d. Supplied Air demand. e. f. Supplied Air continuous flow (Airline). ĺ Self-Contained Breathing Apparatus (SCHA). g. . h. Other (specify) 5 1 . 3. Indicate extent of usage. ł a. On a daily basis. b. Occasionally, but more than once a week. ŧ c. Once a week. <u>.</u>... d. A few times a month. е. Once a month. • ; f. Once every few months. g. A few times a year. .! h. Rarely. Emergency situations only. i. ٦ Į 4. How many hours do you normally use a respirator when you must use it? (Write in

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Number)

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'i II. Please answer all of the following questions. If you have ever had any of the i listed conditions, mark in the "YES" column, and give the approximate date the condition occurred. Use the space at the end of each page to explain any "YES" answers.

			YES	NO	DATE				YES	NO	DA'
1.	A -	Unexplained fever					G.				
					<u> </u>		<u> </u>	taste		_	
	В.	Unexplained weight loss				4.	λ.	Hay fever			
	<u> </u>	Unexplained weight			├─── ┤			Sinus trouble			<u> </u>
		gain					יין	Stills CIUDIE			ł
	D.	Loss of energy/					c.	Frequent sore			
		fatique						throat			
	Ε.	Drenching night	- 1				D-	Frequent hoarseness			
	_	sweats			·						Į
	F.	Beat intolerance	İ				Ξ.	Dental problems			
	G.,	Persistent			i	5.	Α.	Tuberculosis	+		-
ļ		unexplained itching								ĺ	
ŀ	н.	Any illness within					В.	Abnormal chest	t		
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ľ	8.	Poor night vision	- †				D.	Lung collapse			
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IV.	FAMILY	MEDICAL	EISTORY

1. Please complete the following chart to the best of your knowledge.

AMILY MEMBER	Check if Deceased ()	Current Age or Age at Death	Significant Medical Problems and/or Cause(s) of Death
Father			
Mother	 		
usband/Wife	<u>∤</u> ∙		
Brothers/ Sisters			
	<u> </u>		
Children	<u> </u>		
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2. Have any of your blood relatives (parents, grandparents, brothers or sisters) had any of the following?

		·· · · ·	AT ANY AGE?				
	YES	NO			YES	NO	
a.			Anemia or blood disorder	g.			Other cancer or Leukemia
Ъ.			Emphysema (severe breathing difficulty)	ħ.			Diabetes (sugar)
c.			Glaucoma	i.			Epilepsy (convulsions)
a.			Bay fever, asthma or allergy	j۰			Kidney disease
е.			Intestinal cancer	k.			Heart attack or angina (severe chest pain)
f.			Breast cancer	1.			A stroke

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		V. SOCIAL HISTORY		
y	1.	Have you smoked cigarettes in the past? (NO means less than 20 packs or 12 onces of tobacco in a lifetime or less than 1 cigarette a day for a year)	of cig YES	arettes NO
	2.	Do you now smoke cigarettes?		
			YES	NO
	3.	If you smoked in the past, at what age did you quit? (write in age) _		
	4.	If you now smoke or smoked in the past, how many years total have you smoked? (Write in number)		
•• •	5.	If you now smoke or have smoked in the past, how many packs per day do smoke on the average? (Chose the closest answer)	o/did	уоц
	·	A Less than 1/2 E 2 1/2		
		B. 1 F. 3		
· •		C. 1 1/2 G. More than 3		
		D 2		
	6.	Do you now or did you ever smoke a pipe? (YES means more than 12 ounces of tobacco in a lifetime - the standard pouch of pipe tobacco contains 1 1/2 ounces)	YES	NO
	7.	Do you now smoke a pipe?	YES	NO
	8.	If you now smoke a pipe or smoked in the past, how many years total has smoked? (write in number)	ive you	1
	9.	Do you now or did you ever smoke cigars? (YES means at least greater than one cigar per week for one year)	YES	NO
	10.	Do you now smoke cigars?	YES	NO
- <u>-</u>	11.	If you now smoke cigars or smoked in the past, how many years total ha smoked? (Write in mumber)	ve you	I
: •	12.	Do you currently use chewing tobacco?	YES	NO
	13.	If you use chewing tobacco, how much do you use in a week? (Write in a	n answ	ver)
•	14.			
		Do you regularly drink alcoholic beverages?	YES	NO
	12+	If YES, how many drinks, beers, or glasses of wine do you drink daily? A. Less than 1 D. 5-6		
. 1		B. 1-2 E. 7-8		
. 1		r. More than 8		
- 1	16.	Have you ever been diagnosed as being alcoholic or received treatment	for	

j

received treatment for alcoholism? YES NO If YES, Please explain _____

VI.	OCCUPATIONAL	WORK	HISTORY

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-	ł	Please	e list <u>all</u> the jo	bs you have had p	prior to y	our pres	ent job.		
	NZ	ME OF COMPANY	DATES EMPLOYED	JOB DESCRIPTION	PROTECTI	VE WEAR	KNOWN EX	POSU	IRE
• •					YES	NO			
				[YES	NO			
. .					YES	NO			
;									
• •					YES	NO			
- •					YES	NO			<u> </u>
			<u> </u>		YES	NO			
• • •	spa	ase answer all ce provided at	questions. If the end of each	you need more spa page	ce to exp	lain you	r answer,	use	the
		Have you ever If YES, pleas	changed your re: e explain	sidence because o	f a healt	h proble	m? Y	ES	NO
	2.			e industrial plant	ts or area	as of hea		tion ES	? NO
		If YES, pleas			<u> </u>	<u> </u>			•
	3.	Have you ever If YES, where		ne United States :	for great	er than i		hs? ES	NO
	4.	Does anyone i	n your household g work or leisure	have contact with activities?		ls, dust		r ES	NO
5 T	5.						<u>.</u>	ES	NO
	6.	Do you have as If YES, please	nimals at home or e explain	in the workplace	27	······································	Y	ES	NO
	7.	Have you ever work? If YES, please		ms or an illness	which you	ı think w		ed to ES	NO
	8.	congested?	worked with a su	bstance which mad	le your no	se, ches		uses ES	ю
	Plea ques	ise use this sp		ny "YES" answers.	Indicat	te the nu	mber of 1		
5									
Ł									
					- <u> </u>	·····			
1-4									

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VII. TOXIC EXPOSURE HISTORY

1 A.

		n or been			-		
		YES	NO			YES	NO
1.	Assembly line			16.	Medical facilities		
2.	Ceramics			17.	Mining		
3.	Chemicals			18.	Painting		
4.	Dry Cleaning		Ċ.	19.	Petroleum		
5.	Electronics			20.	Plastic Manufacture		
6.	Farming			21.	Plating		
7.	Foundry/Smelter			22.	Plumbing/Pipefitting		
8.	Grain elevator/silo			23 -	Printing		
9.	Grinding			24.	Refineries		
10.	Eazardous Waste			25.	Refinishing		
11.	Heavy equipment			26.	Sandblasting		
	Operation			27.	Sawmill		
12.	Insulation			28.	Shipyards		
13.	Jewelry			29.	Textiles		
14.	Laboratory			30.	Welding		
15.	Machinery						
Please explana	explane any "YES" answ tion:	ers. Ind	licate t	ne numbe	r of the industry when	giving	your
Please explana	explane any "YES" answ tion:	ers. Ind	Licate t	he numbe	r of the industry when	giving	your
lease xplana	explane any "YES" answ tion:	ers. Ind	Licate t	he numbe	r of the industry when	giving	your
Please explana	explane any "YES" answ tion:	ers. Ind	Licate t	he numbe	r of the industry when	giving	your
Please xplana	explane any "YES" answ tion:	ers. Ind	2icate t		r of the industry when	giving	your
Please explana	explane any "YES" answ tion:	ers. Ind	Micate t		r of the industry when	giving	your

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-1	Now	Past		Now	Past
. Ethylene Oxide			(organochlorines) K. Aldrin		
4. Piberglass			L. Chlordane		
45. Flouride			H. DDT		
4 Formaldehyde			N. Dieldrin		
47. Freon			0. Endrin		
4. Herbicides A. 2,4-D			P. Lindane		
1 8. 2,4,5-T			53. Lead		
. C. Dioxin			54. Mercury		
4. Hexane			55. Manganese		
57]. Bydrazine			56. MEK (MethylEthyl Ketone)		
51. Hydrogen Sulfide			57. Methanol		
5 Insecticide	<u> </u>		58. Methyl Chloride		
(Urganophosphates) A. Diazinon			59. Methyl Chloroform		
B. Dichlorovos			60. Methylene Chloride		
C. Dimethoate			61. Naptha		
D. Malathion			62. Beta Napthylamine		
E. Methylparathic			63. Nickel		
F. Parathion			64. Nicrobenzene		
G. Trichlorfon			65. Oil Mist		
(carbamates) H. Aldicarb					
. I. Baygon					
J. Zectran					
lease explain any "Now"	' or "PAS	T [*] Answers.	Indicate the number of the	cubetan	~~
Nam ground your explain	12102-			substan	CE
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R BURT PRATER, JK, M.D. PHILLIP R. ROGERS, M.D. SCOTT D. HENDERSON, M.D. MICHAEL P. SEYFRIED, M.D. STEPHEN K, THOMPSON, M.D. MEMBERS, 40MA

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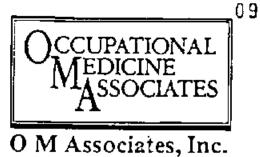
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LYNN A. HENDERSON, DIRECTOR CHARNER BELLAMY, R.N., C.F.N.P. ROBERT J. MUNOZ, P.A. C. GINGER BOYKIN, R.N., C.F.N.P.

To the Examining Physician,

Please review the preceding Periodic Medical Monitoring Questionnaire very carefully. If you find that a section has not been completed, please be sure that it is completed at the time of the examination. If you find that certain answers require elaboration, please do so in the spaces provided.

You will receive the appropriate protocols regarding which tests are to be performed and with what frequency. If certain tests are not indicated at the time of the examination, but have been performed in the recent past, please indicate the results and dates in the appropriate sections, and include copies of all laboratory studies.

The physical examination section is divided into two parts. Part A may be performed by your nursing or support staff. Please verify that all information is correct and properly recorded. Part B is to completed and signed by you. Please provide a brief description of any abnormal findings. Pay special attention to those physical attributes that might affect this person's ability to wear a respirator, drive a motor vehicle safety or perform their proposed or current job safely. Please assure that legible copies of all laboratory work are included before returning this booklet.

You will receive a report with a summary of the entire examination as well as a summary of any recommendations made to the company.

Sincerely,

Scott D. Henderson, M.D. Medical Director O M. Associates, Inc.

CHAMBLEE/DUNWOODY 4553 N. Shallowford Rd. Suite 22-B Atlanta, GA 30338 455-7008 OMff 19: C 1987

PEACHTREE CORNERS 4028 Holeomb Bridge Rd. Suite 200 Norcross. GA 30092 449-9014

ART B. This section is to be a	complet	ed and si	gned by the physi	leian. •9247
- Most recent chest X-ray. Da a. Normal	ite per	formed	<u> </u>	
- b. Other (Describe)				
Most recent EKG (if indicate	ed). D	ate perfo	rmed / /	
A. Normal.				
B. Other (Describe)				
. Check each of the following	items	in the ap		a. and Description of
Enter "NE" if not evaluated	Norma	L Abnorma		ormal Findings
EYES (Including pupils, EOMs,				
b. EARS (including canals, TMs)	┢	+ <u>-</u>		
b. EARS (Including canals, IMs)]			
NOSE AND SINUSES				
HOUTH, TEETH, PHARYNX				
FACIAL FEATURES (Including				·· • • • • •
facial hair affecting				
respirator usage) NECK (Including ROM, thyroid,	┣	┫		
cervical lymph nodes)				
.T. LUNGS AND CHEST				
BREASTS		f		<u>.</u> . <u>.</u>
HEART				
j PERIPHERAL VASCULAR	<u> </u>	+		
LYMPHATICS				
1. ABDOMEN, LIVER, SPLEEN		· .		
HERNIA CHECK				
CI. GENITALIA		1		
o. RECTAL		f	1	
FECAL		1	1	· · · · · · · · · · · · · · · · · · ·
_i (occult blood test)		<u> </u>		
g. MUSCULOSKELETAL, GENERAL				
BACK		<u> </u>	+	
T. EXTREMITIES	<u> </u> 		<u> </u>	
E. SKIN				
1. NEUROLOGIC (Including DIR'S,		<u> </u>		
PSYCHIATRIC			 	
rs	_			
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AUTHORIZATION FOR RELEASE OF INFORMATION TO PRIVATE PHYSICIAN

Do you have a private physician: Yes() No()

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If yes, do you request that Occupational Medicine Associates send the results of your examination to him/her: Yes() No()

PRIVATE PHYSICIAN NAMÉ:

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•	Phone	

ADDRESS:_____

_____ ·· ·_ ___

Your Name

Date

Company

APPENDIX C

ACCIDENT REPORTING AND RECORD KEEPING

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APPENDIX C ACCIDENT REPORTING AND RECORD KEEPING

C.1 <u>GENERAL</u>

C.1.1 All accidents which occur incident to an operation, project, or facility for which this manual is applicable, will be investigated, reported and analyzed as prescribed by the designated authority.

C.1.2 On contract operations, the prime contractor shall be responsible for recording and reporting all accident exposure and experience incident to the work. (This includes exposure and experience of the prime contractor and of his sub-contractors.) As a minimum these records shall include exposure work-hours and a log of occupational injuries and illnesses (OSHA Form 200 or equivalent as prescribed by 29 CFR 1904).

All diagnosed occupational illnesses and injuries that result in a fatality or a lost work day shall be investigated and reported to the designated authority in accordance with the requirements of the agency having jurisdiction.

C.1.3 On contract operations, the prime contractor shall keep a record of employee exposure to toxic materials and harmful physical agents. Also, the prime contractor shall notify the designated authority and the employee of any excessive exposure and the hazard control measures that will be taken.

C.1.4 An accident with any of the consequences listed below shall be immediately reported to the designated authority. These accidents will be investigated in-depth to identify all causes and to recommend hazard control measures. Except for rescue and emergency measures, the accident scene shall not be disturbed until it has been released by the investigating official. The consequences requiring an in depth investigation are:

- a) Fatal injury
- b) Five or more persons admitted to a hospital.
- c) Property damage in an amount specified by the designated authority.

Normally investigative officials, having expertise in areas related to the incident, will be selected from operating elements other than the element involved. The format for the investigation report will be as specified by the designated authority.

C.1.5 A daily record of all first aid treatments not otherwise reportable shall be maintained on prescribed forms and furnished to the designated authority upon request.

C.1.5 Injured persons are responsible for reporting all injuries as soon as possible to their employer or immediate supervisor. No supervisor shall decline to accept a report of injury from a subordinate.

Source: USCOE, EM 35-1-1.

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APPENDIX D

CHRIS CHEMICAL DATA SHEETS

Sources:

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Chemical Hazards Response Information System (CHRIS), 1984. DOT/USCG. Washington, DC: U.S. Printing Office.

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500 500 50 50 500 500 50 500 500 500 500	and an age of the second secon	ne nd herù fuille ana:	6.4 Fire Exploguenting Agents not to be Lined: Waller is carager note contain will 64th and served has and encode not be 446t 6.6 Served Hesserts of Comparison Product2: Not partners 6.6 Determine in First, Not partners	11. HAZARD ELASSIFICATIONS 11.) Code of Foderal Regulations: Figurments Rule 11.2 Mail Matter Sola Water Transportation:
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Water Pollution	Desperant to example the minimum processing of a crimerous site of the work with and prove which accurately and accurately and accurately and accurately and accurately and accurately and accurately and accurately and accurately and accurately and accurately and accurately and accurately and accurately and accurately and accurately accurate	is white minange. No combos phicasa		12. PHYSICAL AND CHURCAL PROPER 13.1 Physical State at 16°C and 1 acros Loand 13.2 Michaelant Weight: 58 (2) 13.3 Putting Paint at 1 care:
(See Raspone	HSE TO DESCHARCE a Gathalle Hangbook) ng-reph Barwanciay q Buoh	Z. LABIL 2.1 Catagory: Flammacus liquid 3.2 Close: 3	WATCH FOLLOTION L1 Aquantic Tencicity: 14 550 gom/24 fw/lgundph/shed/face water 13 000 gom/24 fw/lgundph/shed/face water 2.000 gom/24 fw/lgundph/shed/face water 2.2 WitherApent Tencinty: Fol perturn 4.3 Bininguna Company Company (DOC); (Theor) 122%-5 days	1301° = 36 11° = 328 3°K 12.4 Promoting Point:
DOEN GOEN 194; Mation: 1.971080 Mil	 6. OBSERVABLE CRARACTERISTICS 6.1 Province Elevie (an interpret/): Local 6.2 Color: Coortees 6.3 Deler: Seminari; planaers, repaintang page of mont or Nut: Servers, repaintang, page perversing Halabar; Latonic, pageont, narversing 	8.4 Fabri Chair Channerster Hone rolled	Had permine 12, 10 Yease (See) Sewith: 20 13, 11 Ratio of Epochic Hants at Vapar (S. 1,127 12, 13 Juners Head of Vaparizations 220 But to 122 Lang = 3 11 2 10* Jikg 12,11 Head of Comparisons ~ 12,250 But to ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	
gloves, che 1-2 Symmonie fo acti le si a mitaling la l possibly les 1-3 Tranknem di physican, a his annihor gel méthoda acti agita fil. Thranknet ju	нолича Едиропекто Окране, чар посля вобну родріня от басе кра- віднита Едиралити: Ричіц Атті; послья паняточагна, БОН, прод общ із сантиніза. Едиралите Фибац АТСРИ, / нод- битивня римски теалогабо в сипера най соплотур, на проста агно тийская римски станоста.	N. export presiding to dependent of muchous internet provide section inGESTEDN for product of income the early product excessive constant contents of elegang of the start. In a controlled, reading to incorporate inGESTICEr of women constraining is weighted on subspace. InGESTICEr of women tools and not internet potentiations, induce information the kindown, \$R Dil angoh wall wain water. \$TES: basin Commits a physician	 SHIPPORG INFORMATION Cranas of Purty, Technical NISS, our 0.35, were Responsed 99.55, our unant Biorispo Temperature: Anticaret 6.3 Unit? Stategebart; No recurrent 9.4 Yerrange Open chanse anastari or pressure vectore 	12.14 Hand at Decompanyone. Any perform 12.13 News et Sourance Not perform 12.16 faint of Paymantgalian. Not perform 12.27 News of Fusion: 23.42 callog 12.29 Longing Value; Data not evaluation 13.27 Reed Vapur Pressars: 7.35 perio
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.10 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic (001	Temperature (degrees F)	British thermal unit per pound-F	Temperature (dégrees F)	British thermal unit-inch per hour- square loot-F	Temperature (Cegrees F)	Cantipois
$ \begin{array}{c} -120 \\ -100 \\ -90 \\ -80 \\ -70 \\ -50 \\ -50 \\ -10 \\ -20 \\ -10 \\ 0 \\ 10 \\ 20 \\ 30 \\ 40 \\ 50 \\ 60 \\ \end{array} $	58.350 55.890 55.620 55.250 54.880 54.520 54.150 53.780 53.400 53.030 52.650 52.260 51.900 51.520 51.140 50.760 50.380 50.000 48.610	34 38 38 40 42 44 46 48 50 52 52 54 56 58 60 52 64 68 68 68 68 70	.507 .508 .509 .510 .511 .511 .512 .513 .514 .514 .515 .516 .517 .518 .519 .519 .519 .519 .520 .521 .522	30 35 40 45 50 45 60 65 70 75 80 65 90 95 100 105	1,193 1,184 1,174 1,164 1,165 1,145 1,135 1,128 1,116 1,106 1,097 1,067 1,067 1,077 1,068 1,058 1,049		NOT PERTINENT
70 * 80 90 100 110 120	49,230 48,840 48,450 46,070 47,680 47,280	72 74 76 78 80 82 82 84	.523 .524 .525 .525 .526 .527 .528				

12.21		12.22		12.20		12.24	
SOLUBILITY IN WATER		SATURATED YAPOR PRESSURE		SATURATED VAPOR DENSITY		IDEAL GAS HEAT CAPACITY	
Temperature	Pounds per 100	Tomporature	Pounds per square	Temperature	Pounds per cubic	Temperature	British thermal unit
(degrees F)	pounds of water	(degrees F)	inch	(degrees F)		(degrees F)	per pound-P
	M 5 6 6 6 6	20 10 0 20 30 40 50 60 70 80 90 100 110 120 130 140 150 150 150 150 190	.245 .354 .501 .698 .956 1.291 1.719 2.260 2.935 3.770 4.791 6.029 7.516 9.290 11,390 13,850 16,720 20,060 23,690 23,690 33,300 38,980	-20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 560 170 180 190	.00302 .00426 .00590 .00804 .01079 .01427 .01662 .02399 .03056 .03851 .04803 .05934 .07266 .08823 .10530 .12710 .15090 .17800 .20860 .24310 .28170 .32460	0 25 50 75 100 125 150 175 200 225 250 275 300 325 350 375 400 425 450 425 450 475 500 525 550 575 600	.275 .286 .296 .307 .317 .327 .337 .347 .357 .367 .357 .367 .377 .388 .395 .405 .414 .423 .414 .423 .431 .440 .449 .457 .456 .474 .456 .474 .450 .498

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Fire	Weer payoes set-contered incuant payers	n,ada a dagotaden a sombustation koud ROCUCED WHEN HEATEL ROCUCED WHEN HEATEL ROCUCED WHEN HEATEL Rock, New Noi Carbon (noncor h agint	(J) Between to Fire Not performing (J) Between Tampanitum: Not performed (J) Between Tampanitum: Not perman (J) Between Tampanitum: (J) Advector Tampanitum: (Advector Tampanitum: (Advector Tampanitum: (Communit)	Fee
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SOLUBILIT	12.21 Y IN WATER	12.22 SATURATED VAPOR PRESSURE		SATURATED V	APOR DENSITY	12.24 IDEAL GAS HEAT CAPACITY	
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	ED LIOUID DENSITY		12.18 AT CAPACITY	12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
(degrees F)	Pounds per cubic foot	Temperature (degrees F)	British (herma) unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square toot-F	Temporature (degrees F)	Canbpois
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	12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
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12.21 SOLUBILITY IN WATER		12.22 SATURATED YAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (Degrees F)	Pounds per cubic foot	Temperature (degrees F)	Botish thormal uni
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- 87 C
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID NEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12,20 LIQUID VISCOSITY	
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12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foc:	Temperature (degrees F)	British thermal uni per pound-P
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		12.22		12.23		12.24	
		SATURATED VAPOR PRESSURE		SATURATED VAPOR DENSITY		IDEAL GAS HEAT CAPACITY	
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUED VISCOSITY	
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	12.21		12.22		12.23	12.24		
	SOLUBILITY IN WATER		SATURATED VAPOR PRESSURE		VAPOR DENSITY	IDEAL GAS HEAT CAPACITY		
Temperature	Pounds per 100	Temperature	Pounds per square	Temperature	Pounds per cubic	Temperature	British thermal unit	
(degrees P)	pounds of water	(degrees F)	mph	(degrees F)	foot	(degrees F)	per pound-F	
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Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal uni per pound-F
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY			12.19 L CONDUCTIVITY	12.20 LIQUID VISCOSITY	
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SOLUBILITY IN WATER		SATURATED VAPOR PRESSURE			APOR DENSITY	IDEAL GAS HEAT CAPACITY		
Temperature	Pounds per 100	Temperature	Pounds per	Temperaturo	Pounds per cubic	Temperature	British thermal unit	
(degrees F)	pounds of water	(degrees F)	square inch	(degrees F)	foot	(degrees F)	per pound-F	
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			12.22 SATURATED VAPOR PRESSURE		12.23 BATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounda per square inch	Temperature (degrees F)	Pounda per cubic foot	Temperature (degraes F)	British thermal unit per pound-F	
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Analy Colored Story Colored Call for Cortin	nei de Vara de Station Courte des Index y de La Station Courte de Index y Index y Index y Index de Index de Index de Station Courte de Index de Station Courte des Index de Station Courte des		14 Fire Ethopsing Agence Hot in ne- Upet: Nei perform 5.5 Special Hazards til Combustion Present Hazards til Combustion Present til Yapos and Agence han have and hazardsa. They reacts active touco and phosphore end 6.4 Beleving at Pipe: Gree of Alcardsa	11. KAZARO ELASSIFICATIONS 11.1 Code of Federal Regularization: ORM.A 11.2 NAS Hasteri Ramog lar dum Water Treasofications: Not total 11.2 NAS Automotive Not total		
Fire	Continent's may septore a	n Thailtean anaiste an an an an an an an an an an an an an	 La sensorial of parts: Gover of Allements Artime Area servicying for struct parts takat to preven wear near 1 getter Tempersture: Data not erreistie & Exection Research responses & Burneng Rete: Data not erreistie & Burneng Rete: Data not erreistie & Artistatic Peans Tangers spec Data not maistie (Connuted) 			
Exposure	Integring to option neurops-contentioneter (and Clarin process) and a second of of the EXES most instants of Sites All, Clarification and the options and the second and of second comparison and the		 CHEMICAL MERCENTY Reactivity With Water Asne Reactivity with Convergen Reference: try hexactivity with Convergen Reference: try hexactivity with Convergen Reference: the Stability Outing Trebusion: Advances and Converse: Legal Despired Advances for disconstructions and Convergences and the Convergence of Convergence and Convergence and the Convergence of the Convergence of Convergence (Convergence) Indext Rests (Neurosciente to President): Data real presidence (Convergence) ResetWelly Group: Claim real presidence 			
Water Poliution	HARSELL TO ACLATIC I May be cangerous if 4 and hopty occal health and well hopty occal health and well	in Clarate		12. PHYSICAL AND EMERICAL PROPERT 12.1 Physical Balay of 15°C and 1 store Uque 12.2 Molecular Weight: 20036 12.3 Molecular Weight: 20036 12.4 Prevalue Point: 12.4 Prevalue Point:		
(See Response typus metho parame Restrict acc Scould be a Overage m	ena enoveci no prywch kessywy, KAL OZAGNATIONS Ry Class: Noi listet i cOrp5: necesi: 1/2783 753	2. LABEL 2.1 Category: None 2.1 Category: None 2.1 Category: None 4. CRSERVABLE CHARACTERSTICS 4. CRSERVABLE CHARACTERSTICS 4.1 Physical State (an ahgewith: Lapad) 4.2 Coor: Characterize state-like managem 4.1 Door: Characterize state-like managem	E. WATER POLLUTION All Adjuster Texterity; Dog pone/66 m/blacgE/TL_/ keen weter B.020-0.000 gone/88 // Imp/kg Dog pone/88 // Imp/kg E.3 Biological Cargon Common (2000) Dog not evaluate Ref Found Chain Cargon/Distance Patawolae Norm	3776 = 2.0°C = 278°K 12.3 Entitical Transportations: Not partment 12.4 Entitical Transportations: Not partment 12.7 Epecific Curvery:		
crowneyther tenach spake 5.2 Symptoms FC planed ward of the cheer owned all to restrike with mouth the cheer more spake more spake more spake more spake more spake	ectives Equipments Wear seri chima perdadang and rubber o kan Ak (chima) (politaninaka) deving Lapasura Eucosure », construint pupit of me sy- stancian twach and consiste hours Exponents: Speed a starman (cal respiration, using the starman (cal respiration, using the starman (cal respiration, using the starman (cal respiration, using the starman (cal respiration, using the starman (cal respiration, using the starman (cal respiration). Start OR with water, Remote consuming	АLTRI HAZARDS солтатное ответству арранские (от нежителя чая большу инчен булгату била об понителя чей столино по булгар иноте в них от то наино социали ней столино во булгар иноте в них от то наино социали или столино. Во булгар иноте в них от то наино социали или социали на паку волон в них от то наино социали или социали на паку волон. Тhe купсквата паку билическо соки и вничасти социали и социали социали социали иното-понила. По купсквата паку, конто со колинования все социали социали или, конто со колинования все социали социали или, конто со колинования все состать социали или, конто со колинования все состать социали или, конто со колинования все состать социали или, конто со колинования все состать социали или на сосоранования и протито уче всехот на это коса со учествите сосоранования. 2 ре на всехот на это коса со учествите сосоранования со	 SKIPPING INFORMATION SKIPPING INFORMATION Catadian al Partity: CVTHEDN insectable Many powers, buttl, and spier solutions are sold units a catality of incide forms. Storage Temperature: Becom 120°F. Decomposition indo-focustopic occurs al higher temperatures. Bard Abmosphere: Data not evaluative B.4 Vanzing: Cate not evaluation 	 12.14 Next of Decomposition: Not performed 12.15 Next of Decomposition: Not performed 13.15 Next of Pendeur: Data rot performed 12.25 Hext of Pendeur: Data not performed 12.25 Landing Yaker, Data not pendetic 13.27 Hext Vision Pressure: Data not pendetic 13.27 Hext Vision Pressure: Data not pendetic 		
signe pi atr; jegstrepri er i fang aggen Processeni, ; en 15-20 mm ossip mitan issuer.title (processing (Frydraes, dry seaso , children with 1 mg of singers at to be obstructing free seaso 2.3 gm at 100 mi of physics wait 2.1 millions find in not seaso sector mysicson, report that the to conversion report.		6.10 Door Theetnee: Date not instable 6.11 BDLH Vielar: 5000 mg/m* 6. FIRE MA2A	CARDS, (Cantinuad)		
5.7 Late Todatly 5.8 Yeaser (Ges) is 6.8 Laquid or Boli	Cata not evalute Marti Characteristica: Norm	ikely www.heizard. If stalled on clothing and allowing in	 8.11 Statisticametric fair in Puel Rever, Cate vol. 1 9.12 Flame Temperature: Data rest avannos 	194409 .		

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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperatura (degrees F)	Pounds per cubic foci (estimala)	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unti-inch per hour- square fool-F	Temperature (degroes F)	Centipoise
77	77.089	85	⁻ .380		N	70	45.270
79	77.089	90	.984		0	72	42,680
79	77.089	95	.389		I Ť I	74	40.260
60	77.089	t00	.393		! !	76	37.980
81	77.069	t05	398		P	78	35.87D
82	77.089	\$10	.402		E A	80	33.880
83	77.089	115	.406		A A	62	32.020
64	77.089	120	,411		Ι Τ Ι	84	30.270
85	77.089	125	.415			86	28,620
66	77,089	130	,420		N 1	68	27.080
87	77.069	135	.424			90	25.630
68	77.069	140	.429		Б И Т	92	24.270
69	77.089	145			1 T	94	22,990
90	77.069	150	.436			96	21.780
91	77.089				1 1	98	20.650
82	77.089				1	100	19.580
63	77.089					102	18.580
84	77.089				1 1	104	17.630
85	77.089					106	16.740
96	77.089					108	15,900
87	77,029					110	15.100
9B	77.089					112	14.350
89	77.089					114	\$3,650
100	77,089					116	12,980
101	77,089				1	118	12.350
102	77.089				1	120	12.350

SOLUBILIT	12.21 Y IN WATER	12.22 BATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperatura (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degroos F)	Pounda per cubic toot	Temperature (degroes F)	British thermal un per pound-F
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			P E A T		P E R T		P E R T
			7 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				N € N T

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	n, pel-conternet breathing and bacing proves > ge # possess Call fre departs	PRESS. MC PONCINE	Reparate pre-colling					
Eventuate an Eley sidenta	and take weige spray to "knock and take weige spray to "knock amount pacturing at material							
Ngaly kacal I	waith and pollution control no							
	Contraction ADSONCLOS AND INDITATING GASES ARE PRODUCED IN FIRE. Wash opposed between disenting accounts, and projective overclotwing indicating downin DITENCUISH with WATER, FORM, OF CARBON DIGNOE. Fire							
Fire								
.	CALL FOR MEDICAL AID							
	POISONOUS & BRIALES.							
	intering to ever. Mana in Interin an A program from the prophet. Of And HOT reputitions							
	aut HOT month-to-mon I creating a discut, get UDUD	57 967)						
Exposure	We have also and ever.							
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	IF IN EYES, not even to p IF SWALLOWED and work of mile CO NOT REDUCE VOMITIN		-Christman -shar					
	t Not harmful to accurace Ma.		· ·					
Water Pollution	May be dangerbuik if it white Motory legal fragits and	-						
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	NSE TO DISCHARGE	2 LABEL 21 Generation Pr						
titus vertere Period acco	¢-poseon	1.7 Came 6	*					
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	IAL DESIGNATIONS Ty China Hangarame	4.1 Prysiant (Re	NULE ENAUGETERISTICS					
hydrocation 3.3 Fermula: Chistr		Lapadas 4.1 Color: Color	pes.					
3.5 HERALIN Design 3.4 DOT 62 Hour 104	mer: 2.0/1062		ety address: smoot.					
3.8 CAS Regarry &	6z 74434							
	-	LTH NAZAROS						
6.2 Tymptome For	caive Equipment Self-conten- towing Experience Interaction of In contentiations causes reput	Prepar causes long ap	The source of th					
end burns sk			,					
	OR EVER. Auto was wase k							
1.5 Shart Tarm Int	velaçãos Limitas 20 cara (o 3 : postars: Data nai evalução	n n						
6.) Ludie Technity: 6.0 Vageor (Cam) for	Deta not available Rard Characteristics: Vajar a		ch the personnel will not					
Lis Lister or Bolid	ie moderale or high water dan Instant Characteristics: Fart	ly severe also creater; re	ادت النقاع فلنبطأ ال					
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L COLE MALANDS	10 HAZARD A\$35\$\$MENT 5001
1 Flash Paint: Practically not bernnable	(See Mazero Assessment Hancosce)
Financial Links in Air: 10%-15%	A-8-C-I-J
 Pro Estimation Agents Not proved Pro Estimation gagens tiel to be 	
Used: Not performin	
Lis Special Vinceros er Communities	LI. MAZARO CLASSIFICATIONS
Products: Tons: and enurong passe are	11,1 Cost of Fearral Regulations:
generated when supposed to tree or next Behavior in Proc. Contension may explore	Pages. 1
L' Ignition Transportatione, MMPF	11.3 HAS Helard Raing for Ball. Water
Electrical Housest Hot permanent	Transportsdort
Lit Burning Rase: Hits persivers	Category Nation
. 10 Adebatis Phine Temperature: Date not emission	Hagen
LI Buillingenging Air to Fust Rusia	Vapor events
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12 Plate Temperature Data no eventte	Postoria anna ao anna an an an an A Mister Postoria
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7. CHENGERI, MACTIVITY	Reactively
1 Reactivity With Water; No rescan	Other Chemicals
 Restlivity with Commun Materials: No sections 	Self Preschon 0
reaction J Biology During Transport Scape	11.3 HOPA Hazard Chambleretion:
A Hearthing Agents for actor une	Gelegery Dessification
Constitut Not performed	Heaven Hazard (Black)
.6 Palymentantien; Not persneri	Papersongiality (Pape)
 Intributor of Polymorization: Not performing 	
Predoct): Data not available	
B Baactretty Grouge 35	
	·
	12 PHYSICAL AND CHEMICAL PROPERTIES
	12.1 Physical State of 1915 and 1 apro
	12.3 Beforg Parks at 1 pigg
	38.37 - 3 6°C - 778.8%
	12.4 Freezing Peint
L WATER POLLSTION	-125"F127"C - 167"K
	12.8 Critical Temperature
L1 Aquantin Taxinity: Ninta	376°F = 111°C = 464°C 12.4 Official Province: Hot partners
Li Relation Topicity: None	12.7 Landin Gravity
. Giological Caygon Denteres (BOO):	1.68 at 20°C (liquid)
Norm	12.4 Light Burtiste Templory
J Feed Chain Concentration Polential Name	24.5 denominaria — 0.0245 Niro pi 15°C 12.0 Calendi Water Interfactor Terratoria
	12.10 Vapar (Gas) Specific Gravity: 3.3
	12.11 Rollin of Specific Horse of Vapor (Cash)
	1.247
· · ·	12.12 Links Haal of Paperizster: 108 Bat/b - 487 Bat/g -
	1.40 × 10 ⁴ //mg
	12.13 Next of Connection:3180 Du/lo
	=1771 cal/g = 74.15 X 10* J/kg
	12.14 Heat of Decemperative Net persons
1. SHIPPING INFORMATION	12.1.8 Parel of Boliction: Not persisten 12.1.8 Parel of Perymonitization: Not performent
1 Grades of Partys Commercust not tess	12.23 Heat of Punkac 13.05 casing
stan 82.5%	12.11 Limiting Value: Date not available
2 Etimpe Temperature; Amberi 3 Interi Absorpture; Na requirement	12.37 Rold Vepor Pressure: 45 pm
4 Yortzing: Satery result	
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
ounds per cubic locs	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British lihermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise	
107.700	35 20 25 20 15 10 5 0 5 10 15 20 25 30 35	.194 .195 .195 .195 .196 .196 .196 .196 .197 .197 .197 .197 .198 .198	-90 -90 -90 -90 -90 -90 -90 -90 -90 -90	.795 .787 .778 .771 .764 .756 .748 .740 .732 .724 .716 .708 .708		NOT PERTINENT	
	1004	(degrees F) 107.700 -35 -30 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30	toot (degreen F) per pound-F 107.700 35 .194 30 .195 25 .195 20 .195 15 .195 10 .196 5 .196 0 .196 10 .196 20 .196 -15 .196 0 .196 20 .197 15 .197 20 .197 25 .198 30 .198	ioot (degrees F) per pound-F (degrees F) 107.700 -35 .194 -90 -30 .195 -80 -25 .185 -70 -20 .195 -60 -15 .195 -50 -10 .196 -40 -5 .196 -30 0 .196 -20 10 .196 -10 10 .197 0 15 .197 10 20 .197 20 25 .198 30 30 .198 30	Code (degrees F) Introduction per pound-F Tattportunation (degrees F) Unit-inch per hour- square foot-F 107.700 -35 .194 -90 .795 -30 .195 -80 .787 -25 .195 -60 .771 -20 .195 -60 .771 -15 .196 -40 .756 -10 .196 -40 .756 0 .196 -40 .738 -10 .196 -40 .756 -5 .196 -30 .748 0 .196 -30 .748 10 .197 0 .724 15 .197 10 .716 20 .197 20 .708 25 .198 30 .700	Councy per councy (degrees F) Interpretation per pound-F Interpretation (degrees F) Unit-Inch per hour- square (coil-F) (emperature (degrees F) 107.700 -35 .194 -00 .795 -30 .195 -80 .787 -25 .185 -70 .778 -20 .195 -60 .771 -15 .196 -40 .758 -10 .196 -40 .758 -5 .196 -30 .748 0 .197 0 .724 10 .197 0 .724 15 .197 10 .708 20 .197 20 .708 30 .197 0 .724 15 .197 .10 .708 25 .198 .30 .700	

12.21 SOLUBILITY IN WATER		12.72 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS REAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic	Tompersoure (degrees F)	British thermal uni per pound-F
68.02	.090	70 60 50	.651 .944 1.340	70 60 50	.01479 .02090 .02893	0 25 50	.098 .101 .104
		-40 30 20	1.864 2.547	40 30	.03929 .05244	75 100	.105 .109
			3,424 4,532 5,914	20 10 0	.06888 .08914 .31380	125 150 175	.112 .114 .117
		1D 20 30	7.616 9.694 12.200	10 20 30	.14350	200 225	.120
i		40 50	15.190 18.730	40 50	.22030 .26890 .32500	250 275 300	.125 .127 .129
		60 70 80	22.660 27.710 33.300	60 70 80	.38940 .46270 .54570	325 350	.1 32 .134
		90 100	39.710 47.020	90 100	.54570 .63900 .74310	375 400 425	.137 .139 .141
		110 120	55.300 64.639	1 10 1 20	.8587¢ ,98640	450 475	.144 .148
						500 525 550	.14B .150 .153
						575 500	.155

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Fire	FLAVMAGLE February explose a grand of an an accident weak Very may explose a grand of an an accident weak Is degund with any commical, excerce lower, or carbon develop Water may be infinited on an are Code exposed contenents with regime								
Exposure	CALL FOR MEDICAL AID YAROR Integrary to synam and Broat, Birthyski pragtowy, prijas of condicional depression Barbark pragtowy has stopped, see principal respirator I pragtowy has stopped, see principal respirator I pragtowy has stopped, see principal respirator I pragtowy data charact, give principal respirator I pragtowy data charact, give principal respirator Well some consummers confiring and shows. Found sometical ansay were point of water IF NE EVES most eventor confiring and shows. F SWALDOWED and were all CONSCIDUS, have were the set of grintski								
Water Pollution	Opengercase to equasiat live in May be designedual if it letter Notify local Depth and well Notify local Depth of memory of	ie ondes '							
(Les Respons	WRE TO DISCHARCE e Mathada Mandbook) ngingh Resmabiny a baan	L LABEL 1.7 Cetegory: Flettenacie Iques 1.7 Canee: 3							
3. CHEM 3.1 CC Comparish 3.2 Formatic Chil 3.3 HOURD Desig 3.4 DOT TO Mic. 11 3.5 CAS Registry	CONDU Interes 52/1185 RD	4. DESERVABLE CHARACTERES 4.) Physical State (an efferent US 4.2 Centre Colones 4.3 Octor; Like numbers; planamit (su	ud						
Investi L2 Synopoins FC Con case of scopool.co 13 over.and \$1 Theoremaph Li S. Short Term I & Short Term I & A Tasicity og In & Veper (Tan) i system i ge L3 Liquid or See	sective Gaussment: Organic ca Maximg Espectres: Louid Caus matchin, discretes, nacidal, m Espectres, provident Caus and Paracelation and administra call projectes del Value: 200 point del val	le 8 5/40 (mil) cause a alight smaring of the eyes or read at effect at temporary. mem feature. If spelled on clothing and align	l Darsal, e ter hall e uri hacqui						

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 FIRE HAZARDS Flash Humit, STF C.C.: 277 D.C. Flash Humit, STF C.C.: 277 D.C. Fire Extension Lance in Art: 110-11.5 https://doi.org/10.1000/000000000000000000000000000000	IS. HAZARD ASS(SSMURT CODE (See Halard Announder Hardbork) A-P-Q-R-S
Used: Watan may be instaction Bend: Watan may be instaction Products: NOI bertrand 4.6 Betavier in Prot. Not perform 8.7 Synchronia Hiscoric Clean & Group II 8.9 Suming Rate: 4.1 continue 5.16 Additects: France Temperature: Date not eventsive 8.11 Statistics France Temperature: Date not eventsive 8.12 France Temperature: Date not eventsive 8.13 Excellence Clean Not eventsive 8.14 France Temperature: Date not eventsive 8.15 France Temperature: Date not eventsive 8.15 France Temperature: Date not eventsive 8.16 France Temperature: Date not eventsive 8.17 Statistics Advisor Performance Not 1.8 Generative with Constant Materials 7.9 Similary Daring Transport: Sizzee 7.9 Sectorizing Agentia for Acido and Calaborative of Pedymentations 7.9 Pedymentative: Rescent Is Products: Date not eventsive 7.9 Intervent 7.9 State Rate: Rescent Is Product: Date not eventsive 7.9 Not partners 7.9 Note: Date not eventsive 7.9 Not partners 7.9 State Rate: Rescent Is Product: Date not eventsive 7.9 Rescention (Date not eventsive 7.9 Not partners 7.9 Date Rate (Rescent Is Product: Date not eventsive 7.9 State Not State not eventsive 7.9 State Not State not eventsive 7.9 State Note Note Productsive 7.9 State Note Note Note Note Note Note Note No	I.I. NAZAMI CLASSIFICATIONS Second Response Resp
L. WATER POLLUTION R.1 deputit Tanktry; 5640 mg//148 tr/buogd//T/hrph water 4.3 Waterford Tockfy: Date rot evaluate 6.3 Relegical Orygen Comerci (ICO); 214%, 5 carps 8.4 Figued Chain Comparis plan Polyatian. Notae	 12. PHYSICAL AND CHENICAL PROPERTIES 12.1 Preprint State of 10°C and 1 sinc, Logue 12.3 Realing Paper of 1 sinc, (72.3°F = 70 5°C = 352.5°4 12.4 Preventing Paper -123.3°F = -263.3°C = 128 6°K 12.4 Critical Preventive:
 Skipping INFORMATION Gradma of Party: 98.5 + % Barage Temperature Anthread Bart Admissionment No recomment Vending Open Communication (or pressure-rectain) 	 A - /10° GBrg = -/10 B T 7.2° J/kg 12 (A Heat A Outdriver (ext)4 BkJ/kg 5 Sak/g = -0.2 X 10° J/kg 13 Heat of Popyhericsson: Hot carinerie 12.25 Heat of Popyhericsson: Hot carinerie 12.25 Heat of Popyherics Data Act available 13.26 Limiting Value: Data Act available 12.37 Head Valuer Pressure: 3.3 trans

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12.17 SATURATED LIQUID DENSITY				12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Ternoeralure (degrees F)	Pounds per cubic fooi	Tomperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermat unit-inch per hour- square foot-F	Temperature [degrees F]	Centopoise
35 40 45 50 55 60 65 70 75 80 85 80 85 90 95 100 105 110 115 120	51,460 51,280 51,110 50,940 50,760 50,500 50,420 50,420 50,420 50,420 49,900 49,720 49,550 49,200 49,550 49,200 49,030 48,860 48,860 48,510	-35 -30 -20 -15 -10 5 0 5 10 15 20 25 30 35 40 45 55 60 65 70 75 80	.501 .502 .503 .504 .505 .507 .508 .509 .510 .511 .512 .513 .514 .516 .517 .518 .517 .518 .519 .520 .521 .522 .523 .524 .526 .527 .528	10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105	1.073 1.068 1.063 1.058 1.058 1.053 1.048 1.038 1.038 1.038 1.033 1.026 1.023 1.028 1.023 1.013 1.008 1.003 .998 .993 .988 .983 .988		NOT PERTINENT

SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
(degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal or per pound-F
68.02	27.000	۰	.148	a	.00216	0	
		10	.216	10	.00310	25	.352
		20	.310	20	.00435	50	.368
		30	.437	30	.00599	75	.384
		40	.604	40	.00335	100	.399
		50	.823	50	.01085	125	.414
		60	1.304	60	.01427	150	.429
		70	1,451	. 70	.01853	130	,444
		80	1.909	60	.02376	200	.458
	· ·	90	2.465	90	.03012	225	.472
		100	3,147	190	.03778	250	.486
		1 10	3.977	110	.04590	275	.500
		120	4.977	120	.05768	300	.526
		130	··· 6.171	130	.07030	325	.538
		140	7.586	140	.08498	350	.551
		150	9.250	150	.10190	375	.563
		160	11.190	160	.12130	400	.575
		170	13.450	170	.14350	425	.586
		180	16.050	160	.16850	450	.596
		180	19,030	190	.19670	475	.609
ľ		200	22.420	200	22830	500	.620
		210	26.270	210	.26350	525	.630
	[220	30,610	220	.30250	550	.640
		230	35.480	230	.34550	575	.550
ſ		240	40.930	240	.39290	600	.660

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Солтинан Вулик Талануско-2н-1, 4-ок Талануско-офексион Балануско-офексион Собекси	aire .	Gotorium, Fapily, ammona (100) mith mater, instating rapor is produced	 FIRE HAZUROS Fireh Pears: 102°F Q.C Fireh Pears: 102°F Q.C Fire Extriguishing Agents: Water kg, alicenter Halt, dry Cherhold, or carbon degree 	IA. HALARD ASSESSMENT CODE (See Harmed Amounter HarkBook) ▲-P-CI		
Antonia activitati Cast time despi tecnenie activit	na f Double C stor space and value. Stored Stored Stored States and States forter age	rces	4.1 Fire Scrogussing Agents Mel to be Weed: Not pertraind 4.3 Special Instants of Combustion Products: Instange viscors are generated when heating 4.3 Selected in Fire Viscors is nearer than all	11. HAZARD CLASSIFICATIONS 11.1 Code of Poderol Regulations: Family Code of Poderol Regulations: Family RAS Hazard Rating for Suble Reger Transponsition;		
Fire	FLAMMARIE Fisikhter, slong «spor kad Visco mej statos i symm E-syngueti witi wate, or of Eoof statosid comamers wi	j m an angippeni pros. Namijal, ja Cafladi Golda	and may been some ostance to source of greats and lean back. 4.7 Synthem in megonitary: SOUP F 4.8 Electrical Hargard: Not personne 4.8 Benchman Rate: 13 card/ram 4.18 Acambicat Flavos Samgashure; Outa rol projektive (Contrology)	Contegory Rate Fire		
Ехрозите	 Mapse to Fridin & Init presidency finds in Convert, and It presidency is childrafe, over a COULD Intrastraj is childrafe, over a COULD Intrastraj is childrafe, over a Remove conductivated condition Remove conductivated condition Remove conductivated condition Remove conductivated condition Remove conductivated condition Remove conductivated condition Remove conductivated condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition Remove condition	i headaucha, or driftcuil breathing, er artetopi (regling son argumen ang and phone	 CHEINKAL REACTIVITY Anastivity With Water: No reaction Resolutity with Comman Nationaire No reaction Stability Conneg Transport: Stative Stability Conneg Transport: Stative Stability Conneg Transport: Stative Stability Conneg Transport: Stative Stability Conneg Transport: Stative Stability Conneg Transport: Stative Stability Conneg Transport: Stative Stability Conneg Transport: Stative Stability Conneg Transport: Stative Stability Conneg: 7 	AssPret: Efect. Ractowy Other Chemitel Sal Resident 11.3 IdPA Hatard Chemitication: Category Chestific, Health Hears Bluel Figurescar, (Reg).		
Water Poliution	Effect of the concentre whith May be demonstrate if 4 arrian hopey boards and weath hopey boardors or nearby	n annar mighag. In chunais		JZ PHYSICAL AND CHEMICAL PROPER IZ.1 Physical Base of 18°C and 3 mine IZ.9 Metropole Wadgits 67.12 IX.3 Bolling Point of 1 one RDZ-8°F = 128.3°C = 421 4°R.		
-	NSE TO DISCHARGE Historia Handbaan a Iwan	2 UNEL 1.1 Campary: Aarmater volati 1.2 Cause 1	L WATER FOLLUTION L1 Aquatia Teodetty: Data noi evalupian L3 Webstow/ Tooletty: Data noi evalution L3 Webstown Conyean Demons (BOD): proto: 0.9%, 5 days 3.1%, 20 days L4 Road Chain Concentration Personal More	12.4 Pressing Point: 22.47		
	nation: 1.3/2054 \$4	4. OBSERVABLE ENABLECTERISTICS 4.1" Physical State (an ohipped): Land 4.3 Color: Converse 4.3 Color: Fishy, investment		App partment 12.10 Yapor (Cam) Specific Gravey: POI partment 12.11 Ratio of Specific Houts of Yapor (C (mil) 1.051 18.10 Latent Heat of Yaportation: 182.8 Dauts = 101.8 cpt/g = 4.234 X 107 Jing 13.13 Heat of Combustion: Data het systa		
Abber boos L3 Symptome For Absorbton M L3 Treastream et il caset and we lotte ma or SKIN OR EY SGenton too S.1 Threshold Lim	actives Equipment: Opport, say and glower, googles or lace or forwing Esposers, Liquid cause Wangh shah may cause randow transfer and management random million, and call is physically if a to million, men immediately induct TS: emendately fluch with plan methy.	ng pun ang nya puna. Basatring napora ar ang hawitacha Inach OCOLI, mana pahani ké ingsh an, kang him ang paga, awa antaaw naporason, INGESTION, Omang: Paat syngkonalacany, ng krown antagala, ng ol watao ke as laasi 15 mm; ke nyas ga magaal	 3. SKIPPTING (RFURMATION 1.1 Emotes of Parmy: Environ gradien available, maps system 89%. 4.2 Example Temperature: Amplitus 5.5 Intel Alimetechnets: Na reductorest 6.4 Yesting: Open 	12.14 Heat of Decomposition: Any perman- 12.16 Heat of Solution: Data cot evaluate 12.16 Heat of Polyder/Collect N() perman- 12.19 Heat of Polyder/Collect N() perman- 12.19 Heat of Polyder/Collect N() perman- 12.17 Reid Velocit Pressent: 0.15 perman- 12.17 Perman-12.17 P		
 Late Tooletty by leg Late Tooletty: Late Tooletty: Late Tooletty: Vapor (Cas) in system if pre- Lib Liquid or Solid 	pastern: Grade 2; LDus + 0.3) Data not available many Characterisanistics: Vapons dans in man concentrations. The Entitlet Characteristics: Varies cause emanting and reddening / cause emanting and reddening / cause emanting and reddening /	o 5 g/kg (gumm pag, rat) Clude il Light Untering di Rei eyes ar respundby 9 erisci il Lingtoney 1.114 facanti il spaint an ciailung eng escued 10	L. FIRE HJ22 6.11 Stanchiermettes Air te Fuer Retto: Osta not r U.13 Planar Temperatura: Data not ergelepia	1775 (Contoured) neutrite		
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degreea F)	Pounds per cuthic tool	Temperatura (dogrees F)	British thermal unit per pound-F	Temperature (degrees F)	Bintish mermal unit-inch per hour- square toot-F	Temperature (degrees F)	Centipoia
35	63.740	70	.476		N		
40	83.550	75	.477				N
45	63.360	60	.478		C T		0
50	63.170	65	.480		1 1		Т
. 55	52,680	80	.481				
60	62.790	85	.482		Ē	ſ	<u>e</u>
65	62.600	100	.484		R I	1	E
70	62.410	105	.485		1 7 1	1	Ħ
75	62.220	110	.488				T
80	62.030	115	.468		N		1
85	61.840	120	.489		Ē		N
₽Q	61.650	125	490		N N		E
95	61,450	130	.482		T T		N
100	81.260	135	.493				T
105	61.070	140	.494			1	
110	60.660	145	.496]		
115	60.690	150	.497		! 1		
120	60_500	155	.498				
	t í	160	.499				
	1 1	165	.501		!		
	ļ .	170	.502				
		175	.503				
		180	.505		F 1		
		185	_506				
		190	.507				
	' '	195	.508				

			SATURATED VAPOR PRESSURE		12.21 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Tomperature (degrees F)	Pounds per 100 pounds of water	Temperature (dogrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic Inot	Temperature (degrees F)	British thermal unit per pound-P (estimate)	
	M I S C I B L E	-30 -20 -10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 150 170 160 190 200 210 220	.002 .003 .005 .008 .013 .021 .023 .049 .073 .106 .152 .213 .294 .401 .538 .714 .936 1.213 1.558 1.976 2.487 3.102 3.836 4.712 5.742 6.949		.00003 .00005 .D0009 .00014 .00025 .00036 .00054 .00060 .00117 .00166 .00232 .00320 .00434 .00581 .00767 .00999 .01288 .01841 .02071 .02588 .03205 .03936 .04795 .05797 .06959 .08297	50 52 54 58 60 62 64 68 68 68 68 68 70 72 74 76 78 80 82 84	.274 .274 .274 .274 .274 .274 .274 .274	

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NAPHTHA: COAL TAR

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15. HAZARO ASSESSMENT CODE (See Report Lessenment Reads

A-T-U-V-W

11. HAZARD CLASSIFICATIONS

12 INTSICAL AND CHENICAL PROPERTIES 12.1 Physical State at 19°C and 1 alor: Land

11.5 Coop of Pederal Regulations: Combusition Hand 11.5 MLS inscore Reamp for Dum Wester

Transsectation: Not used 11.3 INFPA Heganit CaseMastion;

Not based

	Commun Prost Mature of Decision, V system	Alama,	Cotorium in pale Gaspiere-ine paty patter imajory rappr a produced.	FITE HAZAIDS A1 Frank House 10714 C C. A3 Frankmatche (Units in Air; Dela nol evaluative G.3 Fite Extendement Agental Foam, Eaton
	Cas the cen Avoid contain Sony upperior Include and	ge i posebe haap poor pa arreat of work aport and vapor, and van water some vapor, and van water some vapor, and van water some vapor, and vapor, and post-dom some vapor and a post-dom some vapor aport and post-dom some vapor aport and post-dom some vapor aport and post-dom some vapor aport and post-dom some vapor aport ap		dumite, or by chemical 4.4 Pre Exempletency Agents has to pa Uved: Not partnern 4.5 Special Hackards of Constantian Products: Not partnern 4.6 Sentence in Pre- Not partnern 4.7 Special Temperature: NO-6577
•••	Fire	Соптанатона. Елимония — Калл. der с Соор журовой солчалися на	anniga in gartion dioacht in anaine.	R.J. Electricel Hassets Gass L Group D A.P. Barrang Ramit 4 minimum, I,10 Addied/P Rame 1 miniputstary: Dira; not problem C.11 Statchomestic Air to Fuel Return Dira; not problem Q.12 Planes Temperature; Cars not eventible
	Ехрозиге	Or loss of consecutives Move any loss and B prestring has append by I prestring has append by I prestring has anti- actual groups and even interreg to alore and even I prestrict a set of Rest for the conservation of the conservation of the Rest for the conservation of the conservation of the Rest for the conservation of the conservation of the Rest for the c	es, nesoscres, difficult intelling e e orbitosi respiratori. anygen. ees or vorming ng ant Janan. efty bi webe. et and haab web penty bi webe. e COMSCIOUS, neve worm grate webe	 7. CHEMICAL REACTIVITY 7.1 Reactivity With Weiser Manaction 7.2 Reactivity with Common Materials No-reaction 7.3 Reading units Common Materials No-reaction 7.4 Medwideling Agents de Acids and Canadics Noi personni 7.5 Polymerization Non personni 7.6 Venders at Pelywerization: Nat pertensit 7.7 Meder Radio Remotion to Pediadic Optimization 7.8 Pelactic Optimization 7.9 Pediadic Optimization 7.8 Resetivity Group: 20
ting and a second second second second second second second second second second second second second second s	Water Pollution	Effect of the concentrations Found to physical 4 error May be compared if a error Making local hand 5 error web	n weine realizer. He officents.	
	(See Perspectation) Mechanical I Snowe be re		2. LABL 2.1 Category: Nore 2.2 Classo Mat pertnent	L WATER POLLUTION 6.1 Aquide Testisty: Case on available 6.2 Waterbow Testisty: Cate not available 6.2 Braiscistal Corpus Domand (BCO): Data not developin 6.4 Page Casis Concentration Polantial None
		nd eveletik union 12/2111 19	OBSERVABLE ENABLETERISTICS Physical State Case stagework: Locad Sator: Colories to pale yellow Sator: Like barcare, lokares, and sylene	
	or race photo Cyncerkinger Nas concern fel Nas concern et l La Treesmen et	ethe Easterneric hydrocartor isoning Expansion Provide L isoning Expansion of acute isoning the environment isonic state that because isonic state that the environment isonic state that the isonic state isonic state isonic state the environment isonic state i	a 520 mg/kg cause a sign screening of the syste of responsibly a effect is bencarray. New NASACT II spinal on calabing and alcound to	SHIPPERG INFORMATION SHIPPERG INFORMATION S.1 Groups of Party sports and copy Land and party for a second seco
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Molecular Weight Not partners Bailing Point at 1 ator 200-5007F = 93-2007C = 368-5131K 12.3 12.5 Freezing Point: his paravare 124 Gritical Temperature: Not parane Critical Pressures not pertrain 124 12.0 12.7 Specific Granty: 9 06-0 64 at 20°C Dourth Liquid Service Tenaters (est.) NOT AVAILABLE ni pour 12.8 20 denes/on = 0.020 Mins at 20°C Liquid Water Insertants Tanaton (rst.) 45 denes/cm = 0.045 Mins at 20°C Vision (Dec) Seechic Growty: cas Perturbat. 12.8 12.10 Case not available 12.11 Rate of Specific Heats of Vapor (Gas): (equ.) 1 030 (equ.) 1 030 S2.12 Latent Hert of Vepertontions (est.) 101 Bio/ts = 56.2 cat/g - 2.35 X 10* J/kg 12,13 Have at Constantiate (etc.) —15,200 Basilo — —10,100 caling = —424 8 10° Jing 12.14 Heat of Declargentmer Ket perior 12.15 Heat of Schröter Ket periors 12.16 Heat of Polymerization: Not perior 12.23 Heat of Polymerization: Not perior re NOI pertenent -----12.29 Limiting Volum: Data not amatable 12.27 Read Vapar Pressure: 0.13 pea NOTES JUNE 1985 -

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9 295 NAPHTHA: COAL TAR

SATURATED LIQUID DENSITY					12.19 AL CONDUCTIVITY	12.20 LIQUID VISCOSITY	
iemperature (oograas F)	Pounds per cubic foot (esumate)	Temporature (cegrees F)	British thermal unit per pound-F (estimate)	Temperature (Degroes F)	British thermal unit-inch per hour- square foot-F (estimate)	Temperature (degrees F)	Centipois (estimate
50	53.680	50	.478	50	1.040		
52	53,680	52	.478	52		50	8.343
54	63.680	54	.478	54	1.040	52	8.841
56	53,680	58	.478	56	1.040	54	6.370
58	53,680	58	A78	56	1.040	56	7.927
60	53,680	60	.478		1.040	58	7.511
62	53.680	52	.478	62	1.040	60	7,119
64	53,680	84	.478		1.040	62	6.751
68	53.680	66	.478	54 66	1.040	64	6.404
68	53,680	68	478	68	1.040	66	6.078
70	53,680	70	476	70	3.040	68	5.770
72	53,680	72	478	70	1.040	70	5.481
74	53.680	74	.478	74	1.040	72	5.207
76	53.68D	76	.478		1.040	74	4.950
78	53,680	78	.478	76	1.040	78	4.707
80	53,580	80	.478	78	1.040	78	4.477
62	53,680	82	.478	60	1.040	60	4.260
84	53,680	64	.478	62	1.040	82	4.056
86	53,680	86	.476	64	1.040	84	3.862
68	53.660	88		86	1.040	86	3.676
BC .	53.680	90	.478	88	1.040	68	3.506
82	53.680	92	.478	90	1.040	90	3.342
84	53,680	92 194	.478	92	1,040	92	3.187
96	53,580	96	.478	94	1,040	94	3.D4D
98	53.680	98	.478	96	3.040	96	2,901
100	53.680	948 100	.478	98	1.040	98	2.770
		100	.478	100	1.040	100	2.645

12.21 SOLUBILITY IN WATER		12.22 BATURATED VAPOR PRESSURE		12-23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperatura (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch (estimate)	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thormal un per pound-F
					· <u> </u>		Por pound-i
		90	.094		N		
	N	100	.124		0		
	s o	110	.163		PT		1 2
	0	120					
		130	.272		P		1 ^
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i		230	2,281				ן ג
		240	2,728				
		250	3.247				Б
		250	3.646				
		270	4.535				E
		280	5.323				
		290	6.221				
		300	7.241				
ſ		310	8.394	1			
	1	320	9.695		4		
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		340	12,790			i	

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Common Bynefi I-Octamol Com excend Hydryfoetanol Actinol G-1	presi Ficaria pri vester.	Courses Busint actor	6. FILT RAZAIDS 8.1 Plan Pairs 1797 C.C. 6.2 Paraging Lords in Ar: Day no research 4.3 Phy Latinguistics density from, parton domain, or or provided)), HAZARO ISSESSMENT COOL (has hand familiar hundrack) A-T-U		
Cas me cons Ascel contac (contac and p	a possecia. Karap packar avve soverel Lever stated arrow percentrate meternal metri and polyhon eccircle spen metri and polyhon eccircle spen		LA For Estimations Adverts Polt in the Unite Heatman of Combustion Products the parameter La Battaria Heat physical Products the Parameter La Battaria Instrument La Constant Name	3). RAZARO CLASSIFICATIONS 11.1 Code of Federal Propulsions: NOL MARCH Products Propulsions: NOL MARCH Astrong for Buds Water Transportgamer Not Indus 14.2 NFPA Maximi Classifications		
Fire	Соляднаятия Базлудния вейн эну (Унайный, Соса акуламая солядания ней	Rown, or cardon postan Inneter.	B.B. Burnierg Partie: 1.7 mPh/mit. (app/Sa.) B.B. Burnierg Parties Temperature: Organ for evention A.11 BinderMemoriel: Air ta Partie Parties Date out available B.11 Fillers Temperature: Data not provided	Category Casalin Faces Handh Hacard (Blas),		
Exposure	CALL FDR WEDKAL AD LabitSD Integring IS HAY. Will born area. This of the second second and the Print of the System Second second and the IP HI EYES. hold synthesis cont	यु प्रत्ये वर्गवस्थ गा प्रत्ये ज्यापन, ग अर्थ्य फिल्डर-ज्या प्रव्यापु वर्ग व्यापन,	 CHERICAL ALACTIVITY Rescherty With Bahar; Fin reaction Paractivey with Convenion Measurable No respices Statisting Curring Transport. Section HoutiveRefining Ageness Section and Charactive Not permitting Independent Not permitting Independent Not permitting Independent Convenient Independent Convenient Independent Convenient Independent Convenient Independent Convenient Independent Convenient Independent Convenient Independent Convenient Independent Convenient Independent Convenient Independent Convenient Independently Convenience Independently Convenience 			
Water Pollution	Effect of low concentrations Facility to dependent Lady to dependent if a series Notify topic health and watch health commany of marity of	a minana.		12. PHYSICAL AND CERTINGAL PROPERT 12.1 Physical Stam of 13°C and 1 ame Load 19.2 Manager Wagne 120.23 12.3 Balling Paint of 1 pine 200°F = 199°C = 400°C 12.4 Francing Paint		
Cies Response Marchanau Shave be n	ELSPORESE TO CISCALARCE Z LABEL Close Research Microbiols Microbiolic Contemport Microbiolic Contemport Should be reflected Chemical and pryname integrated		K. WATES POLLITION A.1 Aqueon Testicity, Data voi eventure (.3 Westernet Testicity, Data voi eventure (.3 Besimpsoil Copygen Demand (2007); VOPA, 3 days K.4 Fean Chain Canadramation Ponances, Hore	57 = -15°C = 254°K 11.4 Critical Temperature 721°F = 315°C = 454°K 12.4 Critical Pressure 400 case = 77 stm = 2.7 MPUr 13.7 Specific Gravery, 0.458 of 27°C (Pauc) 12.4 Light Barroos Foreign 37.5 cipms/cm = 6.0275 M/m /		
	namene hist hered an van availaten	 OBSERVARLE CHARACTERISTICS Physical Barle (as shaped) Lond Cason Courses Onlar: Bareni 		 12.8 Liquid Water interfactal Tension: B.52 synamics. e.6.00822 M/m st 12.19 Vager (Ges) Synamics Gravity; Hop parameter 12.11 Ratio of Specific Husta of Yaper (G (.544 12.12 Later Houst of Vagerization: (.78 Barts = 17.5 colg = a.08 X 10° J/Lg 		
6.2 Bynomen Po 6.3 Traidman pi 6.4 Threaded Li- 6.4 Diori Term in 6.4 Tablety by in 6.7 Late Telonys 6.4 Yapar (2014) 4	actives Equipment: Destructing Agenting Expensions: entrances per Exponence Paints with concast on of Values: Ones not eventuation materials (and/or for any eventuation gambions: Groups 1; or of net LOAn force returns: Groups and the Con- transite (Concession and Con- ing GA-15 grow).	s ang eynas ancuanta ci ≕eter. atite	 Sattrying, Usfürstafföll Sattrying, Usfürstafföll Granns at Pursy: Dam non sveisbir Bar upper Tungerschutz, Adoent Bar upper Tungerschutz, Adoent Sattring Coon (Barre arrester) 	12.13 Hand M (Announther,14,120 (Bou-) =0.953 caling275.3 z 104 12.14 Hand M Decompositions has perment 13.15 Hand of Socketters has perment 13.15 Hand of Pathers Data not evaluated 13.25 Hand of Pathers Data not evaluated 13.25 Hand of Pathers Data not evaluated 13.27 Rules Vapor Pressure: Data not evaluate		
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SATURATED LIQUID DENSITY				12.19 LIQUID THERMAL CONDUCTIVITY			
Temperature (degraes F)	Founds per cubic loci	Temperature (degrees F)	British thermal unit per pound-F (estimate)	Temporatura (degrees F)	British thermal unit-inch per hour- square loci-F	Temperature (dogrees F)	Centapoin
35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 115 120 125 130 135 140	52.680 52.520 52.380 52.240 52.240 51.960 51.960 51.820 51.680 51.400 51.400 51.260 51.400 50.840 50.840 50.840 50.840 50.840 50.700 50.560 50.420 50.280 50.130 48.990 48.850 49.710	68 69 70 71 72 73 74 75 78 77 70 60 81 82 63 84 85	.499 .499 .499 .499 .499 .499 .499 .499	95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170	1.113 3.110 1.107 1.104 1.101 1.098 1.095 1.092 1.089 1.089 1.083 1.080 1.083 1.080 1.077 1.077 1.071 1.058	55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140	11,840 10,830 9,555 8,809 7,772 7,029 6,368 5,761 5,257 4,789 4,369 3,654 3,350 3,654 3,350 3,075 2,627 2,603 2,400

		12.22 SATURATED VAPOR PRESSURE		SATURATED	12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Tamperature (Degreas F)	Pounds per cubic	Temperature (degrees F)	British thormal uni	
68.02	. 500	80 100 120 140 160 200 220 240 260 280 300 320 340 320 340 340 340 400 420 440 460 480	.002 .005 .013 .032 .070 .144 .275 .497 654 1.404 2.219 3.388 5.016 7.225 10.150 13.950 16.790 24.850 32.300	60 100 120 140 160 220 220 240 260 260 300 320 340 350 380 400 420 440 460 480	.00004 .00011 .00028 .00065 .00138 .00273 .00507 .00639 .01481 .02367 .03639 .05410 .07805 .10960 .15930 .20160 .26520 .34280 .54620 .54520 .54520	0 25 50 75 100 125 150 275 200 225 250 275 300 325 350 375 400 425 450 475 500 525 550 575 600	.328 .342 .355 .369 .395 .409 .422 .435 .447 .435 .447 .460 .472 .485 .467 .509 .521 .532 .544 .555 .567 .576 .589 .600 .611 .621	

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12.21		SATURATED VAPOR PRESSURE		12.23		12.74	
SOLUBILITY IN WATER				SATURATED VAPOR DENSITY		IDEAL GAS HEAT CAPACITY	
Temperature	Pounds per 100	Temperature	Pounds per square	Temperature	Pounds per cubic foot	Temperature	British shermal un
(degrees F)	pounds of water	(degroes F)	inch	(degrees F)		(degrees F)	per pouno-F
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	12.17 JOUID DENSITY	12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY			
Temperature (degrees F)	Pounds per cubic faci	Temperature (cegrees F)	British thermal unit per pound-F	Temperature (cogrees F)	British thermal uns-inch per hour- square foot-F	Temperature (Degrees F)	Cantipoisi
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115	98,730	160	.215			135	.616
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50LUBILIT	12.21 Y IN WATER	SATURATED V	12.22 APOR PRESSURE	SATURATED V	12.23 APOR DENSITY	IDEAL GAS P	12.24 IEAT CAPACITY
Temperature (degrees F)	Founds per 100 pounds of water	Temperatura (degrees F)	Pounds per square inch	Temperature (degraes F)	Pounds per cubic tabl	Temperaturo (Gegrees F)	Brosh thermal un per pound-F
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SATURATED L					12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees P)	Pounds per cubic foot	Temperature (degrees F)	Botish thermal unit	Temperature (Degraes F)	Brinsh mermal umt-anch per hour- square toot-F	Temperature (degrees F)	Centoorse	
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12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic Ipon	Temperature (degrees F)	British (hermal uni per cound-F (estimate)
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	5	\$D	.467	10	.00668	140	.393
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	L L	30	.854	30	.01185	220	428
	e	35	.999	35	.01357	240	.437
		40	1.153	40	.01550	250	.445
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		60	1.966	60	.02570	340	.47B
	! 1	65	Z_264	65	.02898	360	.486
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	12. PHYSICAL AND CHEMICAL PROPERTIES
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1. WATER POLLETION	- 377 - < −376 - <2478
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUIO VISCOSITY	
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12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
(degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degraes F)	Pounds per cubic	Temperature (degrees P)	British thermal un per pound-F
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		75	2.364	75	.05495	25	.150
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		90	3.335	90	.07540	100	.163
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		100	4.152	100	.09220	150	.171
	•	105	4.619	105	.10170	175	.175
		110	5.130	. 11D	.11190	200	,179
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1		130	7.663	130	.16150	300	.190
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		140	9.270	140	19220	350	.199
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i		180	18.730	180	.36390	550	.219
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25	83,370	50	.228		E	40	.564
30 35	83,110	60	.230		+ A	45	.564
35	92.649	70	.231		; T	50	.845
40	92.589	80	.233		i i	55	.627
45	82,330	9 0	.235		N	60	.610
50	92,070	100	.238		€	55	.593
55	91,809	110	.238		E N T	70	.577
60	91,549	120	.240		I T I	75	.582
55	91,290	130	.241			80	.548
7D	91.030	140	.243			85	.534
75	90,770	150	.245		1 1	90	.521
80	90.509	160	.246		1	95	.508
85	90.250	170	.248		1 1	100	.496
90	89.990		.		1 1	105	.485
95	89.730					110	.474
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125	68,169				i l		

	12.21	12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS NEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperatura (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperaturo (degrees F)	British thermal un per pound-F
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sten Peopern	utst TO DISCHARGE • Noticula function) rydryf: Reminability na	2 14861 11 Crimpony: 13 Crime 3	Flarernative injunt			
3. CREM 3.1 CO Compatibil Hydrocarbo 3.2 Permain Celli 3.3 UACAUN Desig 3.4 DOT US Res 1 3.4 DOT US Res 1 3.4 CAS Regimery	n CHu million: 3.2/1214 134	L: Physical \$ L9 Caler: Gold L1 Delon Public	VABLE CHARACTERISTICS tem (an artigently Local rima get, anomal, barowne file premeri			
5.2 Bympione Fi Panchethe : ggwriad (rgwriad (rgwriad (rgwriad (ranket) (rgwriad (Sall Truck (Sall Tru	настиче Башфиланті: Ай-Аларр айомінд Ехерикичта Учасна айомінд Ехерикичта Учасна альнае сосулат, сиродит, си альнае сосулат, сиродит, си альнае сосулат, сиродит, с сультат, ринасти Соберто I веда 15 км. БАСА: нула об на систо, кибе 2 Сося – изация с Силата Соберто I корона Солиталисти систера и сосула Солиталисти Солитали и социна Соберто I с органи ответски систера и социна Соберто I с органи ответски систера и социна Соберто I с органи ответски систера и социна соберто I с органи ответски систера и социна ответски систера и социна ответски соста с органи ответски систера и социна ответски соста с органи ответски систера и социна ответски соста с органи ответски соста ответски сос	entrase eyes and upper in L could initiate syme and dema, and reached density density into dema, and reached many server to know an density call L watch with actus and set of 30 mm. OS to 5 g/kg my follow regardion, nors baues a \$60% shares in the affect in temporary demands reactor. It splice	aparagry lance, cause decremen. causes drying of skin. P causes drying of skin. P one partitionary edama. If relocat nearpranon and coryan if is declare. EVES: Bash with tar. ng of the syste or respiratory			
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	6. THE RAZARDS	14. HAZARO ASSESSMENT CODE
61	Finn Pairs 47# CC: 157 O.C.	(San Hazard Americani Handbook)
N.	Plannender Landa in Ar. 1275-75	4-T-U
•	Fire Estimations Agents: Catter deade	
	or one characteristics email lines, ordinarly	
	indell for thego total. Pipe Extinguiseting Againta Hail III Br	LI. HAZARD ELASSIFICATIONS
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	s source of grance and hash back.	Cologitry Rating
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	Barring Bala; 5.7 men/men. Adapters: Rame Tamparature:	Louis or Bold Interfaces 1
	Cata not evaluate	Pressne
		Water Polycon
		Accusic: Toxicity 3
	Coninued	Adapter Energ
	7. CHEMILAL BEACTIVITY	Avactivity
2.1	Associatively With Water: No reaction	Dener Cremicule
7.1	Reactivity with Common Meterlets: NO	Water 0
	mechan	1.4 NPL Hanne Countrators
	Elability During Transport Slatin	Calegory Casalitation
1.4	Restricting agency for Actin and Constitute Not performed	response response (Bland)
7.6	Polymerization: Not performent	Flammataity (Flact) 3
	lengage of Polymerastan	Reschuty (Talcal
	Not partnerst	
13	Motor Ratio (Reaccurt in Product): Data not evaluable	
7.4	Reactivity Group #2	
	-	
		12. PHYSICAL AND CHENICAL PROPERTIES
		12.1 Permittai Blatte at 15 C and 1 alter:
		Lagrand .
		12.3 Minimeniar Weight: 02.14
		12.3 Bolling Fort at 5 abs: 201,1*F = 110,6*C = 383,8*K
		12.4 Presing Point
	E. WATER POLLISTION	-1297F = -45 0°C = 178.2°H
		12.1 Critical Temperature:
L1	Approxim Texticity:	551.47 - 215 6°C - 561.8°K
	1180 mg///98 hr/sumish/TL_/histh water	12.4 Critical Pressure: 505.1 pero - 49.55 altr - 4.105
D	Waterford Taxinity: Onto not eventure	Mill/m ¹
L	Belegical Orygan Commit (SCO):	12.7 Specific Granity:
	O'h, & days: 31% (Parce). 8 days	0 pet7 at 20°C diquets
4.4	Food Cliest Consumption Printing	0 ptf7 at 20°C signat 12.8 Light Surface Territors
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1.4	Food Cliest Consumption Printing	0 pet7 at 20°C stopast; 12.5 Lipped: Sarrisco Trenders; 28.0 genesics = 0.0270 N/m = 20°C 12.5 Lipped: Water Interfacted Tartelor; 36.1 genesics = 0.0201 N/m et 25°C 12.19 Vaster gians Specific Growty; Not perment
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12.17 SATURATED LIQUID DENSITY				12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temporature (degrees F)	British thermal unit per pound-F	Temperaturo (degrocs F)	British thermal unit-Inch per hour- isquare foot-F	Tomoerature (degraes F)	Centipose
30 20 10 10 20 30 40 50 60 70 80 90 100 120	57,180 56,870 56,550 56,240 55,930 55,620 55,310 54,990 54,680 54,680 54,680 53,750 53,430 53,120 52,810 52,810 52,500	0 5 10 15 20 25 30 35 40 45 50 55 60 55 60 55 80 85 90 95	.398 .397 .399 .400 .402 .403 .404 .406 .407 .409 .410 .411 .413 .414 .415 .417 .418 .420 .421 .422	D 10 20 30 40 50 80 90 100 110 120 130 140 150 160 190	1.028 1.015 1.005 .994 .983 .972 .982 .951 .940 .929 .919 .929 .919 .929 .919 .929 .919 .929 .919 .929 .919 .929 .915 .885 .855 .855 .855 .854 .843 .833 .833 .822	0 5 10 15 20 25 30 35 40 45 50 55 50 55 50 55 70 75 80 85 90 85	1.024 .978 .935 .634 .857 .821 .768 .757 .727 .700 .673 .649 .625 .603 .582 .582 .582 .582 .582 .582 .582 .582
		100 105 110 115 120 125	.424 .425 .427 .428 .429 .431	200 210	.811 .800	100	.477

12.21		12.22		12.23		12.24	
SOLUBILITY IN WATER		SATURATED VAPOR PRESSURE		SATURATED VAPOR DENSITY		IDEAL GAS NEAT CAPACITY	
Temperatura	Pounds per 100	Temperature	Pounds per square	Temperature	Pounda per cubic	Temperature	British thermal un
(degrees F)	pounds of water	(degrees F)	inch	(degrees F)	foct	(degrees 두)	
68.02	.050	0 10 20 30 40 50 60 70 80 90 100 110 120 120 120 120 120 150 150 150 150 150 200 210	.039 .057 .084 .121 .172 .241 .331 .449 .500 .792 1.033 1.332 1.700 2.148 2.690 3.338 4.109 5.016 6.083 7.323 8.758 10.410	0 10 20 30 40 50 60 70 80 50 100 110 120 130 140 150 160 150 160 150 180 200 210	.00070 .00103 .00150 .00212 .00296 .00405 .00547 .00554 .00727 .00954 .01237 .01584 .02207 .02518 .03127 .03850 .04700 .05691 .06840 .06840 .06840 .06840 .08162 .09675 .11400 .13340	0 25 50 75 100 125 150 175 200 225 250 275 300 325 350 375 400 425 450 475 500 525 550 575 600	.228 .241 .255 .286 .281 .294 .308 .319 .331 .343 .355 .367 .378 .367 .378 .389 .400 .411 .422 .432 .443 .453 .453 .453 .453 .453 .453 .453

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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19		12.20 LIQUID VISCOSITY	
(degrees F)	Pounds per cubic lact	Temperature (dogrees F)	British thermal unit per pound-F	Tampersture (degraes F)	British thermal unit-inch per hour- square foot-F	Temperature (oegrees F)	Cantipois
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Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per equare inch	Temperature (degrees F)	Pounds per cubic loct	Temperature (degrees F)	British thermal unit per pouno-F	
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CHAPTER 2

AGENT INFORMATION

2-1. <u>Classification and description</u>. a. <u>Classification</u>. H, HD, and HT are persistent blistering agents. They are classified as Class A Poisons by Department of Transportation (DOT) and as Chemical Group A agents by DARCOM.

b. <u>Description</u>. The commonly used name for agents H, HD, and HT is "mustard." H is used to identify agent made by the Levinstein process which contains up to 30 percent sulfur compounds as impurities. HD indicates agent which has been refined by distillation to remove impurities. HT is a mixture of 60 percent HD and 40 percent T. T is a sulfur and chlorine compound similar in chemical structure to HD.

2-2. Physical and Chemical Properties¹. a. Properties of HD.

(1) Chemical name - 2,2' dichloro-diethyl sulfide.

(2) Molecular Wt. - 159.08.

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(3) Specific gravity - 1.27 at 20°C.

(4) Vapor density (compared to air) - 5.48.

(5) Melting point - 14.5°C.

(6) Boiling point - 217°C.

(7) Flash point - 105°C. (Class III B combustible liquid)

(8) Decomposition temperature - 149° to 177°C.

(9) Vapor pressure - 0.072mm Hg at 20°C.

(10) <u>Solubility</u>. Only slightly soluble in water (.06 to .09% by weight at 25°C). Soluble in all proportions in most oils and organic solvents.

Properties vary with the purity of the material. The properties given are based on minimum specifications grade agent.

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DARCOM-R 385-31 2-2a(11)

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(11) <u>Bydrolvsis</u>. Reacts with water to give as final products, hydrogen chloride and thiodiglycol. Once dissolved in water the hydrolysis is rapid; however, the solubility rate is so low that hydrolysis of agent is very slow. Because of its temperature dependency, the solubility rate is fairly rapid at 100° C and at 5° C no reaction occurs.

(12) <u>Physical characteristics</u>. Mustard agent is a clear to amber or dark brown liquid having an odor similar to garlic.

b. <u>Properties of H</u>. The properties of H are essentially the same as for HD. The color of the liquid may vary from amber to dark brown and the odor is more pronounced than HD. Because of the sulfur impurities, a sediment may form in containers after long periods of storage.

c. <u>Properties of HT Mixture (60/40)</u>. Agent properties are similar to HD except as noted below.

Melting point - Approximately 0°C.

(2) Specific gravity - Approximately 1.26 at 20°C.

2-3. <u>Physiological effects</u>. a. <u>General</u>. Mustard agent has been identified as carcinogenic, mutagenic, and tetragenic. Chronic exposures (10-20 years) are considered to be a health hazard, therefore, certain health minimums must be met if workers are exposed. For these reasons monitoring of work areas and medical surveillance must be carefully controlled and adequate records maintained. To protect the health and welfare of workers no unprotected worker may be exposed to mustard agent vapor levels equal to or greater than 0.4 mg/m^3 . Mustard will produce physiological effects as a result of liquid or vapor contamination of the body. The severity of the effects is dependent on the degree of liquid contamination and on the vapor concentration and associated exposure time. The mustard agents as liquid contamination on surfaces may persist for long periods because of their low volatilities. Agent on contaminated surfaces may be trans-

b. <u>Physiological effects of mustard</u>.

(1) Eve effect. The eye is most vulnerable to mustard either by liquid or vepor contact. Conjunctivitis (red eye) can occur following an exposure to a vapor concentration barely detectable by odor. Long exposures to low concentrations or exposures to high concentrations can result in permanent eye damage.

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DARCOM-R 385-31 2-3b(2)

(2) <u>Skin effects</u>. The initial effect after skin contact with either vapor or liquid is a reddening of the skin similar to sunburn; except with mild vapor burns, the reddening progresses to blistering and tissue destruction. The initial exposure is not accompanied by any sensation but as symptoms develop there may be an itching or burning sensation.

(3) <u>Respiratory effect</u>. Inhalation of mustard vapor or aerosol causes damage to the mucous tissues of the upper respiratory tract. Damage develops slowly and may not reach maximum severity for several days following exposure. The symptoms are hoarseness, sore throat, and coughing. In cases of severe exposure there is a predisposition to secondary infection such as bronchial pneumonia.

(4) <u>Cumulative effects</u>. The rate of detoxification for mustard is very low. Very small repeated dosages are cumulative in their effect and even more serious because of the tendency toward sensitization. Exposure to vapors from spilled mustard may, in the first instance, cause only minor symptoms such as "red eye." Repeated exposures to such vapor may produce severe respiratory symptoms.

c. <u>Method of operation</u>. Mustard is an insidious agent. The agent's odor quickly becomes unnoticeable after the first detection, because the agent causes the olfactory nerves to become insensitive. Another indication of the insidiousness is the absence of pain for a period possibly of hours after liquid or vapor contact with the skin, and for many minutes even after eye contact with the liquid. With regard to skin exposure, the presence of moisture or perspiration on the skin tends to increase the effect of exposure to agent.

2-4. <u>Dosages</u>. The eyes are more sensitive to mustard vapor than either the skin or the respiratory tract. Totally incapacitating eye damage of several days duration can be produced by dosages which are insufficient to produce "even partial" incapacitation by either the percutaneous or respiratory route. Personnel working in areas where mustard agent filled items are present without protection from the inhalation of agent vapors shall not be exposed to concentrations exceeding the following limits:

a. 0.4 mg/m3 maximum exposure level.

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b. 0.01 mg/m³ for a single three hour period.

c. 0.005 mg/m³ for a single eight hour period.

d. 0.003 mg/m³ for any eight hour exposure period average over five or more consecutive workdays.

When known or suspected agent concentrations exceed the above values, appropriate toxicological agent protective clothing will be worn as outlined in chapter 4.

