In Partial Fulfillment of Consent Order Requirements
CERCLA Docket No. 87-1

BASELINE RISK ASSESSMENT
SHERIDAN DISPOSAL SERVICES SITE
WALLER COUNTY, TEXAS

Volume I

011228

Prepared For:

The Sheridan Site Committee

W.O. #91-15

November 1, 1988

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BASELINE RISK ASSESSMENT:
NO ACTION ALTERNATIVE

SHERIDAN DISPOSAL SERVICES SITE
WALLER COUNTY, TEXAS

1 - INTRODUCTION

In accordance with The Superfund Public Health Evaluation Manual (October 1986) (herein after referred to as the EPA Guidance), this Risk Assessment is an analysis of site conditions and is performed for the purpose of providing guidance for:

1. Assessment of risk to public health under current site conditions;

2. Assessment of hypothetical future exposure pathways assuming most probable projected future landuse for the area and abandonment of the site; and

3. Assessment of hypothetical future exposure pathways assuming a worst case improbable development scenario and abandonment of the site.

Sections 2 through 6 present summaries of all the available information on site history, source material descriptions, chemical analysis of source materials and chemical and toxicological properties of detected constituents. Section 7 presents the procedures used for and results of a formal selection process for indicator chemicals which will be used to determine the extent of contamination from and in the source areas. Section 8 presents background data on existing landuse and environmental conditions at the site. Section 9 contains an assessment of exposure pathways under current and hypothetical future landuse conditions for the "no action" alternative. Section 10 evaluates the risks for current site conditions associated with calculated exposure levels for the "no action" alternative. Section 11 does likewise for the most probable hypothetical future landuse at the site, assuming site abandonment. A worst-case future improbable development case is presented in Appendix F.

The purpose of the exposure pathway assessment (Section 9) is to identify complete pathways (i.e., those with actual human receptors) and the mechanisms and routes of exposure possible at the site. The assessments in Sections 10 and 11 attempt to quantify the levels of exposure based on concentrations in the source material(s) and worst-case receptor locations that might result in

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measurable exposure to potential human receptors. This process involves the identification of receptor areas and receptors for each pathway. The exposure pathway assessment then examines:

1. The potential for migration of constituents from source areas to each receptor area;

2. The potential worst-case predicted concentrations which might realistically be attained at the receptor area under different landuse conditions.

This Risk Assessment (RA) has been performed in association with the on-going Source Control Feasibility Study (FS) and Ground Water Remedial Investigation (RI) in order to define the remediation necessary to protect human health and the environment in the receptor areas at risk. The purpose of the Feasibility Study is then to identify alternative remedial measures and select those which will be consistent with CERCLA and the NCP, and which will most cost-effectively reduce any unacceptable levels of risk which might occur under probable future landuse conditions.

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2.1 Geographical Location

The Sheridan Disposal Services (SDS) Site is located in Waller County, Texas, approximately nine miles north-northwest of the City of Hempstead, Texas and two miles northwest of the intersection of Clark Bottom Road and Farm Road 1736 (Fig. 2-1). The property is bounded on the east, south and west sides by farm and ranch lands, and on the north by the Brazos River. The site lies within the Gulf Coastal Plain Physiographic Province and is transitionally positioned between the Post Oak Savannah and Blackland Prairie Natural Regions of Texas.

2.2 Facility Description

The facility currently occupies approximately 110 acres, and includes a 42 acre irrigation/evaporation system, a 12 acre main pond and a 17 acre dike around the main pond (Fig. 2-2). The area of the main pond and dike is based on a water surface elevation in the main pond of 170.5 feet (mean sea level); these areas will vary with changes in the main pond water level. An incinerator and a group of nine treatment and storage tanks are located on the east side of the main pond on the dike. Remaining acreage consists of borrow ditches excavated for the dikes and other "buffer zone" acres inside the perimeter fence.

The main pond is located in a naturally occurring low-lying area that was gradually expanded to a maximum size of about 22 acres utilizing a system of dikes. The main pond was used as a surface impoundment for material disposal and for open pit burning. The dike was built of native soils from around the pond and from combustion residuals from waste burning and appears to have been completed partially on top of sludges existing at the time of construction. Over time, the dike height was increased using barrels, ash from the incinerator, and additional native soils. This mixture was also used to fill in part of the main pond as an attempt at closure. This partial closure activity reduced the size of the main pond to approximately 12 acres.

Water that accumulated in the main pond due to precipitation was pumped into the irrigation/evaporation system and allowed to evaporate. The tanks were used for the separation and treatment of oil/water emulsions and storage of solvents and fuel oils.

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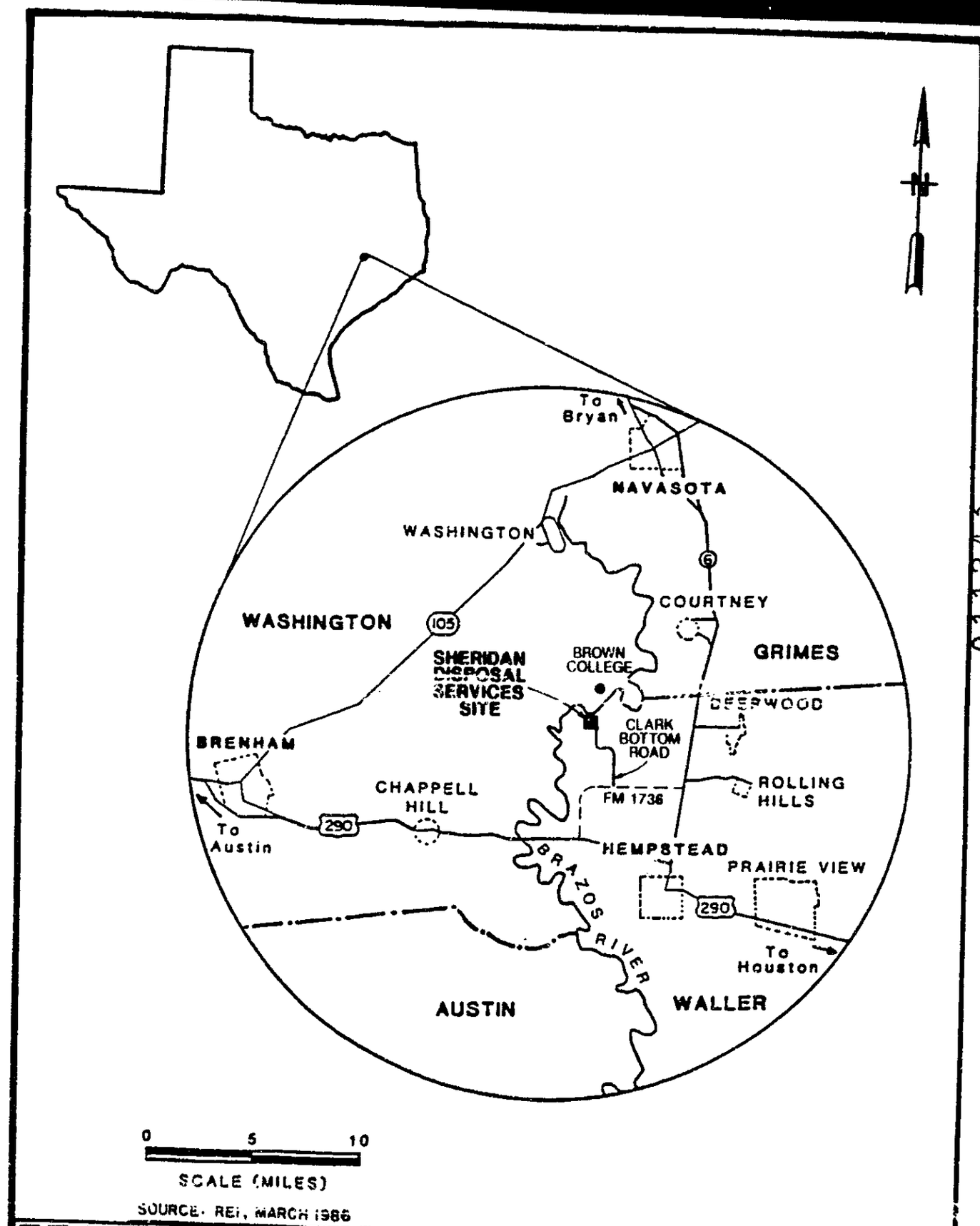

SOURCE: REI, MARCH 1986

ERM-Southwest, Inc.
NEW ORLEANS, LOUISIANA HOUSTON, TEXAS

DATE	9/2/87	W.O.NO.	9115A007

FIGURE 2-1

REGIONAL COMMUNITIES WITHIN A 12-MILE RADIUS

Sheridan Disposal Services
Hempstead, Texas

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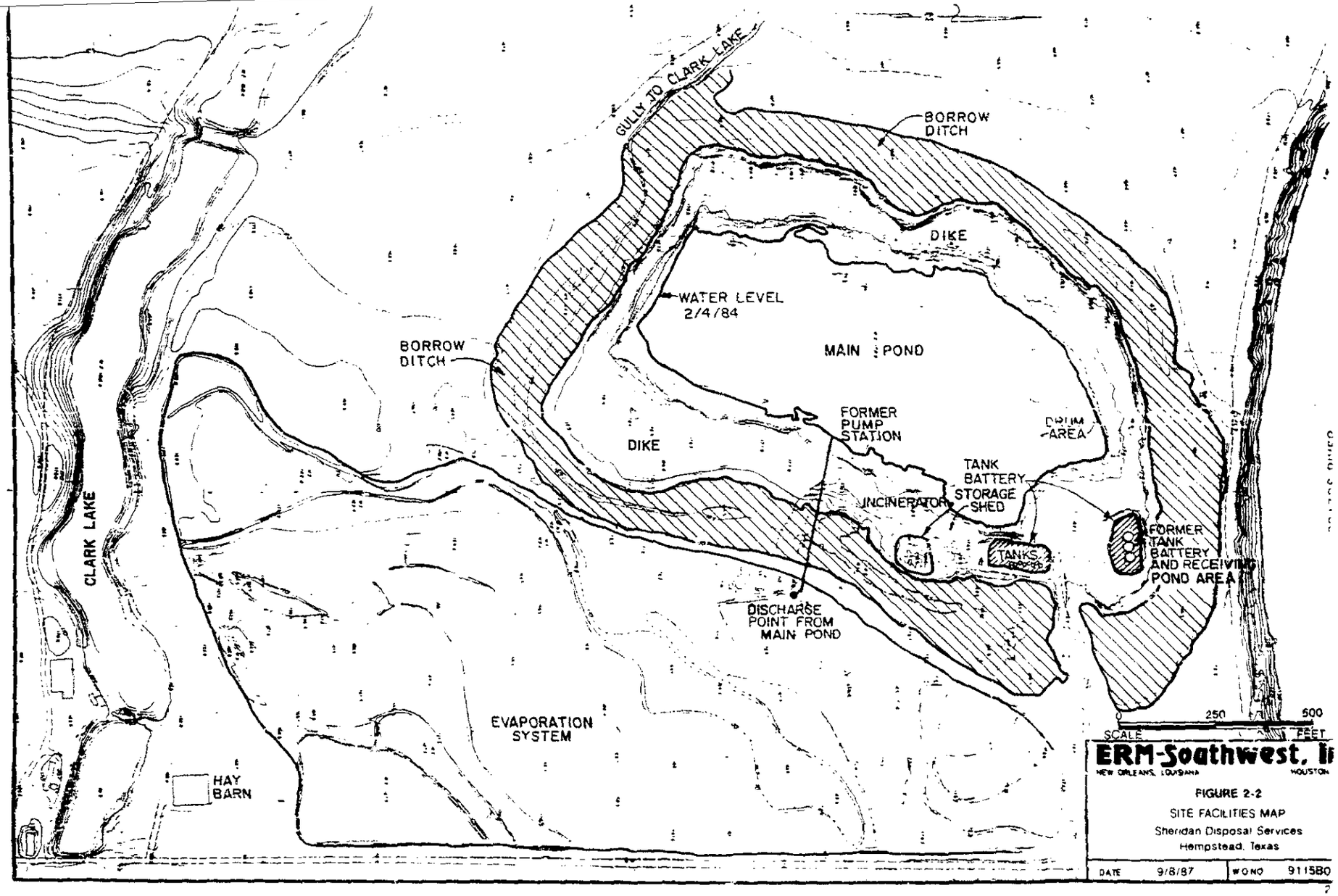
GULLY TO CLARK LAKE
BORROW DITCH
DIKE
WATER LEVEL 2/4/84
MAIN POND
BORROW DITCH
FORMER PUMP STATION
DRUM AREA
DIKE
TANK BATTERY STORAGE SHED
INCINERATOR
TANKS
FORMER TANK BATTERY AND RECEIVING POND AREA
CLARK LAKE
DISCHARGE POINT FROM MAIN POND
EVAPORATION SYSTEM
HAY BARN
0
250
500
SCALE
FEET
ERM-Southwest, Inc.
NEW ORLEANS, LOUISIANA
HOUSTON
FIGURE 2-2
SITE FACILITIES MAP
Sheridan Disposal Services
Hempstead, Texas
DATE 9/8/87
W.O.NO 911580

2.3 Chronological History of Site Management, Use and Modifications

The Sheridan Disposal Services Site, owned and operated by Mr. Duane Sheridan of Hempstead, Texas, began accepting industrial wastes for disposal in the late 1950's. These wastes were disposed by open pit burning and surface impoundment of ash residue in a naturally low-lying area of Mr. Sheridan's property. As the volume of material accepted at the site increased, a dike composed of native soils and combustion residuals from waste burning was constructed (sometime in late 1963) around the natural depression to form the main pond. This dike may have been completed such that some sludges were covered by the base of the dikes. Native soils appear to have come from the borrow areas shown in Figure 2-2. These site management practices and facilities were used through 1971.

A group of storage and treatment tanks were constructed beginning in September 1971 in response to an order from the Texas Water Quality Board (TWQB), predecessor to the Texas Water Commission (TWC). These tanks were used for steam treating oil-water emulsions. Separated oils were used as fuel for a system of ground flares that was installed in 1972.

A smaller pond (approximately 400,000 gallons) was constructed in the northeast corner of the main pond dike (Figure 2-2). It was used to receive incoming materials. From there the waste generally would be pumped into the steam treatment system for emulsion treatment. Any recovered oils were either sold or used for ground flares or boiler feed to generate steam. Leftover residues were disposed of in the main pond. Liquid wastes from the smaller pond would be discharged directly into the main pond when the steam emulsion system was not working or overloaded.

In November of 1972 a fire destroyed the oil burner (incinerator) system and the surface of the main pond was ignited, burning off the surface layer of oil. At this time, the volume of wastes disposed of in the main pond caused a freeboard problem. Twice during 1973 severe rainfall brought the height of liquids in the pond to within six inches of the top of the dike. The height of the dike was increased in 1975 to mitigate this occurrence.

During 1974 and 1975, several trial burns of new incinerators were performed by Sheridan Disposal Services. Permit approval was granted to SDS by the Texas Air Control Board (TACB) for a liquid waste burner (incinerator) that was designed and built by Mr. Sheridan. The incinerator was in use until June 1978 when a fire destroyed portions of the system.

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In order to take care of the continuing problem of accumulated pond wastewater, a new facility -- the irrigation/evaporation system -- was built in 1976 adjacent to the main pond. This 42 acre impoundment received wastewater from the main pond into a series of small cells where it was allowed to evaporate.

SDS began closing the main pond with dike and other materials in October 1978. An initial closure plan was agreed to by SDS and the TWQB in 1979. This plan called for initial closure of the main pond, pumping of accumulated stormwater from the pond into the evaporation system, and maintenance of the pond dike. Pond water was transferred to the evaporation system and approximately seven acres of the main pond corresponding to the receiving basin was covered with fill material.

A final closure plan was submitted to the Texas Department of Water Resources (now the Texas Water Commission (TWC)), by Sheridan Disposal Services. It was rejected in January 1984, at which time the TDWR determined that SDS did not have the expertise or resources to properly close the site. At that time the TWC contacted certain companies whose waste may have been disposed of at the SDS Site, to request assistance in the site closure. The Sheridan Site Committee was formed in response to that request and has since worked with the Texas Water Commission and the Environmental Protection Agency to collect and analyze information necessary to evaluate appropriate closure alternatives.

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3 - SOURCE MATERIAL DESCRIPTION

From available records it is estimated that the total amount of material received by the Sheridan Disposal Services Site exceeded 85 million gallons. Manifest descriptions of some of the waste materials received for disposal at the site are listed in Table 3-1.

The major sources of organic and inorganic chemical constituents are the main pond, pond sludges, affected pond subsoils, and dike materials. There may be limited additional quantities of affected sludges and soils in the evaporation system. These source areas are discussed below.

3.1 Pond Water

The current size of the main pond is about 12 acres. The depth of the accumulated water varies, but averages about 1-1/2 feet.

The main pond is stratified into a partial surface oil layer, an aqueous phase and a heavy sludge layer. The surface oil layer (less than two inches in thickness) currently covers less than 20% of the pond surface area depending upon wind conditions. This layer was sampled July 21, 1987, and analyzed for HSL (Hazardous Substance List) organics. Detected organics are summarized in Table 3-2.

At the present time, the majority of the oil layer has been removed from the main pond and the main pond water is being evaporated in the evaporation system in accordance with an Administrative Order issued by the EPA.

Pond water was sampled during 1987 under three conditions: 1) a grab sample of static water conditions (no pumping) from the middle of the pond (four samples taken from just below the surface and composited; SDS-E-1); 2) a large bulk water sample pumped from shallow water about three feet from the water's edge in the center of the south end of the main pond (SDS-BIO-1000); and 3) a second static water sample taken after pumping from the intake area of the main pond (SDS-GEN-23). Constituents detected in HSL analyses of the two static water samples are presented in Table 3-3. Results for the large bulk water sample are discussed in Section 9 in relation to the air emissions pathway. Results of analyses for general pond water quality and characteristics are presented in Table 3-4. Locations of the three water samples are shown in Figure 3-1.

011247

TABLE 3-1

Descriptions of Materials Listed on Manifests for Disposal at the SDS Site

Alcohol, organic phosphorus compounds, cobalt

Alkyl Benzenes

Ammonia Bromate, Water

Barge, RR Tank Car Washings, & Misc. Chemicals

Benzene, Ethers, Methylchloride

Butyl Acrylates

Calcium Arsenate

Caustic and Latex Polymer

Copper Chloride Powder Catalyst

Diethylene Glycol, Resin, w/Toluene

Drilling Muds

Drum Washing Residue

Fatty Acid Esters

Fatty Alcohols

Filter Cake Residue

Furfural, Butadiene Copolymer

Glycol Still Bottoms

Herbicides

Hydraulic Oils

Insecticides

B, S & W Oils

Kerosene & Grease

Kitchen Grease & Water

Methacrylate

Molasses & Water

Oily Wastewater

Organic Sludge, Skimming, Kerosene and Mineral Spirits

Phenol Formaldehyde

Pickling Acid

Polyethylene, Diatomaceous Earth

Process Wastewater

Soap

Sodium

Sodium Hydroxide

Sour Crude Oil

Spent Chlorinated Solvents

Spent Newspaper Inks and Solvents

Styrene & Ethylbenzene Bottoms

Styrene Monomer w/Diesel

Vegetable Oils

Waste Chemicals

Water & Oil

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B880

B876

TABLE 3-2

Summary of Compounds Detected in a Composite Sample of Floating Oil/Emulsion Layer Collected from the Main Pond 07/21/87

Parameter	Lab No. 64114-001 Field ID: SDS-GEN-20 (mg/kg)
VOLATILE ORGANICS	
Ethylbenzene	1.3
Toluene	0.75
Total Xylenes	3.3
SEMIVOLATILES	
bis(2-Ethylhexyl)phthalate	180
Butyl benzyl phthalate	110
PESTICIDES AND PCBs	
Aroclor 1242	32

Notes: Detection limit ranges were as follows for the organics:
VOLATILES: 0.75-3.8 mg/kg
SEMIVOLATILES: 99-480 mg/kg
PESTICIDES AND PCBs: 1.6-32 mg/kg

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TABLE 3-3

Summary of HSL Compounds Detected in 1987 Samples of
Static Pond Water Samples Collected Before and After Pumping

Parameter	Pre-Pumping Static Grab Sample - Water (1) Sampled 06/18/87 ERM ID: SDS-E-01 Lab.No. 63907-001	Post-Pumping Static Grab Sample - Water (2) Sampled 08/21/87 ERM ID: SDS-GEN-23 Lab.No. 64368-001
	(mg/l)	(mg/l)
HSL-LIST ORGANICS		
Toluene	ND(<0.005)	0.078
Total Xylenes	0.0082	0.097
HSL-LIST METALS		
Aluminum	0.150	0.220
Arsenic	0.032	0.041
Barium	0.160	0.180
Calcium	59	75
Chromium	0.010	0.020
Copper	ND(<0.010)	0.006
Iron	0.360	0.480
Magnesium	20	29
Manganese	0.290	0.410
Mercury	0.001	ND(<0.0002)
Potassium	72	81
Selenium	ND(<0.004)	0.041
Sodium	272	330
Vanadium	ND(<0.01)	0.010
Zinc	ND(<0.02)	0.040

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NOTES:

HSL-list semivolatile, pesticide and PCBs fractions had no detections in either sample.

ND() = Not Detected (detection limit)

(1) Grab sample collected from center of main pond on July 18, 1987.

(2) Collected on August 21, 1987 from main pond at the sump after pumping water from pond to evaporation system.

Table 3-4

Summary of Inorganic Characteristics for
Pond Water and Pond Sludge Samples

Parameter Name	Collected 06/16/87 Main Pond Water [1] Lab No. 63942-001 SDS-BIO-1000	Collected 06/18/87 Main Pond Sludge [2] Lab No. 63942-002 SDS-INCIN
Total Suspended Solids (TSS)	70 mg/l	NA
Total Solids	NA	48.4%
Volatile Suspended Solids (VSS)	60 mg/l	79.7%
Biochemical Oxygen Demand (BOD)	11 mg/l	NA
Total Organic Carbon (TOC)	440 mg/l	46.27%
Oil & Grease	17 mg/l	6260 mg/kg
Ammonia as N	0.8 mg/l	59 mg/kg
Total Kjeldahl Nitrogen as N	7.2 mg/l	280 mg/kg
Chloride	359 mg/l	944 mg/kg
Total Phosphorus as P	8 mg/l	530 mg/kg
Sulfate	29 mg/l	518 mg/kg
Total Cyanide	NT	ND(<1.0 mg/kg)
Potassium	82 mg/l	NT

NOTES:

NT = Not Tested
NA = Not applicable
ND () = Not Detected (Detection Limit)

(1) Composite of two grab samples from two 55-gallon drums of main pond water collected by pumping from shallow water approximately three feet from water's edge along the south side of the pond.

(2) Composite grab sample collected from a 55-gallon drum containing equal portions of 15 sludge sample locations as shown in Figure 3-1.

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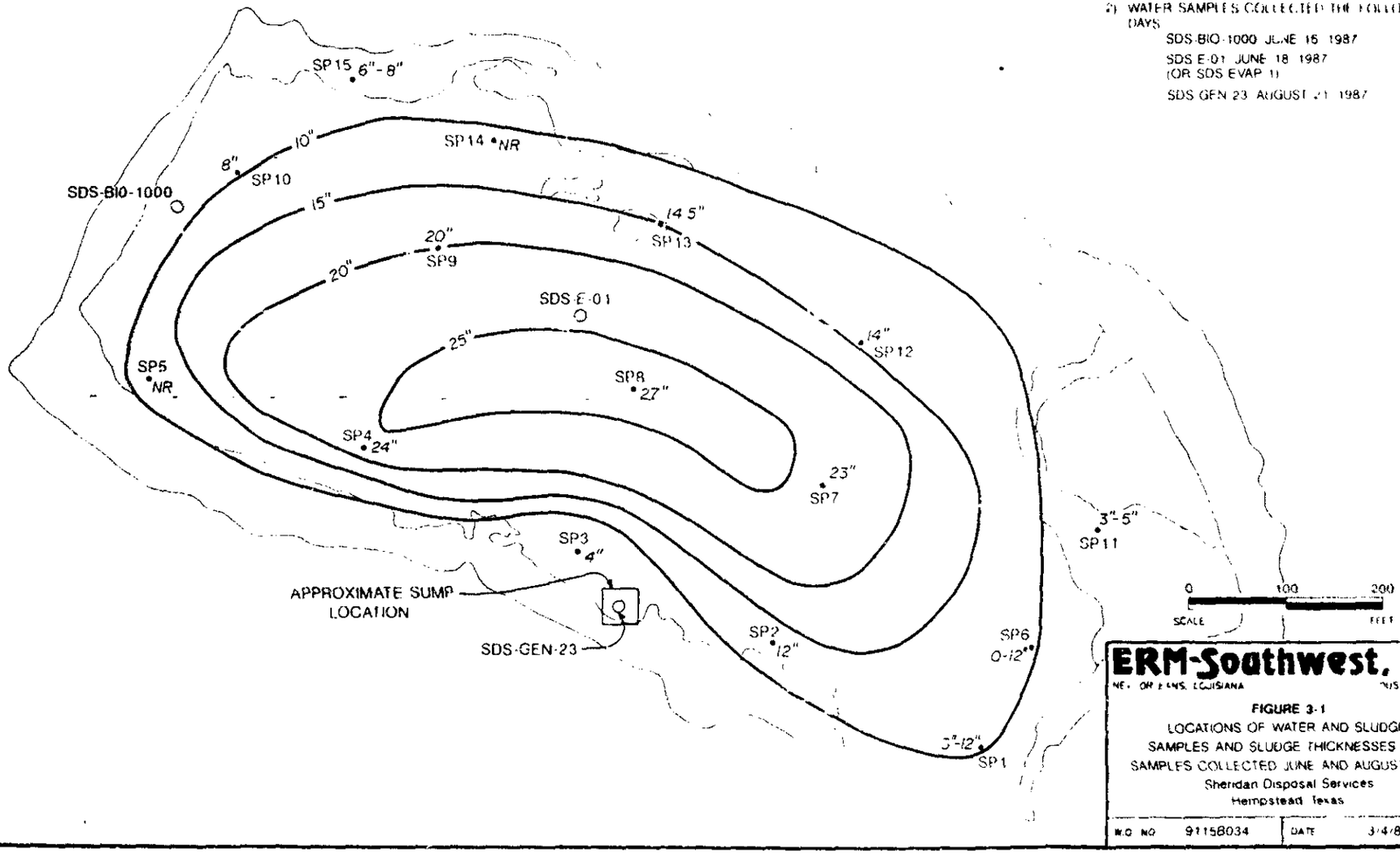

NOTES

1) SLUDGE SAMPLES (SDS-INCIN) COLLECTED JUNE 17 18 1987
2) WATER SAMPLES COLLECTED THE FOLLOWING DAYS
   SDS-BIO-1000 JUNE 16 1987
   SDS E-01 JUNE 18 1987 (OR SDS EVAP 1)
   SDS GEN 23 AUGUST 21 1987

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FIGURE 3-1
LOCATIONS OF WATER AND SLUDGE SAMPLES AND SLUDGE THICKNESSES FOR SAMPLES COLLECTED JUNE AND AUGUST 1987
Sheridan Disposal Services
Hempstead Texas

W.O. NO	91158034	DATE	3/4/88

3.2 Pond Sludge

Based on data developed during sampling of the sludges in the main pond June 17-18, 1987, the viscous pond sludge varies in thickness from about six inches to about 24 inches with an average thickness of 12.4 inches (Table 3-5; Figure 3-1). Since this differs somewhat from an earlier (1984) survey, an average of 18 inches for pond sludge depth will be used.

According to the Source Control RI (SCRI, Page 3-5, July 1987), pond sludge thicknesses range from one foot to just over three feet. An average depth of two feet was assumed for SCRI calculations (Pages 3-5, 1987 RI). These numbers are based on a survey conducted September 18-19, 1984 by Rollins under contract to Texas Department of Water Resources (TDWR). The estimates of total sludge volume reported in the 1987 SCRI (Page 3-4) included sludge which was in the pond levee or has been covered by closure activities. A copy of the sampling locations, probing depth and cross sections of the pond developed by Rollins and submitted in a letter report to TDWR, dated November 7, 1984 is provided in Appendix A.

The pond sludges are approximately 44% water by weight, 38% oil by weight, and 18% solids by weight (Table 3-6). Detected HSL constituents for a composite sludge sample taken July 1987 are provided in Table 3-7. Pond sludge composition was reported in the SCRI (Page 3-4) to be 50% water and volatile organics by weight, 30% non-volatile organics by weight and 20% inorganics by weight based on samples collected in 1984. These are similar to the values reported herein from 1987 samples for water, oil and solids content, respectively.

3.3 Pond Subsoils

No samples of pond subsoils were collected during the SCRI investigations for fear of carrydown of affected material contained in the pond sludge. The constituents of concern in affected soils are expected to be the same as those detected in the pond sludge. It is anticipated that concentrations will decrease with depth.

3.4 Pond Dike Material

The levee or dike around the pond has a surface area of approximately 17 acres. Materials in the dike were sampled at nine locations July 6-10, 1987 in borings completed to a total depth of 20 to 25 feet below the dike grade at each location (Figure 3-2). The preliminary results of the chemical analyses are presented in Table 3-8 (for indicator inorganics) and Table 3-9 (for HSL organics).

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TABLE 3-5

Estimated Sludge Depths Sampled 06/17-18/87

Location	Water Depth (feet)	Thickness of Sludge (inches)	Description of Sludge	Number of Samples Taken
SDS-SP1	3.5	3-12	Not sticky; sandy lumpy. Pond bottom gr. sand.	2 samples for analysis 4 gallons for composite
SDS-SP2	4	12	Grey-green goop, less cohesive upwards in sample	2 samples for analysis 4 gallons for composite
SDS-SP3	NR	4	Low viscosity, some clumps soupy	2 samples for analysis 4 gallons for composite
SDS-SP4	6	24	Very thick, taffy-like or almost like hot tar. Very cohesive.	2 samples for analysis 4 gallons for composite
SDS-SP5	NR	NR	Less sticky than SP4.	2 samples for analysis 4 gallons for composite
SDS-SP6	5	0-12	Black, low viscosity; siver mush at bottom. Another bl. layer underneath ~3".	NR
SDS-SP7	5	23	Soft mud texture, consistent visc.	NR
SDS-SP8	5	20-28 avg = 27	Visc. increase down, some br. sludge on bottom.	2 samples for analysis 4 gallons for composite
SDS-SP9	5	18-24 avg = 20	Black, visc. increase with depth.	2 samples for analysis 4 gallons for composite
SDS-SP10	6	8	Black, tacky medium viscosity	NR
SDS-SP11	2.5-3	3-5	Asphalt-like, black, sticky, chunky, not cohesive	2 samples for analysis 4 gallons for composite
SDS-SP12	4	14	Black w/ gr. tint, very viscous, tar-like, visc. increase slighty w/ depth	2 samples for analysis 3 gallons for composite
SDS-SP13	5.5	14.5	Chunky, inconsistent	1 sample for analysis 3-4 gallons for composite
SDS-SP14	NR	NR	Black, tar-like sludge, vics. increase w/ depth	2 sludge, 4 gallons water
SDS-SP15	6	6-8	NR	NR
Average	4.8'	12.4"		

NOTES:
NR = Not Recorded
- Water surface elevation at time of sample ~ 173 ft MSL
- Samples were taken using a 1-1/2" diameter viscous sludge sampler (PVC pipe with piston, no check valve on bottom).
- Current volume estimate is 30,000 cu. yds. and assumes an average depth of 18". This estimate does not include any nephloidal (i.e., highly fluid) sludge layer.

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8881

Table 3-6

Summary of Results of Analysis for Characteristics
of Pond Sludge Samples Collected 6/17/87 to 6/18/87

Parameter	Units	Sample Location 1	Sample Location 2	Sample Location 3	Sample Location 4	Sample Location 5	Sample Location 6	Sample Location 7	Sample Location 8	Sample Location 9	Sample Location 10	Sample Location 11	Sample Location 12	Sample Location 13	Sample Location 14	Sample Location 15	Average
Oil	%	34.2	54.5	26.1	40.8	40.9	4.7	39.5	45.8	45	21.5	40.3	54.9	43.8	35.4	42	37.96
Water	%	36.5	29.1	59.7	47.6	45.3	56.4	49.2	42.3	46.4	67.7	38.3	31.2	42.7	31.3	32.7	43.76
Solids	%	29	16.3	15.4	12.1	15	39.7	12	11.9	9.9	10.5	20.9	13.9	12.4	32.7	24.6	18.42
pH	S.U.	6.04	6.76	6.33	7	6.45	8.6	6.63	7.51	7.34	6.39	6.97	6.62	6.48	7.17	6.44	6.85
Fluoride	mg/kg	2.8	5.5	4.8	2	3.3	0.7	11	14	20	3.9	5.3	2.5	7.5	10	4.2	6.50
Chloride	mg/kg	373	4516	529	968	1133	1759	1300	3363	1962	918	3420	910	713	676	1360	1593.33
Bromide	mg/kg	65	143	8	ND	ND	86	7.1	70	41	16	91	50	6.7	17	4.6	40.36
Total Phosphorus	mg/kg	1140	200	540	360	260	1630	610	590	410	320	550	360	210	990	390	570.67
Flash Point	degrees F	NF	137	114	113	144	133	125	116	122	134	141	143	115	118	144	119.93
% Ash	%	9.48	10.51	2.75	4.03	7.29	24.2	3.64	3.8	3.6	20.65	10.75	4.09	4.6	5.91	14.04	8.61
Sulfur by X-Ray Fluorescence	%	1.4	1.07	0.66	1.21	1.62	0.95	0.95	1.13	1.25	0.93	1.54	1.04	0.8	1.49	1.25	1.16
Heat of Combustion	BTU/lb	7400	8700	ND	ND	1000	ND	1000	6400	1000	9000	ND	11000	ND	ND	9800	3666.67
Volatile Oil	%	ND	5.4	ND	ND	ND	ND	ND	1	ND	ND	0.8	ND	ND	1	ND	0.55
Non-Volatile Oil	%	34.2	49.1	26.1	40.8	40.9	4.7	39.5	44.8	45	21.5	39.5	54.9	43.8	34.4	42	37.41
Density @ 77 degrees F	g/ml	1.04	1.09	0.99	1.05	1.01	1.16	1.04	1.05	1.06	1	1.1	1.01	1.01	1.14	1.09	1.06
Viscosity @ 25 degrees C	cSt	1.52	1.56	1.55	2.59	1.66	2.85	2.29	1.71	2.48	1.72	ND	1.63	1.79	2.06	2.1	1.83

NOTES:
NF = no flash
ND = not detected
Average calculated using LOTUS 1-2-3 @SUM(cell address range)/15
Samples collected using a 1-1/2 inch viscous sludge syringe-type sampler.

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TABLE 3-7

Summary of Organic and Inorganic HSL Parameters Detected in Main Pond Sludge Sample Collected 6/18/87

Parameter	Composite Sample Main Pond Sludge Lab. No.63942-002 Field ID: SDS-INCIN
	(mg/kg)
VOLATILE ORGANICS (HSL)	
Benzene	170
Ethyl benzene	580
Styrene	340
Tetrachloroethylene	51
Toluene	700
Total Xylenes	1600
SEMIVOLATILE ORGANICS (HSL)	
2-Methylnapthalene	220
Napthalene	270
N-Nitrosodiphenylamine	190
2,4-Dimethylphenol	460
2-Methylphenol	340
4-Methylphenol	850
Phenol	1500
ORGANOCHLORINE PESTICIDES AND PCBs (HSL)	
Pesticides	ND(<0.64-<13)
Aroclor 1016	55
Aroclor 1260	13
TOTAL METALS (HSL)	
Aluminum	2300
Antimony	12
Arsenic	20
Barium	820
Cadmium	2.7
Calcium	5200
Chromium	160
Cobalt	3
Copper	130
Iron	4300
Lead	310
Magnesium	920
Manganese	71
Mercury	0.06
Nickel	69
Selenium	0.6
Sodium	2200
Vanadium	25
Zinc	970

011256

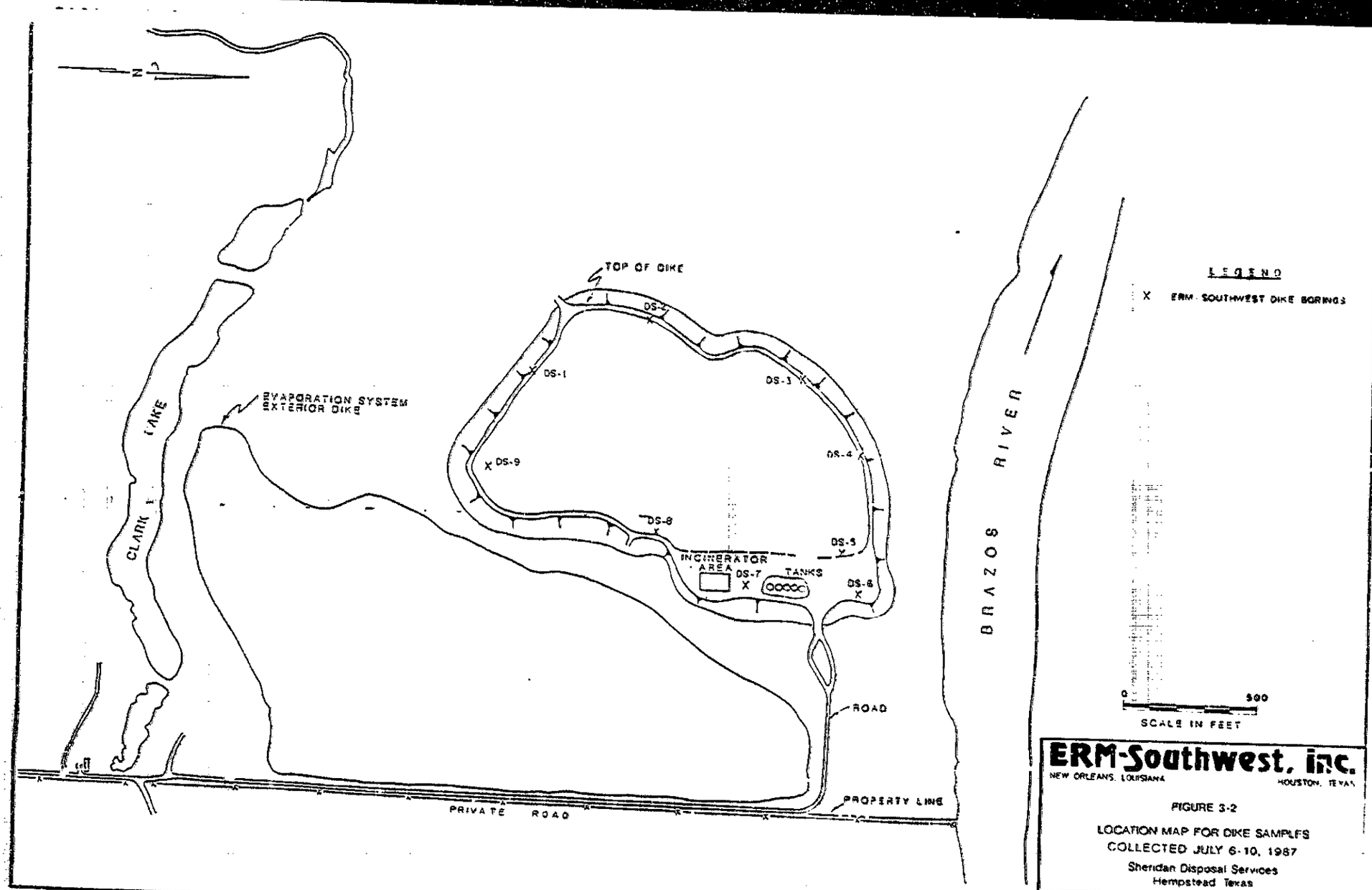

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FIGURE 3-2

LOCATION MAP FOR DIKE SAMPLES COLLECTED JULY 6-10, 1987

Sheridan Disposal Services
Hempstead Texas

W.O. NO.	
9101B33	11/30/87

3 11

011257

TABLE 3.8
Summary of Analytical Results for Inorganic Indicators
for Dike Soils Sampled July 6-10, 1987

Chemical Name	DS-1 Dike 11	DS-1 Dike 12	DS-1 Dike 1001	DS-1 Dike 2011	DS-1 Dike 2012	DS-1 Dike 2013	DS-1 Dike 2014	DS-1 Dike 2015
Depth of Sample	0-4'	4-8'	8-10'	10-12'	12-14'	14-16'	16-18'	18-20'
Sample Type	SOIL	SOIL	SLUDGE	SOIL	SOIL	SOIL	SOIL	SOIL
Total Organic Carbon (%)	1.51	1.43	19.5	0.9	0.67	0.55	0.5	0.13
pH	8.53	8.25	8.74	8.09	8.15	7.81	7.38	7.56
METALS (mg/kg)								
Chromium	NT	NT	8	NT	NT	NT	NT	5
Lead	NT	NT	10	NT	NT	NT	NT	8
Nickel	NT	NT	9	NT	NT	NT	NT	8
Zinc	52	45	2400	15	50	59	26	16

Chemical Name	DS-2 Dike 21	DS-2 Dike 22	DS-2 Dike 2021	DS-2 Dike 2022	DS-2 Dike 2023	DS-2 Dike 2024	DS-2 Dike 2025
Depth of Sample	0-5'	4-8'	10-12'	12-14'	14-16'	16-18'	18-20'
Sample Type	SOIL	SLUDGE	SOIL	SOIL	SOIL	SOIL	SOIL
Total Organic Carbon (%)	0.11	3.15	0.52	0.22	0.38	0.11	ND(<0.02)
pH	8.7	8.67	[illegible]	7.56	8.18	8.5	8.72
METALS (mg/kg)							
Chromium	NT	7	NT	NT	NT	NT	[illegible]
Lead	NT	10	NT	NT	48	NT	45
Nickel	NT	19	NT	NT	NT	NT	5
Zinc	[illegible]	56	19	15	13	11	10

Chemical Name	DS-3 Dike 31	DS-3 Dike 32	DS-3 Dike 2031	DS-3 Dike 2032	DS-3 Dike 2033	DS-3 Dike 2034	DS-3 Dike 2035
Depth of Sample	0-5'	4-8'	10-12'	12-14'	14-16'	16-18'	18-20'
Sample Type	SOIL	SLUDGE	SOIL	SOIL	[illegible]	SOIL	SOIL
Total Organic Carbon (%)	0.86	16.66	0.3	0.2	[illegible]	ND(<0.02)	0.6
pH	8.99	8.45	7.86	8.36	8	8.44	8.23
METALS (mg/kg)							
Chromium	NT	17	NT	NT	6	NT	11
Lead	NT	19	[illegible]	NT	NT	NT	
Nickel	NT	9	NT	NT	NT	NT	16
Zinc	25	1180	20	12	13	[illegible]	33

Chemical Name	DS-4 Dike 41	DS-4 Dike 42	DS-4 Dike 2041	DS-4 Dike 2042	DS-4 Dike 2043	DS-4 Dike 2044	DS-4 Dike 2045	DS-4 Dike 1002
Depth of Sample	0-4'	4-8'	10-12'	12-14'	[illegible]	16-18'	18-20'	[illegible]
Sample Type	SOIL/SLUDGE	SLUDGE	SOIL	[illegible] OIL	SOIL	SOIL	SOIL	SOIL
Total Organic Carbon (%)	0.64	5.42	0.45	0.47	0.38	ND(<0.06)	0.06	[illegible]
pH	8.87	7.57	8.56	.72	[illegible]	8.84	8.98	[illegible]
METALS (mg/kg)								
Chromium	NT	[illegible]	NT	NT	8	NT	NT	NT
Lead	NT	18	NT		10	NT	NT	NT
Nickel	NT	20	NT	NT	[illegible]	NT	NT	NT
Zinc	30	70	[illegible]	46		11	10	12

Chemical Name	DS-5 Dike 51	DS-5 Dike 52	DS-5 Dike 2051	DS-5 Dike 2052	DS-5 Dike 2053	DS-5 Dike 2054	DS-5 Dike 2055	DS-5 Dike 1003
Depth of Sample	0-5'	5-10'	10-12'	12-14'	14-16'	[illegible]	[illegible]	[illegible]
Sample Type	SOIL	WASTE	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Total Organic Carbon (%)	0.88	9.61	[illegible]	1.75	0.5	0.41	0.04	0.34
pH	8.85	7.10	[illegible]	[illegible]	[illegible]	7.28	8.52	8.5
METALS (mg/kg)								
Chromium	NT	50	NT	NT	NT	NT	NT	7
Lead	NT	1200	NT	NT	NT	NT	NT	6
Nickel	NT	35	NT	NT	NT	NT	NT	9
Zinc	2900	340	67	60	51	30	[illegible]	17

Chemical Name	DS-6 Dike 61	DS-6 Dike 62	DS-6 Dike 2061	DS-6 Dike 2062	DS-6 Dike 2063	DS-6 Dike 2064	DS-6 Dike 2065	DS-6 Dike 1004
Depth of Sample	0-5'	5-8'		11-13'	13-15'	[illegible]	17-19'	[illegible]
Sample Type	SOIL	SLUDGE	SOIL	SOIL	[illegible]	SOIL	SOIL	SOIL
Total Organic Carbon (%)	0.59	1.02	1.98	0.46	0.49	0.23	0.21	ND(<0.02)
pH	7.84	6.81	8.16	[illegible]	[illegible]	[illegible]		8.55
METALS (mg/kg)								
Chromium	NT	15	NT	NT	NT	NT	[illegible]	[illegible]
Lead	NT	[illegible]	NT	NT	NT	NT	NT	8
Nickel	NT	13	NT	NT	NT	NT	NT	8
Zinc	24	84	23	45	20	17	17	15

NOTES:
NT = Not tested
ND() = Not Detected (detection limit)

TABLE 3 8 (Continued)
Summary of Analytical Results for Inorganic Indicators
for Dike Drill Sampled July 6 10, 1987

Chemical Name	DS-7 Dike 71	DS-7 Dike 72	DS-7 Dike 1003	DS-7 Dike 2071	DS-7 Dike 2072	DS 7 Dike 2073	DS 7 Dike 2074
Depth of Sample	0-6'	4 7'	7-9'	9-12'	12-14'	14 16'	16-18'
Sample Type	SOIL	SOIL	WASTE	SOIL	SOIL	SOIL	SOIL
Total Organic Carbon (%)	0.53	0.68	6.71	0.33	0.37	1.56	0.08
pH	8.59	8.06	8.32	7.89	7.48	8	7.98
METALS (mg/kg)							
Chromium	NT	NT	7	NT	NT	NT	5
Lead	NT	NT	21	NT	NT	NT	7
Nickel	NT	NT	7	NT	NT	NT	8
Zinc	26	18	670	22	24	17	15

Chemical Name	DS 8 Dike 81	DS 8 Dike 82	DS 8 Dike 2081	DS-8 Dike 2082	DS-8 Dike 2083	DS-8 Dike 2084	DS 8 Dike 2085	DS-8 Dike 2086
Depth of Sample	0 3'	3 8'	8 10'	10-12'	12 14'	14 16'	16-18'	18 20'
Sample Type	SOIL	SOIL/SLUDG	SLUDGE	SOIL	SOIL/OBS	SOIL	SOIL	SOIL
Total Organic Carbon (%)	0.53	0 08	17.02	0.51	0.51	0.16	NDE=0.063	NDE=0.063
pH	8 1	8 29	8.2	7 54	8 1	8.46	8.36	8 59
METALS (mg/kg)								
Chromium	NT	8	14	NT	10	NT	NT	NT
Lead	NT	5	870	NT	9	NT	NT	NT
Nickel	NT	19	9	NT	13	NT	NT	NT
Zinc	16	24	530	15	23	14	20	14

Chemical Name	DS 9 Dike 91	DS-9 Dike 92	DS-9 Dike 2091	DS-9 Dike 2092	DS-9 Dike 2093	DS 9 Dike 2094	DS-9 Dike 2095	DS-9 Dike 2096	DS 9 Dike 2097
Depth of Sample	0-3'	3-9'	9-10'	10-12'	12-14'	14 16'	16-18'	20-22'	22-24'
Sample Type	SOIL	SLUDGE	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Total Organic Carbon (%)	0.65	23.5	1.32	0.44	0.17	0.44	0.07	0.13	0.09
pH	8.65	8.81	8.75	7.9	7.9	8.22	8.15	8.09	8.4
METALS (mg/kg)									
Chromium	NT	12	NT	NT	6	NT	NT	NT	NT
Lead	NT	8	NT	NT	6	NT	NT	NT	NT
Nickel	NT	16	NT	NT	7	NT	NT	NT	NT
Zinc	42	1000	40	17	15	31	17	21	23

NOTES:
NT = Not tested
NDE = Not Detected (detection limit)

TABLE 3-9

Summary of HSL Analyses for Organic Compounds (in mg/kg) Detected in
Dike Soils Sampled July 6-10, 1987

Chemical Name	64035-015 DS-1 Dike 1001	64035-009 DS-2 Dike 22	64035-029 DS-3 Dike 32	64035-036 DS-4 Dike 42	64035-039 DS-4 Dike 2043	64035-055 DS-5 Dike 52	64035-062 DS-5 Dike 2054	64035-047 DS-6 Dike 62	64035-051 DS-6 Dike 1004	64035-019 DS-7 Dike 1005	64035-025 DS-8 Dike 52	64035-026 DS-8 Dike 2051	64035-042 DS-8 Dike 2065	64035-044 DS-9 Dike 92	64035-047 DS-9 Dike 2095
Depth of Sample	8-10'	3-9'	4-8'	4-9'	14-16'	5-10'	21-25'	3-9'	20-24'	7-9'	3-8'	8-10'	12-14'	3-9'	12-14'
Sample Description	Sludge	Sludge	Sludge	Sludge	Soil	Waste	Soil	Sludge	Soil	Waste	Soil/ Sludge	Sludge	Soil/ Organic	Sludge	Soil
VOLATILE ORGANIC FRACTION															
Benzene	0.1	1.3	6	ND(<0.4)	0.013	210	ND(<0.005)	1.7	ND(<0.005)	1.8	ND(<11)	6.0	ND(<0.005)	0.076	ND(<0.005)
Chlorobenzene	ND(<0.045)	ND(<0.5)	4.1	0.49	0.39	ND(<17)	ND(<0.005)	ND(<0.6)	ND(<0.005)	0.52	ND(<11)	ND(<0.4)	ND(<0.005)	ND(<0.05)	ND(<0.005)
Ethylbenzene	ND(<0.045)	2.8	ND(<2.9)	1.4	0.022	100	ND(<0.005)	1.1	ND(<0.005)	ND(<0.15)	ND(<11)	0.6	ND(<0.005)	ND(<0.05)	ND(<0.005)
Styrene	ND(<0.045)	2.8	ND(<2.9)	0.55	ND(<0.005)	ND(<17)	ND(<0.005)	ND(<0.6)	ND(<0.005)	ND(<0.15)	250	2.1	ND(<0.005)	ND(<0.05)	ND(<0.005)
Toluene	0.094	0.05	ND(<2.9)	8.9	0.016	180	ND(<0.005)	1.9	ND(<0.005)	ND(<0.15)	ND(<11)	3.8	ND(<0.005)	0.081	ND(<0.005)
Xylene	0.052	16	ND(<2.9)	5.7	0.11	510	ND(<0.005)	5.6	ND(<0.005)	ND(<0.15)	47	5.7	ND(<0.005)	0.21	ND(<0.005)
Acetone	1.4	5.6	ND(<14)	6.6	0.89	ND(<85)	0.19	19	ND(<0.025)	ND(<0.75)	ND(<56)	10	ND(<0.025)	2.0	ND(<0.025)
Carbon disulfide	ND(<0.045)	ND(<0.5)	19	ND(<0.4)	ND(<0.005)	ND(<17)	ND(<0.005)	ND(<0.6)	ND(<0.005)	ND(<0.15)	ND(<11)	0.66	ND(<0.005)	ND(<0.05)	ND(<0.005)
Methylene chloride	5.6	27	ND(<14)	ND(<2)	0.44	ND(<85)	ND(<0.025)	ND(<3)	ND(<0.025)	33	ND(<56)	ND(<2)	ND(<0.025)	ND(<0.25)	ND(<0.025)
1,1-dichloroethene	ND(<0.045)	0.57	ND(<2.9)	ND(<0.4)	ND(<0.005)	ND(<17)	ND(<0.005)	ND(<0.6)	ND(<0.005)	ND(<0.15)	ND(<11)	ND(<0.4)	ND(<0.005)	ND(<0.05)	ND(<0.005)
1,2-dichloroethane	ND(<0.045)	ND(<0.5)	ND(<2.9)	ND(<0.4)	ND(<0.005)	44	ND(<0.005)	ND(<0.6)	ND(<0.005)	ND(<0.15)	ND(<11)	ND(<0.4)	ND(<0.005)	ND(<0.05)	ND(<0.005)
2-Butanone (MEK)	0.54	ND(<2.5)	ND(<14)	ND(<2)	0.01	ND(<85)	0.17	9.0	ND(<0.025)	ND(<0.75)	ND(<56)	2.2	ND(<0.025)	0.39	ND(<0.025)
2-Hexanone	0.32	ND(<1.0)	ND(<5.8)	ND(<0.8)	ND(<0.01)	ND(<34)	ND(<0.01)	1.2	ND(<0.01)	ND(<0.3)	ND(<25)	ND(<0.8)	ND(<0.01)	ND(<0.1)	ND(<0.01)
4-methyl-2-pentanone (MIBK)	1.5	1.2	ND(<5.8)	5.9	0.05	77	0.049	3.4	ND(<0.01)	ND(<0.3)	ND(<25)	4.2	ND(<0.01)	1.5	0.012
SEMIVOLATILE ORGANIC FRACTION															
Acenaphthene	ND(<33)	ND(<3.3)	ND(<13)	170	5.5	ND(<26)	ND(<0.66)	ND(<0.6)	ND(<0.33)	ND(<33)	ND(<3.3)	ND(<3.3)	ND(<0.66)	ND(<33)	ND(<0.33)
Chrysene	ND(<33)	ND(<3.3)	ND(<13)	ND(<16)	ND(<1.6)	ND(<26)	ND(<0.66)	ND(<0.6)	ND(<0.33)	ND(<33)	ND(<3.3)	4.7	ND(<0.66)	ND(<33)	ND(<0.33)
Fluorene	ND(<33)	ND(<3.3)	ND(<13)	47	1.9	ND(<26)	ND(<0.66)	ND(<0.6)	ND(<0.33)	ND(<33)	ND(<3.3)	ND(<3.3)	ND(<0.66)	ND(<33)	ND(<0.33)
2-Methylnaphthalene	ND(<33)	ND(<3.3)	ND(<13)	660	20	81	ND(<0.66)	ND(<0.6)	ND(<0.33)	ND(<33)	4.9	ND(<3.3)	ND(<0.66)	ND(<33)	ND(<0.33)
Naphthalene	ND(<33)	ND(<3.3)	ND(<13)	ND(<16)	ND(<1.6)	47	ND(<0.66)	ND(<0.6)	ND(<0.33)	ND(<33)	3.6	ND(<3.3)	ND(<0.66)	ND(<33)	ND(<0.33)
Bis-(2-ethylhexyl) phthalate	ND(<33)	ND(<3.3)	ND(<13)	ND(<16)	ND(<1.6)	ND(<26)	ND(<0.66)	ND(<0.6)	ND(<0.33)	ND(<33)	4.6	ND(<3.3)	ND(<0.66)	ND(<33)	ND(<0.33)
Butyl benzyl phthalate	ND(<33)	12	ND(<13)	ND(<16)	ND(<1.6)	ND(<26)	ND(<0.66)	ND(<0.6)	ND(<0.33)	ND(<33)	ND(<3.3)	ND(<3.3)	ND(<0.66)	ND(<33)	ND(<0.33)
Diethyl phthalate	ND(<33)	ND(<3.3)	ND(<13)	ND(<16)	ND(<1.6)	ND(<26)	ND(<0.66)	ND(<0.6)	ND(<0.33)	ND(<33)	ND(<3.3)	25	ND(<0.66)	ND(<33)	ND(<0.33)
Di-n-octyl phthalate	ND(<33)	6.1	ND(<13)	ND(<16)	ND(<1.6)	ND(<26)	ND(<0.66)	ND(<0.6)	ND(<0.33)	ND(<33)	8.0	ND(<3.3)	ND(<0.66)	ND(<33)	ND(<0.33)
N-Nitrosodiphenylamine	ND(<33)	9.3	ND(<13)	ND(<16)	ND(<1.6)	34	ND(<0.66)	ND(<0.6)	ND(<0.33)	ND(<33)	5.2	ND(<3.3)	ND(<0.66)	ND(<33)	ND(<0.33)
Dibenzofuran	ND(<33)	ND(<3.3)	ND(<13)	140	5.5	ND(<26)	ND(<0.66)	ND(<0.6)	ND(<0.33)	ND(<33)	ND(<3.3)	ND(<3.3)	ND(<0.66)	ND(<33)	ND(<0.33)
2,4-Dimethylphenol	ND(<33)	ND(<3.3)	ND(<13)	ND(<16)	ND(<1.6)	87	ND(<0.66)	ND(<0.6)	ND(<0.33)	ND(<33)	ND(<3.3)	ND(<3.3)	ND(<0.66)	ND(<33)	ND(<0.33)
Phenol	ND(<33)	20	57	22	ND(<1.6)	640	ND(<0.66)	97	ND(<0.33)	ND(<33)	11	6.4	ND(<0.66)	ND(<33)	ND(<0.33)
2-Methylphenol	ND(<33)	ND(<3.3)	ND(<13)	ND(<16)	ND(<1.6)	81	ND(<0.66)	ND(<0.6)	ND(<0.33)	ND(<33)	ND(<3.3)	ND(<3.3)	ND(<0.66)	ND(<33)	ND(<0.33)
4-Methylphenol	ND(<33)	ND(<3.3)	ND(<13)	ND(<16)	ND(<1.6)	170	ND(<0.66)	15	ND(<0.33)	ND(<33)	ND(<3.3)	ND(<3.3)	ND(<0.66)	ND(<33)	ND(<0.33)
PESTICIDES AND PCBs															
alpha-BHC	ND(<0.8)	ND(<0.8)	ND(<8.0)	ND(<0.4)	ND(<0.04)	ND(<0.80)	ND(<0.08)	ND(<0.08)	ND(<0.008)	1.4	ND(<0.4)	ND(<8.0)	ND(<0.008)	ND(<0.8)	ND(<0.008)
Gamma-BHC	ND(<0.8)	ND(<0.8)	ND(<8)	0.69	0.057	ND(<0.8)	ND(<0.08)	ND(<0.08)	ND(<0.008)	ND(<0.16)	ND(<0.4)	ND(<8)	0.008	ND(<0.8)	ND(<0.008)
4,4'-DDD	ND(<1.6)	ND(<1.6)	ND(<16)	1.2	ND(<0.08)	ND(<1.6)	ND(<0.16)	ND(<0.16)	ND(<0.016)	ND(<0.32)	ND(<0.8)	ND(<16)	ND(<0.016)	ND(<1.6)	ND(<0.016)
4,4'-DDE	ND(<1.6)	ND(<1.6)	ND(<16)	ND(<0.8)	ND(<0.08)	ND(<1.6)	ND(<0.16)	ND(<0.16)	ND(<0.016)	0.78	ND(<0.8)	ND(<16)	ND(<0.016)	ND(<1.6)	ND(<0.016)
4,4'-DDT	ND(<1.6)	ND(<1.6)	ND(<16)	2.1	0.5	ND(<1.6)	ND(<0.16)	ND(<0.16)	ND(<0.016)	ND(<0.32)	ND(<0.8)	ND(<16)	ND(<0.016)	ND(<1.6)	ND(<0.016)
Dieldrin	ND(<1.6)	ND(<1.6)	ND(<16)	ND(<1.0)	0.25	ND(<1.6)	ND(<0.16)	ND(<0.16)	ND(<0.016)	0.75	ND(<0.8)	ND(<16)	ND(<0.016)	ND(<1.6)	ND(<0.016)
Aroclor 1232	ND(<8.0)	ND(<8.0)	ND(<80)	ND(<4)	ND(<0.4)	11	ND(<0.8)	ND(<0.8)	ND(<0.08)	ND(<1.6)	ND(<4)	ND(<80)	ND(<0.008)	ND(<8)	ND(<0.08)
Aroclor 1242	ND(<8.0)	ND(<8.0)	ND(<80)	7.6	ND(<0.4)	ND(<8.0)	ND(<0.8)	ND(<0.8)	ND(<0.08)	ND(<1.6)	7.7	ND(<80)	ND(<0.08)	ND(<8)	ND(<0.08)
Aroclor 1260	ND(<16)	ND(<16)	ND(<160)	ND(<8.0)	ND(<0.8)	34	ND(<1.6)	7.8	ND(<0.16)	ND(<3.2)	ND(<8.0)	ND(<160)	ND(<0.16)	ND(<16)	ND(<0.16)

NOTE: ND(<) = Not Detected (detection limit)

011260

The pond dike system was constructed from surrounding clays and combustion residues from the incinerator. It is estimated that up to 10% of the dike material may consist of a waste stream characterized by a diatomaceous earth filter aid wetted with a petroleum oil (1987 SCRI, pages 1-13 and 1-33). This filter cake material contained unspecified organo-metallic chemicals as well as insoluble barium and zinc salts. Additionally, a number of drums have been incorporated into the dike structure in the north and west sections of the dike system. Soil borings conducted on the dikes in July 1987 indicate discrete sludge or other waste layers varying in thickness from two to seven feet. These layers occur at depths consistent with pre-construction grade elevations of the natural depression utilized by Sheridan for disposal since the late 1950's.

SDS began initial closure actions in 1979. Approximately five acres of the pond in the northern section were covered with construction debris and dike material. In addition, another two acres of the southeastern portion of the pond were capped using fill materials and on-site soils. (These seven acres are included in the estimated dike area of 17 acres.) These actions have resulted in portions of the pond being covered with materials such as construction debris and soils that are different in composition from the remainder of the dike.

011261

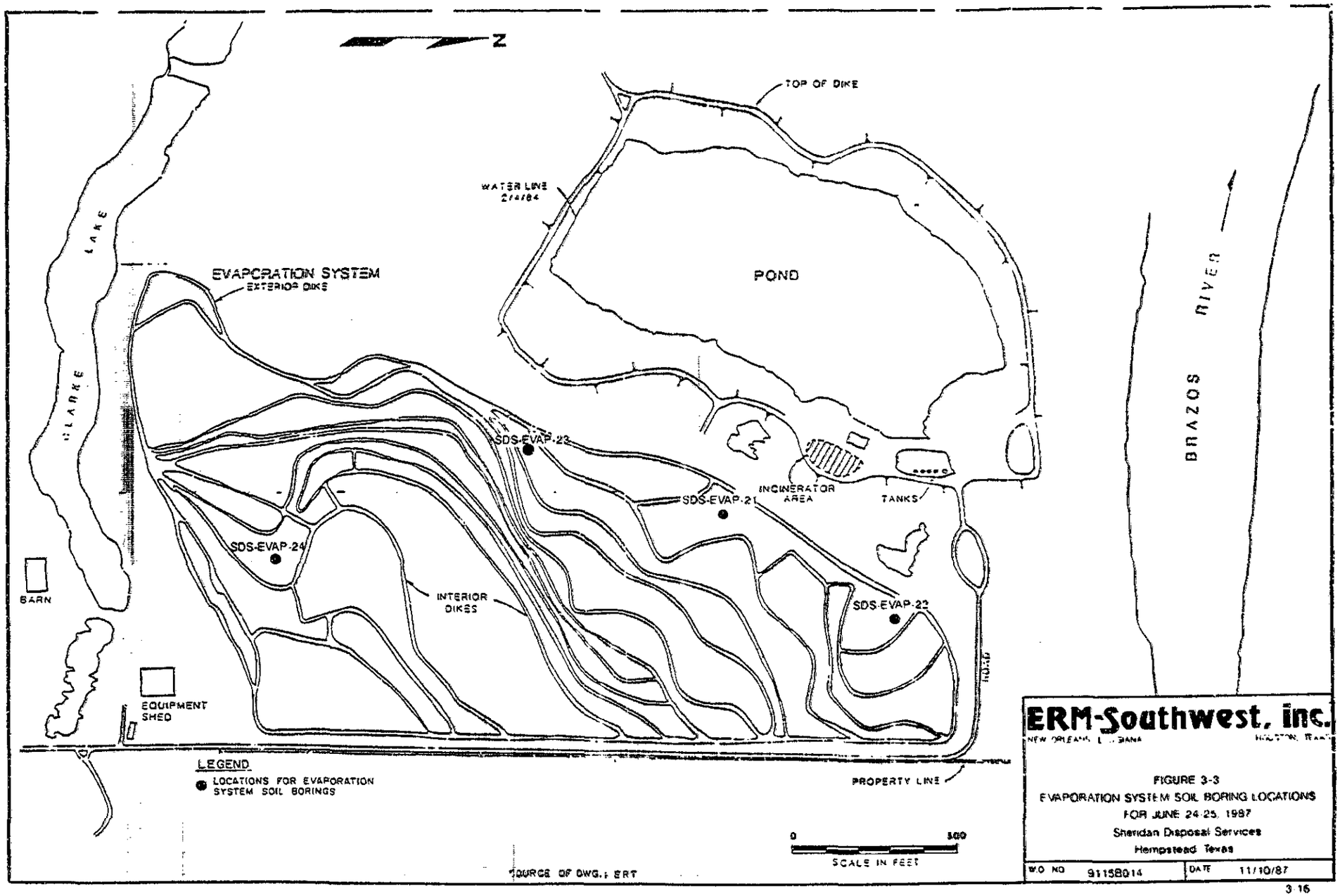
3.5 Evaporation Area Sludges and Soils

The evaporation system consists of 42-acres of water retention cells. The evaporation system was resampled at four locations June 24-25, 1987 (Figure 3-3) prior to application of water from the main pond to maintain freeboard on the main pond. Data from priority pollutant organic analyses of these soil samples are presented in Table 3-10. The majority of organic compounds that were identified in the evaporation system are isolated in two sludge deposits at or near the point of pond discharge into the evaporation system (samples 21 and 22).

Samples collected in actual evaporation system soils at depth or away from the outfall only showed the presence of bis-(2-ethylhexyl) phthalate in only one location. No other organic compounds were detected above sample detection levels (Table 3-10).

3.6 Miscellaneous Source Materials

Treatment process units at the SDS Site are located on the top of the dike and include an incinerator, a boiler and nine tanks. The tanks were used for separation and treatment of oil/water emulsions and storage of solvents and fuel oils. The tanks vary in size from 500 to 1000 barrels in capacity. The tanks presently contain sludges, as well as the surface oil layer that was removed from the pond during the summer of 1987.



ERM-Southwest, inc.

NEW ORLEANS, LOUISIANA — HOUSTON, TEXAS

FIGURE 3-3
EVAPORATION SYSTEM SOIL BORING LOCATIONS
FOR JUNE 24-25, 1987
Sheridan Disposal Services
Hempstead, Texas

W.O. NO	91158014	DATE	11/10/87

3-16

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B896

TABLE 3-10

Summary of Detected Priority Pollutant Compounds from Evaporation System Soils Sampled 6/24-25/87
(mg/kg)

Compound Name	Areas with Overlying Sludge Deposits											
	SDS-Evap-21-1, 21-2, 21-3 & 21-4				SDS-Evap-22-1, 22-2, 22-3 & 22-4				SDS-Evap-23-1 & 23-2		SDS-Evap-24-1 & 24-2	
	63963-005 0.5 feet	63963-006 2.0 feet	63963-007 3.0 feet	63963-008 6.0 feet	63963-001 0.5 feet	63963-002 2.0 feet	63963-003 3.0 feet	63963-004 6.0 feet	63963-009 0.5 feet	63963-010 2.5 feet	63963-011 0.5 feet	63963-012 2.5 feet
VOLATILE ORGANICS												
Benzene	18	0.013	ND(<0.005)	ND(<0.005)	ND(<1.3)	ND(<0.04)	ND(<0.005)	ND(<0.005)	ND(<0.005)	ND(<0.005)	ND(<0.005)	ND(<0.005)
Ethylbenzene	300	0.098	0.04	0.056	23	0.15	0.15	0.0097	ND(<0.005)	ND(<0.005)	ND(<0.005)	ND(<0.005)
Toluene	67	0.054	0.013	<0.005	ND(<1.1)	ND(<0.02)	0.0069	ND(<0.005)	ND(<0.005)	ND(<0.005)	ND(<0.005)	ND(<0.005)
ACID FRACTION ORGANICS												
Phenol	44	ND(<0.33)	ND(<0.33)	1.7	ND(<1.3)	0.47	0.36	ND(<3.3)	ND(<3.3)	ND(<3.3)	ND(<3.3)	ND(<1.1)
BASE/NEUTRAL FRACTION ORGANICS												
Bis-(2-ethylhexyl) phthalate	ND(<33)	ND(<0.33)	ND(<0.33)	ND(<0.33)	77	ND(<0.33)	ND(<0.33)	3.7	ND(<3.3)	ND(<3.3)	ND(<3.3)	ND(<3.3)
Butyl benzyl phthalate	ND(<33)	ND(<0.33)	ND(<0.33)	ND(<0.33)	2[illegible]	ND(<0.33)	ND(<0.33)	ND(<3.3)	ND(<3.3)	ND(<3.3)	ND(<3.3)	ND(<3.3)
Di-N-octyl phthalate	ND(<33)	ND(<0.33)	ND(<0.33)	ND(<0.33)	40	ND(<0.33)	ND(<0.33)	ND(<3.3)	ND(<3.3)	ND(<3.3)	ND(<3.3)	ND(<3.3)
PCBs												
Aroclor 1242	14 (<8)	NT	NT	NT	35 (<16)	NT	NT	NT	NT	NT	NT	NT

EXAMPLE: Sample code SDS-Evap-21-1 means sample location 21, depth 1

ND() = Not Detected (detection limit)
NT = Not Tested.
Note: Sludge thickness in samples SDS-Evap 21-1 and 22-1 is 1.0 and 0.5 feet, respectively

011263

4.1 Identity and Concentration of Detected Compounds

A total of 51 organic compounds and 24 metals have been quantified from various sources at the Sheridan Site. Sources include pond water, pond sludge, evaporation system water (metals only) and evaporation system and dike soils. These data are summarized in Tables 4-1 (organics) and 4-2 (metals).

4.1.1 Organic Compounds Detected

Compounds most consistently detected in pond sludge for the volatile organic fraction are benzene, ethylbenzene, tetrachloroethylene, toluene and xylenes. Evaporation system sludges showed similar volatile compounds as in the pond sludge, but at concentrations about 1/10th as high.

Compounds most consistently detected in pond sludge for the acid organics fraction are all phenols, including phenol and several methylated phenols (cresols). These compounds (especially phenol) were also found in pond water and evaporation system soils.

Compounds most consistently detected in pond sludge for the base/neutral organic fraction were polynuclear aromatics (PNAs), including naphthalene, 2-methylnaphathlene, phenanthrene, anthracene and fluorene. Several phthalates were identified at levels below the analytical detection limits in evaporation system soils and were detected in dike soil samples. Samples of the floating oil/emulsion layer (Table 3-2) on the pond collected in July 1987 showed elevated levels of phthalates.

Pesticides have been identified only in sludges buried in the dikes. Polychlorinated biphenyls (PCBs) have been identified in the pond sludge, floating oil, pond dikes and sludge deposits in the evaporation system, but not in water or evaporation system soils.

4.1.2 Metals Detected

Among the metals tested, those most concentrated (>300 mg/kg) in the pond water, pond sludge and/or dike soils are zinc, iron, aluminum, barium, lead, chromium and copper. Nickel, manganese, boron and vanadium are also present in concentrations between 10-300 mg/kg in the sludge, evaporation system and/or dike soil

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TABLE 4-1

Summary of Organic Compounds Detected On-Site
Sheridan Disposal Services Site

PARAMETER	POND WATER		FLOATING OIL AND EMULSION	POND SLUDGE				EVAPORATION SYSTEM SLUDGE DEPOSITS AND SOILS		BACKGROUND SOILS
	REI DATA July 1984	ERM DATA 06/18/87 08/21/87	ERM DATA 07/21/87	REI DATA COMPOSITE SAMPLES 03/27/84	REI DATA COMPOSITE SAMPLES 05/30/84	ERM COMPOSITE DATA 06/22/87	ERM DIKE SOILS 07/6 10/87	REI DATA December 1985	ERM DATA 06/24-25/87	REI DATA December 1985
	(mg/l)	(mg/l)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	
Volatile Fraction										
Acetone	NT	<0.025	<3.8	NR	NT	<220	<0.025-19	NT	NT	NT
Benzene	<0.50*	<0.005	<0.75	460	>2,500	170	<0.005-210	<0.022-67.9	<0.005-18	<0.022
2-Butanone (MEK)	NT	<0.025	<1.5	NR	NT	<220	<0.025-9	NT	NT	NT
Carbon disulfide	NT	<0.005	<0.75	NR	NT	<45	<0.005-19	NT	NT	NT
Chlorobenzene	<0.50	<0.005	<0.75	NR	<250	<45	<0.005-4.1	<0.03-<30.0	<0.005-<14	<0.030
1,2-Dichloroethane	<0.50	<0.005	<0.75	NR	<250	<45	<0.005-44	<0.014-<14.0	<0.005-<14	<0.014
1,1-Dichloroethylene	<0.50	<0.005	<0.75	NR	<250	<45	<0.005-0.57	<0.014-<14.0	<0.005-<14	<0.014
Ethylbenzene	<0.50*	<0.005	1.3	740	>8,480	560	<0.005-100	<0.036-579	<0.005-300	<0.036
2-Hexanone	NT	<0.010	<1.5	NR	NT	<90	<0.01-8.32	NT	NT	NT
4-Methyl-2-pentanone (MIBK)	NT	<0.010	<1.5	NR	NT	<90	<0.01-77	NT	NT	NT
Methylene Chloride	<0.50	<0.025	<3.8	NR	<250*	<220	<0.025-33	<0.014*-0.221	<0.025-172	<0.014
Styrene	NT	<0.005	<0.75	500	NT	340	<0.005-230	NT	NT	NT
Tetrachloroethylene	0.51	<0.005	<0.75	60	251	51	<0.005	<0.026-43.5	<0.005-<14	<0.021
Toluene	1.61	<0.005-0.078	0.75	1,750	>36,600	700	<0.005-150	<0.03-263	<0.005-67	<0.030
Trichloroethylene	2.91	<0.005	0.75	100	<250	<45	<0.005	<0.0095-<9.50	<0.005-<14	<0.0095
Xylenes*	NT	0.0082-0.097	3.3	2,700	NT	1600	<0.005-510	NT	NT	NT
Acid Fraction										
2,4-Dimethylphenol	<0.50*	<0.015	<99	550	224	460	<0.33-87	<0.09-494	<0.33-<33	<0.09
Phenol	3.55-13.84(a)	<0.015	<99	1,150	1,340	1500	<0.33-660	0.236-1,470	<0.33-44	<0.05
2-Methyl phenol	NT	<0.015	<99	150	NT	340	<0.33-81	NT	NT	NT
4-Methyl phenol	NT	<0.015	<99	NR	NT	850	<0.33-170	NT	NT	NT

NR - Not Reported
NT - Not Tested
* - Compound tentatively identified but not quantified (below detection limit)
(a) - Composite sample collected March 29, 1984

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TABLE 4-1 (Cont'd)

Summary of Organic Compounds Detected On-Site
Sheridan Disposal Services Site

PARAMETER	POND WATER		FLOATING OIL AND EMULSION	POND SLUDGE				EVAPORATION SYSTEM SLUDGE DEPOSITS AND SOILS		BACKGROUND SOILS
				REI DATA COMPOSITE SAMPLES		ERM COMPOSITE DATA	ERM DIKE SOILS	REI DATA	ERM DATA	REI DATA
	REI DATA July 1984	ERM DATA 06/18/87	ERM DATA 07/21/87	03/27/84	05/30/84	06/22/87	07/6-10/87	December 1985	06/24-25/87	December 1985
	(mg/l)	(mg/l)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	
Base/Neutral Fraction										
Acenaphthene	<0.050	<0.015	<99	NR	<32	<130	<0.33-170	<0.063-<5,700	<0.33-<33	<0.063
Anthracene	<0.050	<0.015	<99	NR	33	<130	<0.33-<33	<0.063*-<5,700	<0.33-<33	<0.063
Bis-(2-ethylhexyl) phthalate	<0.050	<0.015	180	NR	<32*	<130	<0.33-4.6	<0.330-<30,000	<0.33-77	<0.033
Butyl benzyl phthalate	<0.050	<0.015	110	NR	<32	<130	<0.33-12	<0.330-<30,000	<0.33-21	<0.033
Chrysene	<0.050	<0.015	<99	NR	<32	<130	<0.33-4.7	<0.083-<7,600	<0.33-<33	<0.083
Dibenzofuran	NT	<0.015	<99	NR	NT	<130	<0.33-140	NT	NT	NT
Dimethyl phthalate	<0.050	<0.015	<99	NR	<32	<130	<0.33-23	<0.330*-<30,000	<0.33-<33	<0.33
Di-N-octyl phthalate	<0.050	<0.015	<99	NR	<32	<130	<0.33-8.0	<0.330-<30,000	<0.33-40	0.451
Fluorene	<0.050	<0.015	<99	NR	35.4	<130	<0.33-47	<0.063-<5,700	<0.33-<33	<0.063
Isophorone	0.077	<0.015	<99	NR	99.8	<130	<0.33-<33	<0.073-<6,600	<0.33-<33	<0.073
2-Methylnaphthalene	NT	<0.015	<99	450	NT	220	<0.33-660	NT	NT	NT
Naphthalene	<0.050*	<0.015	<99	410	92	270	<0.33-47	<0.053-<4,800	<0.33-<33	0.135
N-Nitrosodiphenylamine	<0.050	<0.015	<99	NR	<32	190	<0.33-34	0.075-<5,700	<0.33-<33	<0.063
Phenanthrene	<0.050	<0.015	<99	NR	42.8	<130	<0.33-<33	<0.180-<16,000	<0.33-<33	<0.180
Pesticides										
alpha-BHC	<0.05	<0.005	<1.6	NR	<32	<0.64	<0.008-1.4	<0.330-<30,000	NT	<0.33
gamma-BHC	<0.05	<0.005	<1.6	NR	<32	<0.64	<0.008-0.49	<0.330-<30,000	NT	<0.33
4,4'-DDD	<0.05	<0.01	<3.2	NR	<32	<1.3	<0.016-1.2	<0.860-<84,000	NT	<0.16
4,4'-DDE	<0.05	<0.01	<3.2	NR	<32	<1.3	<0.016-0.78	<0.190-<17,000	NT	<0.19
4,4'-DDT	<0.05	<0.01	<3.2	NR	<32	<1.3	<0.016-2.1	<0.093-<8,500	NT	<0.093
Dieldrin	<0.05	<0.01	<3.2	NR	<32	<1.3	<0.016-0.75	<0.083-<7,600	NT	<0.093
PCB's										
Aroclor 1016	<0.05	<0.050	<16	NR	<9.2	55	<0.08-<80	<1.2-<110,000	<8-<96	<1.2
Aroclor 1232	<0.05	<0.050	<16	NR	<9.2	<6.4	<0.08-11	<1.2-<110,000	<8-<96	<1.2
Aroclor 1242	<0.05	<0.050	32	143.73-154(C)	219	<6.4	<0.08-8.0	<1.2-<110,000	14-36	<1.2
Aroclor 1260	<0.05	<0.100	<32	44.0-76(C)	<9.2	13	<0.16-34	<1.2-<110,000	<16-<32	<1.2
Total PCB's	<20 (b)	NR	NR	132-223	NR	NR	NR	NR	NR	

NR - Not Reported
NT - Not Tested
* - Compound tentatively identified, but not quantified (below detection limit)
(b) - REI data reported in lab backup April 11, 1984 for floating oil samples (RI 0987)
(c) - Individual samples analyzed for PCBs only.

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TABLE 4-2

SUMMARY OF METALS DETECTED ON SITE
SHERIDAN DISPOSAL SERVICES SITE

METALS	POND WATER		POND SLUDGE		SLUDGE RCRA LEACHATE	DIKE SOILS	EVAPORATION SYSTEM WATER	EVAPORATION SYSTEM SOILS		BACKGROUND SOILS	
	RI 1987 (a)	ERM 08/18/87 08/21/87	RI 1987 (b)	ERM COMPOSITE 06/22/87	REI March 1984 (c)	ERM 7/6-10/87	REI 03/29/87	TOTAL RI 1987 (d)	LEACHATE TWQB September 1976	TOTAL REI December 1985	LEACHATE TWQB 11/12/76 (c)
	(mg/l)	(mg/l)	(mg/kg)	(mg/kg)	(mg/l)	(mg/kg)	(mg/l)	(mg/kg)	(mg/l)	(mg/kg)	(mg/l)
Aluminum	NT	0.15-0.22	2450-8790	2300	NT	NT	NT	5,630-7,000	NT	NT	NT
Arsenic	<0.010-0.021	0.032-0.41	<2-2	20	<0.01	NT	<0.010	<1.43 1-2	NT	NT	NT
Barium	<2.50-1.6	0.16-0.18	<300-647.4	820	<0.50	NT	<0.50	40-125	NT	NT	0.020
Beryllium	NT	<0.001	0.5	<0.1	NT	NT	NT	0.25-0.5	NT	NT	NT
Boron	NT	NT	10-15	NT	NT	NT	NT	10	NT	NT	NT
Cadmium	<0.010-0.090	<0.005	0.4-2.5	2.7	<0.01	NT	<0.010	<1.43 0.15-31.4	<0.010	NT	<0.010
Calcium	0.63-1.77	59-75	NT	5200	NT	NT	NT	19.8-43.4	NT	NT	0.07
Chromium	0.28-2.27	0.01-0.02	19-302	160	<0.01	6-60	<0.010	<1.43-207.0	NT	0.1-56.1	<0.02
Cobalt	NT	<0.01	2.5-5	3	NT	NT	NT	2.5-6.87	NT	NT	NT
Copper	0.20-2.99	<0.01-0.006	15-388	130	NT	NT	0.02-0.04	5-41.4	NT	NT	0.010
Iron	35.2	0.36-0.48	4270-9010	4300	NT	NT	11.5-20.5	1,040-5,870	NT	NT	NT
Lead	<1.10-0.60	<0.008	<2-537.1	310	<0.01	<5-120.2	<0.010	3-691.0	<0.050	<1-22.1	<0.050
Magnesium	1.59-5.5	20-29	NT	920	NT	NT	NT	2.37-6.66	1.06	NT	0.1
Manganese	2.97	0.29-0.41	144-244	71	NT	NT	0.60-1.69	183-241	NT	NT	NT
Mercury	<0.005	<0.0002-0.001	<1	0.06	<0.005	NT	<0.005	NT	NT	NT	0.00055
Nickel	0.130-1.24	<0.040	52-90	69	NT	5.38	<0.010-0.10	<1.43-43.9	NT	9.8-24.4	0.03
Potassium	NT	72-81	NT	<500	NT	NT	NT	1.7-3.6	NT	NT	NT
Selenium	<0.310	<0.004-0.041	<2	0.6	<0.01	NT	<0.010	0.2	NT	NT	NT
Silver	<0.010-<0.2	<0.005	<2	<50	<0.01	NT	<0.01-0.11	NT	NT	NT	NT
Sodium	NT	272-330	NT	2200	NT	NT	NT	4.9-17.1	NT	NT	0.00095
Vanadium	NT	<0.01-0.010	20	25	NT	NT	NT	20	NT	NT	NT
Zinc	0.390-9.0	<0.02-0.040	115.6-1300	970	NT	10-2903	0.01-0.03	15.5-1,270	NT	23.1-56	0.02

NT - Not Tested
(a) - Ranges include data from TWQB (October 1975, September 1976, April 1979, February 5, 1976) and RI (March 29, 1984) samples
(b) - Ranges include data from TWQB (March 1976), EPA Fit Team samples (July 1983), and a composite sample by REI (March 29, 1984)
(c) - Reported in the 1987 RI; see Tables 3-7 and 3-9 for REI and TWQB leachate data respectively, Appendix 3a for TWQB leachate (Sept. 1976)
Note that background evaporation system soil leachate of 11/76 is only one sample point
and leachate procedure not well documented. Therefore, data may not be representative
(d) - Ranges include data from EPA Fit Team sample (July 1983) and REI sample (March 27, 1984)

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samples. Sludge leachates contained high magnesium, barium, copper, cadmium, lead and nickel. Pond water only had detectable levels of chromium, copper, iron, magnesium, manganese, nickel, zinc and calcium.

The only metals detectable in evaporation system water were barium, copper, iron, manganese, and zinc. Metals in evaporation system sludge deposits are very similar to those in the pond sludge, both in identity and concentration, except for zinc which was about 1/10th of pond sludge concentrations.

Leachate samples of background soils (TWQB samples collected 11/12/76) used as topsoil on the evaporation system show no detectable levels of cadmium, chromium or lead. Barium, copper, calcium, mercury, manganese, sodium and zinc were found at moderate levels, generally at concentrations about an order of magnitude less than pond sludge leachate samples with the exception of mercury, which was higher.

4.2 Air Emissions

The following conclusions have been reached (SCRI, 1987) regarding ambient air quality at the Sheridan Disposal Site based on independent sampling and analysis by REI and EPA's Emergency Response Team in March 1986:

- The site has no detectable volatile emissions of polychlorinated biphenyls (PCBs) based on detection limits of 0.003 mg/m^3;
- The site has no detectable emissions of volatile toxic organic compounds or listed RCRA hazardous substances above background levels during average annual ambient conditions.

A summary of air quality analytical results is contained in Table 4-3 along with a comparison of Houston urban area mean background and OSHA Threshold Limit Values (TLV). At a detection limit of 0.003 mg/m^3, EPA did not detect polychlorinated biphenyls (PCBs) in any of the Fluorosil-tube samples. No detectable levels of organic vapors were found in the carbon tube samples, except for a background sample at an upwind station (#10). Considering several carbon tubes were located inches above the pond surface, the results indicate that no hazardous volatile materials were emitted from the pond at the time of sampling. Except for acetone in one upwind background sample, no EPA hazardous substance list compounds were detected at quantifiable levels for any of the SCRI samples. (Prevailing wind direction is from the southeast. See Figure 8-3, Section 8).

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TABLE 4-3

Summary of Air Monitoring Results - Detected Compounds
Concentrations in ppb Volumetric Basis

Volatile Compound	Highest Up Wind Value Measured by EPA or REI	Highest Down Wind Value Measured by EPA or REI	Houston Area Mean Background (5/14-5/25,1980) (1)	OSHA TLV-TWA (ppb)	Detection Limit (ug/m3)
Chloromethane	BMDL	BMDL	1.0	50,000	-
Vinyl Chloride	BMDL	ND	5	-	-
Chloroethane	BMDL	ND	0.2	5,000,000	-
Methylene Chloride	BMDL	8.7	NA	100,000	0.01
Acetone	2.7	BMDL	NA	750,000	0.02
1,1-Dichloroethene	BMDL	BMDL	0.03	5,000	0.01
1,1-Dichloroethane	BMDL	ND	0.06	200,000	-
Trans-1,2-Dichloroethene	BMDL	ND	NA	200,000	0.01
2-Butanone	BMDL	BMDL	NA	200	0.008
1,1,1-trichloroethane	1.2	7.7	0.4	350,000	0.01
Carbon Tetrachloride	BMDL	BMDL	0.4	5,000	0.02
Vinyl Acetate	ND	BMDL	NA	10,000	-
Trichloroethene	ND	BMDL	0.1	50,000	0.01
Benzene	4.0	3.7	5.8	10,000	0.009
CIS-1,2-Dichloropropene	BMDL	BMDL	NA	-	-
4-Methyl-2-Pentanone	BMDL	ND	NA	-	-
Tetrachloroethene	ND	BMDL	0.4	50,000	0.02
Toluene	4.6	3.9	10.3	100,000	0.009
Ethyl Benzene	BMDL	0.8	1.4	100,000	-
Xylenes	3.6	1.9	3.8/1.3 m-/o- & p-	100,000	0.009
PCBs	ND	ND	NA	(500 ug/m3)	<0.003

EPA-ER/REI samples March 4/5, 1986
EPA-FIT samples July 1985.
EPA-FIT samples July 1983.
- = No standard
(1) = Source measurement of hazardous organic chemicals in the ambient atmosphere EPA-600 53-83-002, March 1983.
BMDL = Tentatively identified at levels below detection limits.
ND = Not detected
NA = Not Available
(500 ug/m3) = OSHA standard in work place for PCB's

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EPA sample results indicated trace quantities of various EPA hazardous substance list compounds. It should be noted that the laboratory method blank showed positive results for chloromethane, acetone, 2-butanone, cis-1,3-dichloropropene, and toluene. The field blanks contained trace levels of chloromethane and 2-butanone. The only compounds not totally accountable by field or method blanks were benzene and 1,1,1-trichloroethane. According to the SCRI (1987), these trace levels are well under ambient concentrations of benzene found naturally and were comparable to EPA results for the site background level of benzene (1.6 ppb).

4.3 Analytical Methodology and QA/QC

The analytical methods used by REI and ERM-Southwest for the analysis of soil, water and sludge samples are summarized in Appendix B. All sample collection and analyses by REI and ERM-Southwest reported herein have been performed in general accordance with EPA guidelines for proper field and laboratory practices, including the 1986 RCRA Ground-Water Monitoring Technical Enforcement Guidance Document, SW-846, ASTM Standard Methods, and 40 CFR Subchapter N, Part 401.12 "Methods for Analysis of Water and Wastewater".

Analytical QA/QC for the sample runs has been in accordance with EPA recommended frequencies for blanks, duplicates and spiked samples. Field and trip blanks and field duplicates have been supplied for most major field sampling efforts. A complete set of QA/QC and laboratory reports of all 1987 data summarized herein have been provided to EPA under separate cover.

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5 - ENVIRONMENTAL FATE AND TRANSPORT

5.1 Physical/Chemical Properties of Detected Constituents

The physical characteristics of each detected compound dictate a specific set of values and properties that will, in turn, regulate the mobility, persistence and ultimate destination of each compound in the environment. The potential exposure pathways at the SDS Site are discussed in detail in Section 9. Obviously, a compound with high aqueous solubility is more capable of migration in aqueous media than a compound with relatively low solubility in water. Furthermore, the chemical characteristics that govern mobility also play an indirect role in determining relative toxicity since a compound capable of widespread dispersal is potentially more harmful to a greater receptor population. In a similar sense, a compound with a high volatilization rate is more capable of entering into and being transported by the atmosphere, which could potentially expose a greater receptor population.

Physical and chemical properties of a compound are dependent upon the actual physical structure of the compound. The bonding between various atoms in a molecular complex dictates molecular shape, reactivity and physical properties.

Tables 5-1 through 5-4 (found at the end of this section) contain a detailed compilation of physio-chemical data for almost all compounds reported above method detection level at the Sheridan Site. The only exceptions are some inorganics such as sodium, boron, cobalt and potassium that are neither hazardous nor present at sufficient concentrations to significantly effect the fate and transport of other constituents. These tables are provided as a data base for the exposure pathway analysis and risk assessment presented in Sections 9 through 13.

The data summarized in Tables 5-1 through 5-4 were reviewed for the purpose of identifying and evaluating key constituents for the selection of Indicator Chemicals (Section 7). The data for indicator chemicals were then used in the transport models in the Exposure Pathway Analysis (Section 9) and Risk Evaluation (Sections 10, 11 and Appendix F). The data provided in Tables 5-1 through 5-4 underlie many of the conclusions drawn in this document.

5.2 Fate and Persistence

Tables 5-1 through 5-4 also summarize data concerning primary transport pathways and ultimate fate processes for each compound. A reasonably detailed account of characteristic properties is available in the far right-hand column of the tables for

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all compounds detected at the site. EPA has recently published detailed tables of physical/chemical data, fate and persistence and toxicological data. These data are provided in Appendix C to this report to supplement the data summarized in Tables 5-1 through 5-4.

In addition to the data and information provided in the last column of Tables 5-1 through 5-4, the octanol/water partition coefficient (Kow) values are provided when available. Kow is very useful in modeling fate and transport processes. In order to generate Kow data, the compound in question is mixed into a vessel containing equal amounts of water and octanol. After a period of mixing and incubation, aliquots of the two immiscible phases (water and octanol) are analyzed to determine the concentration of the test compound. The lower the Kow value, the more soluble the compound is in water and, conversely, the less soluble it is in non-polar (fatty) substances. Therefore, the Kow allows inferences to be made concerning a compound's transport through water as well as the probability of a compound being concentrated in the adipose tissues of a receptor organism.

The most frequently encountered transport/fate scenarios are: 1) volatilization from a surface water body or soil surface with subsequent photochemical oxidation in the atmosphere; 2) adsorption onto soils; 3) elution from contaminated soils and subsequent "flushing" into the ground water system; or 4) food chain uptake in receptor areas (e.g., aquifer, lake, surface soils). Other scenarios include direct dermal contact; exposure to dusts carried by prevailing winds; ingestion of contaminated food stuffs by humans (i.e., food-chain transmission); and direct ingestion of water or, in the case of small children, soil. All of these pathways or exposure scenarios are evaluated in Sections 9, 10 and 11 using the Indicator Chemicals selected in Section 7.

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TABLE 5-1

Physiochemical Properties, Structural Formulation and Transport Properties for Detected Metals

Sheridan Disposal Services Site

CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Kd (1)	FATE AND PERSISTENCE
References: M CRC	M CRC	M CRC		M B 1 CRC EPA-440 A
METALS				
Aluminum (Al) AW 26.98 MP 660 C BP 2327 C Sol Salts vary in solubility, free metal is insoluble. d 2.70	Al+3	Tin-white, malleable and ductile metal taking brilliant polish. Occurs in nature primarily in combination with silica and as oxide. Luster maintained in dry air but oxide forms in moisture (protecting metal from corrosion). Dusts are moderately flammable when exposed to heat, flame or chemical reactions with strong oxidizers	10	Amphoteric with minimum solubility at pH = 4.4. Increases with pH change in either direction. Forms a variety of soluble complexes. Polymerizes in presence of hydroxide to form white ppt. For aquatic species, only the inorganic soluble complexes appear to be toxic. May coprecipitate nutrients
Arsenic (As) AW 74.92 MP 817 C (@ 28 atmosph) BP 613 C (sublimes) Sol Elemental form insoluble in water. Salts vary in solubility d 5.73	As-3, As+3 As+5	Gray, shiny, brittle, semi-metallic. Burns with bluish flame, giving off garlic-like aroma and dense white smoke. Oxidizes to black finish upon exposure to air. Soluble in HNO3	10	Extremely mobile in the aquatic environment. Predominant fate processes are chemical speciation and clay sorbition. Concentrations in water are generally much lower than in sediment. Sediment transport responsible for transfer of arsenic soil residues. pH and Eh are extremely important factors in aquatic fate. Some seaweeds, freshwater algae and crustaceans accumulate significant amounts of arsenic
Barium (Ba) AW 137.33 MP 725 C BP 1640 C VP 10mm @ 1041 C Sol Salts vary in solubility. Decomposes in water d 3.5	Ba+2	Yellowish white, slightly lustrous. Body centered cubic crystal structure, slightly malleable, easily oxidizable. Incompatible with acids, can detonate in contact with certain halogenated aliphatic hydrocarbons	10	Elemental Ba decomposes to the cationic form in water or alcohol. Generally, Ba will precipitate as an insoluble complex of sulfate, unless it is higher in concentration than available sulfate and carbonate

(1) Distribution coefficient for metals are assigned a value of 10 ml/g corresponding to a conservatively high degree of mobility for heavy metals (but which is a moderate mobility compared to PCBs (Kd>1000) and nitrates (Kd<0.01)), as illustrated in Figure 2.19 of Walton (1985)

For explanation of terms, abbreviations and references see Table 5-5

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TABLE 5-1 (Cont'd.)

Physiochemical Properties, Structural Formulation and Transport Properties for Detected Metals

Sheridan Disposal Services Site

CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Kd (1)	FATE AND PERSISTENCE
References: # CRC	# CRC	# CRC		# B 1 CRC EPA-440 A
Beryllium (Be) AW 9.01 MP 1287 C BP 2500 C (extrapolated) Sol BeO = 0.2 mg/l at 30 C d 1.85	Be+2	Steel gray metal very light with high melting point. Resists attack by HNO3 attacked by strong bases with evolution of H2	10	Undergoes isomorphic substitutions and cation exchange. strongly immobilized by sorption in soils. Can be taken up in plants resulting in yield reduction. There is little information on the accumulation of Be by aquatic plants and animals
Cadmium (Cd) AW 112.41 MP 321 C BP 765 C Sol Elemental form insoluble. But salt: and organic complexes quite soluble d 8.65	Cd+2	Soft, bluish-white metal which is easily cut with a knife. Oxidizes slowly in moist air. Reacts with acids but not alkali	10	Occurs in multiplicity of forms in aquatic environment, depending on water quality (pH, carbonate concentration, etc.). Cadmium is one of the most readily absorbed and accumulated of the heavy metals. Organic ligand formation (with subsequent dissolution) and bioconcentration are the predominant fate pathways. Solubility increases under acidic conditions and very little sorption of Cd takes place
Chromium (Cr) AW 51.99 MP 1857 ± 20 C BP 2672 C Sol Water: insoluble as element CrSO4 soluble CrSO4 7H2O 42.35 g/100 cc Cr2(SO4)3 18H2O 120 g/100 cc CrCl3 very soluble CrCl hexahydrate 58.5 g/100 cc CrO3 166 g/100 cc @ 15 C, 61.7 g/100 cc Other Cr oxides: insoluble Cr2 phosphates insoluble d. 7.14	Cr+3 through Cr+6	Steel gray, lustrous metal which takes a high polish and resists oxidation even in presence of extreme moisture. Reacts with dilute HCl, H2SO4 but not with HNO3 attacked by caustic alkalis	10	The chemical speciation of Cr is of utmost importance, with Cr+3 forming insoluble salts and CR+4 forming soluble compounds. Organic materials might sorb Cr+4. Some bioaccumulation (and thus food chain transport) of Cr is indicated. Adsorption of CR+3 increases as soil pH increases, while Cr+4 is less adsorbed as pH increases. Phosphates can displace Cr+4 at soil adsorption sites

(1) Distribution coefficient for metals are assigned a value of 10 ml/g corresponding to a comparatively high degree of mobility for heavy metals (but which is a moderate mobility compared to PCBs (Kd>1000) and nitrates (Kd<0.01)), as illustrated in Figure 2.19 of Walton (1985).

For explanation of terms, abbreviations and references see Table 5-5

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TABLE 5-6 (Cont'd.)

Physiochemical Properties Structural Formulation and Transport Properties for Detected Metals

Sheridan Disposal Services Site

CHEMICAL CHARACTERISTICS INFORMATION		STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Kd (1)	FATE AND PERSISTENCE
References	M CRC	M CRC	M CRC		M B T CRC EPA-440 A
Copper (Cu) AW 63.54 MP 1083 C BP 2567 C VP 1 mm @ 1628 C Sol Salts vary in solubility free metal is essentially insoluble in water d 8.92		Cu+1 Cu+2	Reddish lustrous ductile malleable face centered cubic crystallization lattice slowly oxidizes in air, moist air causes a duff green coating to form Attacked by most acids to varying degrees	10	Elemental Cu is strongly bioaccumulated and is an essential trace element for most biota Cu generally exists as a carbonate complex in aquatic systems unless pollution of excess organic material cause sorption and organic ligand formation to become dominant fate processes Percent of Cu adsorbed by organic matter Fe and Mn oxides and clays increases as pH increases
Iron (Fe) AW 55.85 MP 1535 C BP 3000 C VP 1 mm @ 1757 C Sol Salts vary in solubility Elemental form essentially insoluble in water d 7.86		Fe+2 Fe+3 (rarely occurs as Fe+1 Fe+4 or Fe+6)	Silvery-white/gray, soft ductile and malleable Forms reddish oxide in moist air used extensively due in part to machineability and numerous alloys with other metals attacked by dilute organic and mineral acids	10	Elemental Fe is very important to most biota in pigments and in electron transport reactions for metabolic functions (i e hemoglobin in respiration in mammals) ubiquitous throughout mineral and biological environment Can bioaccumulate sorption and exchange properties and soluble/insoluble speciation ratios of Fe can be important in fate processes of other metals
Lead (Pb) AW 207.2 MP 327.5 C BP 1740 C Sol Water soluble as element Pb(ClO3)2 151.3 g/100 cc at 18C (hydrated) PbCl2 0.99 g/100cc PbCO3 0.00011 g/100 cc @ 20 C Pb(OH)2 0.0155 g/100 cc @ 20 C Pb2O(OH)2 0.014 g/100 cc (poisonous) Pb phosphates insoluble Pb(PO4)2 0.000014 g/100 cc Pb oxides generally insoluble PbO 0.0023 g/100 cc at 22 C Pb Acetate Pb(C2H3O2)2 44.30 g/100 cc PbSO4 0.00425 g/100 cc @ 25 C d 11.35		Pb+2 Pb+4	Bluish-white silvery-gray metal Very soft and malleable easily melted cast, rolled and extruded Resistant to corrosion Reacts with hot (conc) nitric acid boiling (conc) HCl and H2SO4 Attacked by pure water but resists attack by tap water	10	Solubility dependent upon speciation which in turn is dependent upon conditions of photolysis during entry into the aquatic environment as well as pH redox conditions and available ligands Sorption onto inorganic materials predominant transport processes. Bioaccumulation does occur with changes to body metabolism triggering remobilization of lead in the blood stream Becomes reduced and mobil under water logged conditions Increased pH and Ca2+ diminishes capacity of plants to absorb lead may form low solubility organometallic complexes 1 000 ppm total Pb can safely accumulate in soil without phytotoxicity If treatability experiments demonstrate immobility of Pb at high concentrations

(1) Distribution coefficient for metals are assigned a value of 10 ml/g corresponding to a conservatively high degree of mobility for heavy metals (but which is a moderate mobility compared to PCBs (Kd>1000) and nitrates (Kd<0 01)) as illustrated in Figure 2 19 of Walton (1985)

For explanation of terms, abbreviations and references see Table 5-5

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TABLE 5-1 (Cont'd.)
Physiochemical Properties, Structural Formulation and Transport Properties for Detected Metals
Sheridan Disposal Services Site

CHEMICAL CHARACTERISTICS INFORMATION References M CRC	STRUCTURAL FORMULA M CRC	PHYSICAL PROPERTIES M CRC	Kd (1)	FATE AND PERSISTENCE M & T CRC EPA-440 A
Magnesium (Mg) AW 24.3 MP 648.8 C BP 1107 C Sol: Insoluble in cold water, decomposes to Mg(OH)2 in hot water Mg oxides generally insoluble Organic and ligand complexes generally very soluble d 1.74	Mg+2	Light, silver-white, tough metal. Tarnishes in air, can ignite and readily oxidizes burning with a bright flame	10	Important element in both plant and animal life. Could be associated with increased mobility through formation of soluble organometallic complexes. Can be important in fate processes for other metals because of exchange and sorption properties
Manganese (Mn) AW 54.94 MP 1244 + 3 C BP 1962 C Sol Decomposes in water d 7.20	Mn+1 through Mn+4 and Mn+6, Mn+7 (depending on allentropic forms)	Gray-white, hard, brittle. Superficially oxidizes on exposure to air. Decomposes in water (rapidly on heating). Reacts with dilute mineral acids and aqueous solutions of Na2CO3 and K2CO3	10	Mobility reduced by complexation with humic acid. Mn can be displaced by Fe and Ca in soils. Availability strongly dependent on pH. Acid conditions promote mobility of Mn
Mercury (Hg) AW: 200.6 MP: -38.9 C BP 356.7 C VP: 2 x 10-3 mm at 25 C Sol: 0.28 umol/l at 25 C d: 13.53	Hg+1, Hg+2	Silver-white, heavy, liquid metal. Reacts with HNO3 and hot H2SO4. Low reactive with cold H2SO4 or dilute HCl or alkalies	10	Exists as free mercury, mercury ion in salts and in organic mercury compounds. Complexes with both organics and inorganics. Sediment with high sulfuric content will strongly bind mercury. Methylation of mercury by microorganisms is a detoxication response through formation of organometallic complexes. Methylation by microorganisms occurs in a narrow pH range. Conversion rate of inorganic mercury to methylmercury is less than high bioaccumulation for 1.5% per month methylmercury in fish. As presence of Cl increases, HgCl2 forms and adsorption by soils and clays is reduced

(1) Distribution coefficient for metals are assigned a value of 10 ml/g corresponding to a conservatively high degree of mobility for heavy metals (but which is a moderate mobility compared to PCBs (Kd=1000) and nitrates (Kd=0.01)) as illustrated in Figure 2.19 of Welton (1985).
For explanation of terms, abbreviations and references see Table 5-5

011276

TABLE 5-1 (Cont'd.)

Physiochemical Properties, Structural Formulation and Transport Properties for Detected Metals

Sheridan Diagnostic Services Site

CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Kd (1)	FATE AND PERSISTENCE
References: M CRC	M CRC	M CRC		M B T CRC EPA-440 A
Nickel (Ni) AW: 58.69 MP: 1455 C BP: 2730 C Sol: Elemental form insoluble. But salts can be very soluble. NiOH: 0.014 g/100cc NiSO4, sol in 1.4 pts H2O 29.3 g/100cc, 87.3 g/100 cc at 87.3 C NiCO3: 0.0093 g/100 cc Ni Acetate, C4 H6, NiO4 sol in 6 pts H2O NiBr2 sol in 1 pt H2O 112.8 g/100 cc, 155.1 g/100 cc at 100 C Cl2Ni, sol in 1 pt H2O 64.2 g/100 cc d: 8.90	Ni+1 through Ni+4 (Normal Valence Ni+2)	Lustrous white hard ferromagnetic metal. Stable in room temperature air. Will burn in oxygen. Attacked by acids, but not alkalis.	10	Very mobile heavy metal. Not as prone to precipitation as other metals, but very dependent upon ion exchange with crystalline minerals and chemical speciation. Retention of Ni in soils increases with increasing pH.
Selenium (Se) AW: 78.96 + 3 MP: 217 C (gray) BP: 684.9 + 1 C (gray) Sol: Insoluble in water and alcohol Slightly soluble in CS2 Soluble in Benzene Sodium Selenite is soluble Sodium Selenate, 84 g/100 g H2O at 15 C d: 4.81	Se+2 Se+4 Se+6	Most stable variety crystalline hexagonal. Se is metallic gray. Burns in air. Elemental Se is practically nontoxic, however hydrogen selenide is extremely toxic.	10	Combines directly with hydrogen and halogens. HgSe, CuSe and CdSe are very insoluble. Se is least soluble in acid soils and iron oxides. Can combine with Se to form an insoluble precipitate. Plants translocate selenate only under aerated alkaline conditions. Se in soil occurs generally as selenates or selenites of Sodium or Calcium.
Silver (Ag) AW: 107.87 MP: 961.93 C BP: 2212 C Sol: Elemental form insoluble Salts and oxides vary in solubility d20: 10.50	Ag+1, Ag+2	Brilliant white metallic luster, very ductile and malleable. Stable in air and water, tarnishes when exposed to ozone, H2S. Soluble in HNO3 and hot H2SO4.	10	Solubility of most Ag compounds increases in low pH soils. Sorption by MnOOH and precipitation with halides are probably the dominant controls on the mobility of Ag.

(1) Distribution coefficient for metals are assigned a value of 10 ml/g, corresponding to a comparatively high degree of mobility for heavy metals (but which is a moderate mobility compared to PCBs (Kd=1000) and nitrates (Kd=0.01)), as illustrated in Figure 2.19 of Walton (1985).

For explanation of terms, abbreviations, and references see Table 5-5.

011277

8904

TABLE 5-1 (Cont'd.)

Physiochemical Properties, Structural Formulation and Transport Properties for Detected Metals

Sheridan Disposal Services Site

CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Kd (1)	FATE AND PERSISTENCE
References M CRC	M CRC	M CRC		M B.T CRC EPA-440 A
Vanadium (V) AW 50.94 MP 1890 + 10 C BP 3380 C Sol: Insoluble in elemental form Salts and oxides vary in solubility d 5.96	V+2 through V+5	Bright white metal, soft and ductile Resists alkalies and HCl and H2SO4	10	In soils, V can be incorporated into clays and is associated with aluminum oxides
Zinc (Zn) AW 65.38 MP 419.6 C BP 907 C Sol Water insoluble as element ZnCl2 4.3 g/100 cc at 25 C Zn Acetate C4H6O4Zn 1g/23 ml H2O, 30 g/100 cc CO3Zn 0.001 g/100 cc at 15 C ZnO 0.00016 g/100 cc at 29 C Mn2O8Zn sol in 3 pts H2O O8P2Zn insol ZnSO4 (Heptahydrate) 1 g/0.6 ml H2O, 96.5 g/100 cc d 7.14	Zn+2	Bluish-white lustrous metal stable in dry air becoming covered with whitish coating (basic carbonate) on exposure to moist air malleable at 100-150 C becoming brittle and pulverizable at 210 C Slowly attacked by H2SO4 and HCl	10	Sorbtion onto hydrated clays and organic matrixes predominate the transport processes As an essential trace nutrient bioconcentration is a primary fate process internal organs and bones accumulate much higher Zn levels than edible muscle tissues

(1) Distribution coefficient for metals are assigned a value of 10 ml/g corresponding to a conservatively high degree of mobility for heavy metals [but which is a moderate mobility compared to PCBs (Kd>1000) and nitrates (Kd<0.01)] as illustrated in Figure 2.19 of Walton (1985)

For explanation of terms abbreviations and references see Table 5-5

011278

TABLE 5-2
Physicochemical Properties, Structural Formulation and Transport Properties for Detected Volatile Organics
Sheridan Disposal Services Site

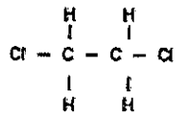
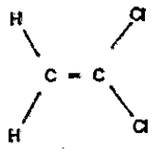
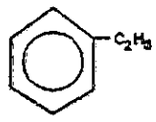
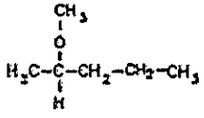
CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Log Kow	FATE AND PERSISTENCE
References: CRC,V,SPH	CRC,V,EPA-440	M,R,CRC,EPA-440	V,W B SPH	V,EPA-440,HB,C
VOLATILE ORGANICS				
Acetone MW: 58.08 MP: -95 C BP: 56.2 C VP: 89mm @ 5 C Sol: Miscible (100%) d20/4: 0.79	$H_3C-\overset{O}{\overset{\|}{C}}-CH_3$ $CO(CH_3)_2$	Volatile, highly flammable, clear, colorless liquid, char. odor, pungent, sweet, fruity taste. Miscible with H2O, alcohol, benzene, chloroform, ether, most oils.	-0.24	N/A
Benzene MW: 78.11 MP: 5.5 C BP: 80.1 C VP: 75 mm at 20 C Sol: 1780 ppm d20/4: 0.88	 C_6H_6	Clear, colorless, highly flammable liquid. Miscible with alcohol, chloroform, ether, carbon disulfide, carbon tetrachloride, glacial acetic acid, acetone and oils. Characteristic odor.	2.13 ——— 2.12	Atmosphere volatilization half life = 4.8 hours. oxidation half life = 3 hours - 2 days, depending upon proportion of direct attack by hydroxyl radicals and direct photo-oxidation. Volatilization is the ultimate transport mechanism from the aquatic environment, whereupon oxidation becomes the primary atmospheric fate process. Although biodegradation has been shown to occur, it is much slower than oxidation and is therefore relatively unimportant.
Carbon Disulfide MW: 76.13 MP: -111.5 C BP: 46.2 C VP: 260 mm at 20 C Sol: 2300 mg/l @ 22 C d20/4: 1.26	$S=C=S$ CS_2	Colorless to faintly yellow. Highly refractive, mobile, v. flammable, liquid. Poisonous. Reagent grade foul smelling. Azeotrope with water up 97.8%, contains 97.2% CS_2. Miscible with ethanol, ether, benzene, chloroform, carbon tetrachloride, oils.	1.94, 2.18 ——— 2.00	Volatilization is presumed to be the most important fate process. Once compound enters the atmosphere high temperatures and UV radiation promote rapid degradation. Has a low potential for sorption onto soils/sediments and/or suspended particles.
Chlorobenzene MW: 112.56 MP: -45.6 C BP: 132 C VP: 8.8 mm at 20 C Sol: 500 mg/l @ 20 C d20/4: 1.10	 C_6H_5Cl	Colorless, very refractive liquid, faint, most unpleasant odor. Freely soluble in alcohol, benzene, chloroform, ether.	2.84	Volatilization half life - 9 hours (estimated). Oxidation half life - 8.7 hours (estimated). High affinity for lipophilic materials.

For explanation of terms, abbreviations and references, see Table 5-5.

TABLE 5-2 (Cont'd)

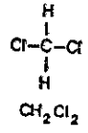
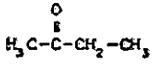
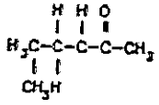
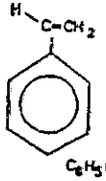
Physiochemical Properties, Structural Formulation and Transport Properties for Detected Volatile Organics

Sheridan Disposal Services Site

CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Log Kow	RATE AND PERSISTENCE
References: CRC,V,SPH	CRC,V,EPA-440	H,R,CRC,EPA-440	V,W	V,EPA-440,MB,C
1,2 Dichloroethane MW: 98.96 MP: -97 C BP: 57.3 C VP: 61 mm at 20 C Sol: 8,690 mg/l @ 20 C d20/4 : 1.78	 $C_2H_4Cl_2$	Heavy liquid, burns with smoky flame; pleasant odor, sweet taste, soluble in water. Miscible with alcohol, chloroform and ether.	1.79 ——— 1.48	Volatilization half life = 20 to 30 minutes. Oxidation half life = 1.5 months. Photo-oxidation in the troposphere is the predominant fate.
1,1-Dichloroethylene MW: 96.94 MP: -122.1 C BP: 37 C VP: 500 mm at 20 C Sol: 22,500 mg/l d20/4 : 1.22	 $C_2H_2Cl_2$	Liquid, mild sweet odor resembling that of chloroform. Practically insoluble in water. Soluble in organic solvents. Uncontrolled polymerization may lead to explosive reaction products with oxygen or ozone. At temperatures above 0 C and especially in presence of oxygen or other suitable catalysts polymerizes to a plastic.	1.48 ——— 1.84	Volatilization half life = 22 to 27 minutes. Oxidation half-life = 6.5 to 8 hours. Photo-oxidation in the troposphere is the predominant fate. Volatilization is the primary transport and process.
Ethyl Benzene MW: 106.17 MP: -95 C BP: 136.2 C VP: 7 mm at 20 C Sol: 152 mg/l @ 20 C d20/4 : 0.87	 $C_6H_5C_2H_5$	Colorless liquid, aromatic odor. Miscible in alcohol and ether; insoluble in NH_3; soluble in SO_2. May react vigorously with oxidizers. Dangerous when exposed to heat or flame. Practically insoluble in water.	3.15	Volatilization half life = 3 - 6 hours. Oxidation half life (atmosphere) = 15 hours. Primary transport pathway out of the aquatic environment is volatilization into the atmosphere. Then oxidation becomes the primary fate process. Other processes (i.e., biotransformation) have not been assessed. Estimated lifetime under photochemical smog conditions: 4.6 hours.
2-Hexanone MW: 100.18 MP: -57 C BP: 128 C VP: 2 mm at 20 C Sol: 35,000 mg/l @ 20 C d20/4 : 0.81	 $C_6H_{12}O$	Colorless liquid. Soluble in alcohol, ether and acetone.	1.38	N/A

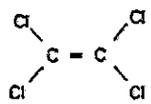
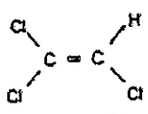
For explanation of terms, abbreviations and references, see Table 5-3.

TABLE 5-2 (Cont'd.)
Physicochemical Properties, Structural Formulation and Transport Properties for Detected Volatile Organics
Sheridan Disposal Services Site

CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Log Kow	FATE AND PERSISTENCE
References: CRC,V,SPH	CRC,V,EPA-440	M,R,CRC,EPA-440	V,W	V,EPA 440,MB,C
Methylene Chloride (Dichloromethane) MW: 84.93 MP: -95.1 C BP: 40 C VP: 362.4 mm at 20 C Sol: 20,000 mg/L @ 20 C d20/4 : 1.33	 CH_2Cl_2	Colorless, liquid; vapor is not flammable and when mixed with air is not explosive. Miscible with alcohol and ether.	1.25 ——— 1.3	Volatilization half life = 30 minutes. Oxidation half life = 0.3 years. Same processes and fate as ethylbenzene with different half life data. Oxidation with water is not important.
Methyl ethyl ketone (2-butanone) MW: 72.11 MP: -86.3 C BP: 79.6 C VP: 77.7 mm at 20 C Sol: 353,000 mg/L @ 10 C d20/4 : 0.80		Flammable liquid, acetone-like odor. Miscible with alcohol, ether, benzene.	0.28	Biodegradation is the most important fate process. It is expected to volatilize rapidly, except in aquatic systems or wet soil, where volatilization is limited by the high solubility of the compound.
4-Methyl-2 pentanone (methyl isobutyl ketone) MW: 100.16 MP: -84.7 C BP: 116.8 C VP: 16 mm at 20 C; 10 mm @ 30 C Sol: 17,000 mg/L @ 20 C d20/4 : 0.80	 $(CH_3)_2CHCH_2CO\ CH_3$	Colorless liquid, characteristic sweet, sharp odor. Faint, ketonic and camphor odor. Miscible with alcohol, benzene, ether.	NA	Estimated lifetime under photo-chemical smog conditions - 2.4 hours.
Styrene (ethyl benzene) MW: 104.14 MP: -30.6 C BP: 145.2 C VP: 5 mm @ 20 C Sol: 300 mg/L @ 20 C d20/4: 0.91 Sp.gr: 0.9045 @ 24/25 C	 $C_6H_5CHCH_2$	Colorless to yellow, very reactive, oily liquid. Penetrating odor. Miscible in alcohol and ether, slightly stable in water. Dangerous when exposed to flame, heat or oxidants. Can emit acid fumes with any of the above reactions. Upon exposure to sunlight, it polymerizes and forms peroxides. Soluble in acetone, benzene and petroleum ether.	NA	On exposure to light and air slowly undergoes polymerization and oxidation with formation of peroxides, etc. Appears to be readily oxidized in water.

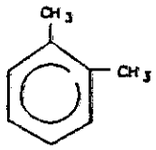
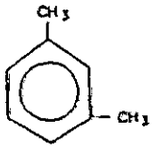
For explanation of terms, abbreviations and references, see Table 5-5.

TABLE 5-2 (Cont'd.)
Physiochemical Properties, Structural Formulation and Transport Properties for Detected Volatile Organics
Sheridan Disposal Services Site

CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Log Kow	FATE AND PERSISTENCE
References: CRC,V,SPH	CRC,V,EPA-440	M,R,CRC,EPA-440	V,W	V,EPA-440,HB,C
Tetrachloroethylene MW: 165.85 MP: -19 C BP: 121.4 C VP: 14 mm @ 20 C Sol: 150 mg/l @ 20 C d20/4 : 1.62	 C_2Cl_4	Odorless non-flammable liquid, ethereal or chloroform-like odor. When heated to decomposition, it emits highly toxic fumes (chlorides). Miscible in alcohol, ether, chloroform, benzene. Slightly soluble in water.	2.88 ——— 2.8	Volatilization half life = 20-30 minutes. Oxidation half life = 10 days. Primary transport process is volatilization into atmosphere, where primary fate process is oxidation. Some metabolic products in higher organisms appear to be biodegraded by microbial pathways.
Toluene MW: 92.14 MP: -95 C BP: 110.8 C VP: 28.7 mm @ 25 C Sol: 515 mg/l @ 20 C d20/4: 0.87	 $C_6H_5CH_3$	Flammable, colorless, refractive liquid with benzene-like aroma. Slightly soluble in water. Miscible with alcohol, ether, chloroform, acetone, glacial acetic acid and carbon disulfide.	2.69 ——— 2.73	Volatilization half life = 5.2 hours. Oxidation half life = 15 hours. Same processes and pathways as for ethylbenzene, with slightly different half life values. Estimated lifetime under photochemical smog conditions - 5.8 hours. Primary transport pathway out of the aquatic environment is volatilization into the atmosphere.
Trichloroethylene MW: 131.38 MP: -73 C BP: 86.7 C VP: 57.9 mm @ 25 C Sol: 1,100 mg/l @ 25 C d20/4 : 1.46	 $CCl_2{=}CHCl$	Nonflammable, mobile liquid with the characteristic odor of chloroform. When heated to decomposition, it emits toxic Cl-fumes. Can react violently with Al, Ba, N2O4, Li, Mg, liquid O2, O3, KOH, KNO3, Na NaOH, and Tl. Practically insoluble in water. Miscible with ether, alcohol, and chloroform. Dissolves most fixed and volatile oils.	2.29 ——— 2.38	Aquatic fate of trichloroethylene is same process as 1,1,1-trichloroethane, but with shorter half lives. Volatilization half life = 20 minutes. Oxidation (in atmosphere) half life = 4 days. Some metabolic products of TCE in higher organisms appear to be biodegraded by microbial pathways. Slowly decomposes (with formation of HCl) by light in the presence of moisture.
Xylene(s) MW: 106.17 MP: -47-14 C BP: 137-144 C Sol: Insoluble in water.	$C_6H_4CH_3CH_3$	Mobile, flammable liquid made up of three isomers (o, m and p). Insoluble in water. Miscible with alcohol, ether, and some organic solvents. Incompatible with oxidizing materials.	3.26	Xylenes have a demonstrated biodegradation rate of 100% removed in 192 hours in a mixed hydrocarbon matrix at 100 ml/l initial concentration. Persistent in ground water and buried soils.

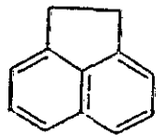
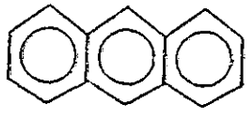
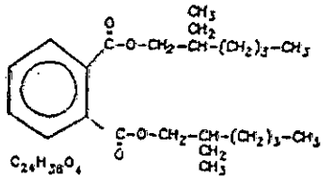
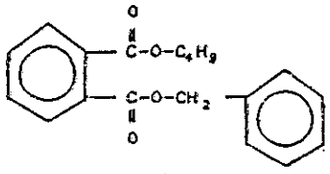
For explanation of terms, abbreviations and references, see Table 5-6.

TABLE 5-2 (Cont'd.)
Physicochemical Properties, Structural Formulation and Transport Properties for Detected Volatile Organics
Sheridan Disposal Services Site

CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Log Kow	FATE AND PERSISTENCE
References: CIC,V,SPH	CRC,V,EPA-440	M,R,CRC,EPA-440	V,W	V,EPA-440,HB,C
o-Xylene MP: -25 C BP: 144.4 C VP: 5 mm @ 20 C Sol: 175 mg/l @ 20 C d20/4 : 0.88		Clear liquid. Considered insoluble with water. Miscible with alcohol and ether. Sweet characteristic odor.	2.77	o-Xylene has a reported disappearance time of 2.8 hours in photo-chemical smog conditions. Persistent in ground water and buried soils.
m-Xylene MP: -48 C BP: 139 C VP: 6 mm @ 20 C Sol: 185 mg/l @ 20 C d20/4 : 0.88		Clear, odorless liquid. Considered insoluble with water. Miscible with alcohol and ether.	3.20	m-Xylene has a reported disappearance time of 1.5 hours in photo-chemical smog conditions. Persistent in ground water and buried soils.
p-Xylene MP: 13.3 C BP: 138.4 C VP: 6.55 mm @ 20 C Sol: 188 mg/l @ 25 C d20/4 : 0.86		Clear liquid. Colorless plates or prisms at low temperature. Considered insoluble in water. Soluble in alcohol, ether and many other organic solvents.	3.15	p-Xylene has a reported disappearance time of 2.4 hours in photo-chemical smog conditions. Persistent in ground water and buried soils.

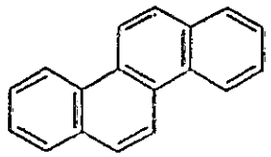
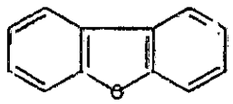
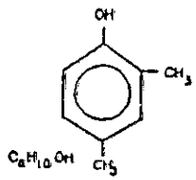
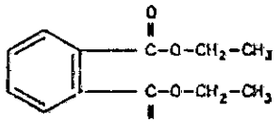
For explanation of terms, abbreviations and references, see Table 5-5.

TABLE 5-3
Physiochemical Properties, Structural Formulation and Transport Properties for Detected Base/Neutral/Acid Organics
Sheridan Disposal Services Site

CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Log Kow	FATE AND PERSISTENCE
References: CRC, V, EPA-440, B	V, EPA-440	CRC, M V,W,MR,	EPA-440 / SPR	V, EPA-440, MR
BASE NEUTRAL & ACID EXTRACTABLE COMPOUNDS (SEMI-VOLATILE)				
Acenaphthene MW: 154.21 MP: 96.2 C BP: 279 C VP: 10E-03 to 10E-02 mm @ 20 C Sol: 3.42 mg/l at 25 C d80/4: 1.02	 $C_{12}H_{10}$	Insoluble in water. One gram dissolves in 31 ml alcohol, 58 ml methanol, 25 ml propanol, 2.5 ml chloroform, 5 ml benzene or toluene. 3.2 grams are soluble in 100 ml glacial acetic acid. Forms water soluble, crystal complexes with desoxycholic acid. Will crystallize if concentrated solutions of the proper amount of the compounds in alcohol or dioxane are allowed to cool slowly.	4.33 4.00	Oxidation not a significant process. Volatilization is not as important as absorption as a transport process. Biodegradation is considered the ultimate fate process. Movement via sediment is considered an important transport process.
Anthracene MW: 178.23 MP: 216 C BP: 340 C VP: 1.85E-04 mm @ 20 C Sol: 0.05 - 0.07 mg/l at 25 C d27: 1.25 d25/4: 1.283	 $C_{14}H_{10}$	Monoclinic plates (from alcohol) colorless with purple fluorescence (when pure) or yellow with green fluorescence (when contaminated with tetracene/naphthacene). Emits acrid fumes when heated to decomposition. Forms molecular addition products with nitro compounds. Soluble in alcohol, methanol, benzene, chloroform, ether, carbon disulfide, carbon tetrachloride and toluene.	5.3 4.45	Although various processes play a role in the fate of anthracene, biodegradation is probably most important. Biodegradation half life = >11.3 hours. Under ideal conditions and high dissolved concentration photolysis is also relevant, with a reported half life of 35 minutes. Darkens in sunlight.
Bis-(2-ethylhexyl)phthalate MW: 390.62 MP: -50 C BP: 386.8 C VP: 1.2 mm @ 20 C Sol: 0.4 mg/l at 25 C d: NA	 $C_{24}H_{38}O_4$	Light colored, oily liquid (frequently used in vacuum pumps). Emits acrid odor when heated to decomposition.	6.3	Biodegradation half life = 4 weeks. Sorption is considered the primary transport process, while bioaccumulation and biodegradation are ultimate fate processes in protists and multicellular organisms.
Butylbenzyl phthalate MW: 312.4 MP: <-35 C BP: 370 C at 760 mm VP: 8.6E-08 mm @ 20 C Sol: 2.8 + 1.2 mg/l (in defonized H2O) d25/25: 1.1	 $C_{19}H_{20}O_4$	Clear, oily liquid.	5.8 - 4.8	Mineralization under aerobic conditions to CO2, under anaerobic conditions to H2, CH4 and CO2. Sorption onto suspended particulates and biota, and complexation with humic substances are probably the most important transport mechanisms. Bioaccumulation and biodegradation are considered important fate processes.

For explanation of terms and abbreviations, see Table 5-5.

TABLE 5-3 [Cont'd.]
Physiochemical Properties, Structural Formulation and Transport Properties for Detected Base/Neutral/Acid Organics
Sheridan Disposal Services Site

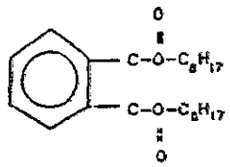
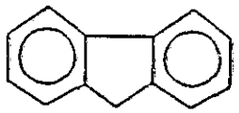
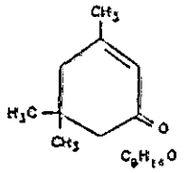
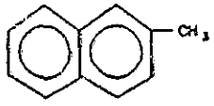
CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Log Kow	FATE AND PERSISTENCE
References: CRC, V, EPA-440, W	V, EPA-440	CRC, M V,W,MR, EPA-440		V, EPA-440, MR
Chrysene MW: 228.29 MP: 255-258 C BP: 448 C VP: N/A Sol: 0.006 mg/l @ 25 C d25/25: 1.27	 $C_{18}H_{12}$	Sublimes easily in vacuum. Slightly soluble in [increasing with temperature], alcohol, ether, CS_2, glacial acetic acid. Moderately soluble in benzene. Insoluble in water.	5.61	N/A
Dibenzofuran MW: 168.19 MP: 86-87 C BP: 287 C VP: NA Sol: NA d99/4: 1.09	 $C_{12}H_8O$	Soluble in alcohol, ether, acetone and acetic acid.	4.12	N/A
2,4-Dimethyl phenol [Xylenol] MW: 122.17 MP: 27-28 C BP: 210 C VP: 0.082 mm @ 20 C Sol: 17,000 mg/l @ 160 C d20/4: 0.9650	 $C_8H_{10}OH$	White, needle-like crystals. When heated to decomposition, emits acrid smoke and fumes. Slightly soluble in water, freely soluble in alcohol, ether, chloroform, benzene, NaOH solution.	2.50	No half life data available. Photo-oxidation in aerated surface waters appear to be a primary fate process, with metal-catalyzed oxidation occurring locally. Data for biodegradation are inconclusive.
Diethyl phthalate MW: 222.22 MP: -40.5 C BP: 298 C VP: 14 mm @ 193 C/ 3.5E-03 mm Sol: 1,000 mg/l @ 20 C; 210 mg/l; 898 mg/l d20: 1.11 Sp.Gr.: 1.120 @ 25/25 C	 $C_{12}H_{14}O_4$	Water-white, stable, odorless liquid.	3.22 2.50	Sorption onto suspended particulates and biota, and complexation with humic substances are probably the most important transport mechanisms. Bioaccumulation and biodegradation are considered important fate processes.

For explanation of terms and abbreviations, see Table 5-5.

TABLE 5-3 (Cont'd.)

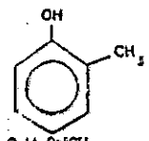
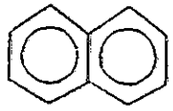
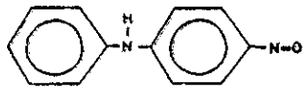
Physiochemical Properties, Structural Formulation and Transport Properties for Detected Base/Neutral/Acid Organics

Sheridan Disposal Services Site

CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Log Kow	FATE AND PERSISTENCE
References: CRC, V, EPA-440, B	V, EPA-440	CRC, M V,W,MR, EPA-440		V, EPA-440, MR
Di-n-octyl phthalate MW: 38 MP: -25 C BP: 220 C VP: <0.2 mm Sol: 3 mg/l @ 25 C d20: 1.51	 $C_{24}H_{38}O_4$	N/A	8.2	Sorption of phthalate esters to organic particulates should increase with chain length. Can form soluble complexes (fulvic acid) in humic soils and water, which increases their mobility. Bioaccumulation is also an important process although there is insufficient data to predict a predominant fate process.
Fluorene MW: 166.22 MP: 116-117 C BP: 293-295 C VP: 10E-03 to 10E-02 mm @ 20 C Sol: 1.9 mg/l @ 25 C d0/4: 1.2	 $C_{13}H_{10}$	Sparkling white leaflets or flakes (from alcohol). Freely soluble in glacial acetic acid, soluble in carbon disulfide, ether, benzene, hot alcohol. Sublimes in high vacuum.	4.18	No half life data available. As with other PAH's (3 rings or fewer), adsorption and biodegradation are primary fate process.
Isophorone MW: 138.21 MP: -8 C BP: 214 C VP: 0.28 mm @ 20 C Sol: 12,000 mg/l d20: 0.92	 $C_9H_{14}O$	Liquid. Characteristic sharp, peppermint-like odor. Soluble in alcohol, ether and acetone.	1.7	No half life data is available. It appears that isophorone's high solubility provides metabolic pathways in appreciable quantity. Volatilization is doubtful due to high solubility.
2-Methylnaphthalene MW: 142.20 MP: 34.6 C BP: 241 C VP: NA Sol: Insoluble in water d20/4: 1.006	 $C_{10}H_7CH_3$	Solid, naturally found in coal tar pitch fumes. Soluble in alcohol, ether and benzene.	N/A	Longer half life in tissues than naphthalene. Volatilization is the major transport mechanism in the environment.

For explanation of terms and abbreviations, see Table 5-5.

TABLE 5-3 (Cont'd.)
Physiochemical Properties, Structural Formulation and Transport Properties for Detected Base/Neutral/Acid Organics
Sheridan Disposal Services Site

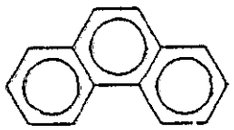
CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Log Kow	FATE AND PERSISTENCE
References: CRC, V, EPA-440, B	V, EPA-440	CRC, M	V,W,HR, EPA-440	V, EPA-440, HR
2-Methyl Phenol MW: 108.14 MP: 30.9 C BP: 191 C VP: 0.24 mm @ 25 C Sol: 31,000 mg/L @ 40 C d20/4: 1.03	 $C_6H_4OHCH_3$	Crystals or yellowish liquid, becoming dark with age and exposure to air and light; phenolic odor. Soluble in about 40 parts water, and in solutions of the fixed alkali hydroxides; miscible with alcohol, chloroform and ether. Obtained from coal tar.	1.97	An aqueous solution is destroyed by photo-oxidation using visible light as a direct energy source and methylene blue as a dye-sensitizer. Biodegradation: decomposition period by soil microflora: one day.
4-Methyl Phenol MW: 108.14 MP: 34.8 C BP: 201.9 C VP: 0.04 mm @ 20 C Sol: 24,000 mg/L @ 40 C d20/4: 1.02	 $C_6H_4OHCH_3$	Crystals or yellowish liquid. Phenolic odor. Obtained from coal tar. Soluble in aqueous solutions of alkali hydroxides; and in common organic solvents.	1.82	Biodegradation: decomposition period by a soil microflora: one day.
Naphthalene MW: 128.17 MP: 80.5 C BP: 218 C VP: .0462 mm @ 20 C Sol: 30-40 mg/L @ 25 C d100/4: 0.88	 $C_{10}H_8$	White, crystalline solid (pure) with other grades ranging in color from tan to brown. Soluble in ether, hydronaphthalenes, fixed oils, volatile oils, alcohol, benzene, chloroform, etc. Volatilizes at room temperature. Odor of moth balls. Sublimes at temperatures above MP.	3.01-3.45	Most easily biodegraded PAH. Half life of approximately one day; attributed to combination of adsorbtion and microbial degradation in an aquatic system.
N-Nitrosodiphenylamine MW: 198.22 MP: 143 C BP: 152 C VP: NA Sol: Insoluble in water.	 $C_{12}H_{10}N_2O$	Green plates with bluish luster (from benzene) or steel blue plates/prisms (from ether and water). Slightly soluble in water and petroleum ether. Freely soluble in alcohol, ether, chloroform, benzene and forms a red colored mixture with H_2SO_4.	2.57	No half life data available. Photolysis sorption and biodegradation might be important, but data to support these conclusions are not available.

For explanation of terms and abbreviations, see Table 5-6.

TABLE 5-3 (Cont'd.)

Physicochemical Properties, Structural Formulation and Transport Properties for Detected Base/Neutral/Acid Organics

Sheridan Disposal Services Site

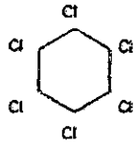
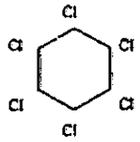
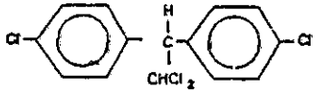
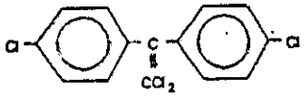
CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Log Kow	FATE AND PERSISTENCE
References: CRC, V, EPA-440, B	V, EPA-440	CRC, M V,W,MR, EPA-440		V, EPA-440, MR
Phenanthrene MW: 178.23 MP: 101 C BP: 340 C VP: 6.8E-04 mm @ 20 C Sol: 1.0 - 1.3 mg/l @ 25 C d4: 0.98	 $C_{14}H_{10}$	Monoclinic plates (from alcohol). Insoluble in water, soluble in organic solvents, especially aromatic hydrocarbons. Sublimes in a high vacuum. Isomeric with anthracene. Soluble in glacial acetic acid. Solutions exhibit a blue fluorescence.	4.46	No half life data available. As with other PAH's (3 rings or fewer), adsorption and biodegradation are primary fate processes.
Phenol MW: 94.11 MP: 43 C BP: 181.78 C VP: 1 mm @ 40 C Sol: 82,000 mg/l @ 15 C d20/4: 1.06	 C_6H_5OH	Colorless, acicular crystals, or white crystalline mass with distinctive odor. Tends to redden upon exposure to air and light. Very soluble in alcohol, chloroform, ether, glycerol, carbon disulfide, petroleum volatile and fixed oils, aqueous alkali hydroxides. Poisonous and caustic. Liquified by mixing with 8% water.	1.46	No half life data available. Biodegradation by microorganisms and metal-catalyzed oxidation appear to be primary fate processes. Biodegradation decomposition rate in soil suspensions two days for complete disappearance and decomposition period by soil microflora in one day.

For explanation of terms and abbreviations, see Table 5-5.

TABLE 5-4

Physiochemical Properties, Structural Formulation and Transport Properties for Detected Pesticides and PCBs

Sheridan Disposal Services Site

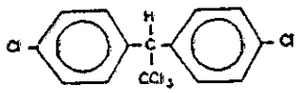
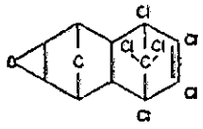
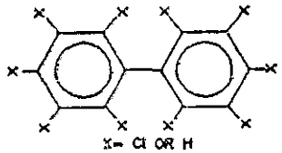
CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Log Kow	FATE AND PERSISTENCE
References: EPA-440,CRC,V,M,EPA-600	V,EPA-440	M,CRC,EPA-600,EPA-440	W,EPA-?00 SPH	EPA-440,V,[illegible]
PESTICIDES				
alpha-BHC MW: 290.83 MP: 159-160 C BP: 288 C VP: 2.5 E-05 mm at 20 C Sol: 1.4 mg/l [in salt water]	 $C_6H_6Cl_6$	Soluble in alcohol, benzene and chloroform. Monoclinic prisms.	3.81 — 3.80	Oxidation and Volatilization are not important process. Sorption is important transport in anaerobic sediments.
gamma-BHC MW: 290.83 MP: 112-113 C BP: 323.4 C VP: 8.4 E-06 mm at 20 C Sol: 17.0 mg/l at 24 C [99% purity]	 $C_6H_6Cl_6$	Soluble in ether, acetone and benzene. Crystals, slight musty odor. Insoluble in water.	4.14 — 3.80	Photo-oxidation by UV light occurs in an aqueous medium at 90-95 C. Will persist in soils 3 to 10 years. Half life in water at 25 C and 1m depth is 4580 hrs. Undergoes anaerobic degradation by microorganisms.
Dichlorodiphenyldichloroethane [4,4-DDD] MW: 320.10 MP: 109-112 C BP: NA VP: 10.2 E-07 mm at 30 C Sol: 0.16 mg/l at 24 C [99% purity] soluble in acetone [Note: Technical 4,4-DDD contains small amounts of the 2,4-DDD isomer]	 $C_{14}H_{10}Cl_4$	Chemical properties similar to 4,4-DDT. Volatilization from water is approximately one-third that of DDT.	5.99 — 6.20	Degradation product of 4,4-DDT. Bioaccumulation of DDD is an important fate process.
Dichlorodiphenyldichloroethylene [4,4-DDE] MW: 318 MP: 88-90 C BP: NA VP: 6.5 E-06 mm at 20 C Sol: 0.04 mg/l at 20 C	 $C_{14}H_8Cl_4$	Volatilization from water may be as much as five times faster than DDT.	4.28, 5.69 — 7.00	Fate and persistence is very similar to DDT [DDE is a degradation product of DDT]. Soil sorption and bioaccumulation are important processes. Low mobility in soils, sediment transport would be an important pathway.

For explanation of terms and abbreviations, see Table 5-5.

TABLE 5-4 (Cont'd.)

Physicochemical Properties, Structural Formulation and Transport Properties for Detected Pesticides and PCBs

Sheridan Disposal Services Site

CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Log Kow	FATE AND PERSISTENCE
References: EPA-440,CRC,V,M,EPA-600	V,EPA-440	M,CRC,EPA-600,EPA-440	W,EPA-600	EPA-440,V,F
			SPH	
Dichlorodiphenyltrichloroethane (4,4-DDT) MW: 354.48 MP: 108-109 C BP: 260 C VP: 1.9 E-07 mm at 20 C Sol: 0.0031-0.0034 mg/l at 25 C (Note: Technical DDT contains up to 30% of the 2,4-DDT isomer)	 $C_{14}H_9Cl_5$	Biaxial elongated tablets. Practically insoluble in water and dilute acids and alkalines. Soluble in various organic solvents (increasing with temperature).	6.18 (at 20 C)	Dominant fate processes are volatilization and sorption to biota and sediments. Bioaccumulation and biotransformation are also important processes. Indirect photo lysis may also be an important loss process for DDT.
Dieldrin MW: 380.91 MP: 175-176 C BP: NA VP: 1.76 E-07 to 2.8 E-06 mm at 20 C Sol: 0.1 - 0.2 mg/l dt: 1.75	 $C_{12}H_8OCl_6$	Practically insoluble in water, moderately soluble in organic solvents and methanol. Attacked by strong mineral acids.	3.5	Sorption to sediment, bioaccumulation and volatilization are important fate processes. One of the least biodegradable chlorinated pesticides.
Polychlorinated biphenyls (PCBs)	 X= Cl OR H $C_{12}H_xCl_{10-x}$	These compounds range from oily liquids to white crystals and hard transparent resins. All have low water solubility, low vapor pressures and high dielectric constants.	2.8 to 7.14.	Adsorption, volatilization and bioaccumulation are major distribution and fate processes. The tendency for adsorption increases with the degree of chlorination and with % organic carbon of the adsorbent. The lighter (less chlorinated) species are more likely to volatilize and the heavier species are more likely to be incorporated into soils and biota.
Aroclor 1016 MW: 257.0 Distillation Range = 323-356 C VP: E-04 mm at 25C Sol: 0.42 mg/l dt: 1.18	16% Cl by Weight	Clear, mobile oil. Replaced 1242 as environmentally more compatible.	4.38	

For explanation of terms and abbreviations, see Table 5-5.

TABLE 6-4 (Cont'd.)
Physiochemical Properties, Structural Formulation and Transport Properties for Detected Pesticides and PCBs
Sheridan Disposal Services Site

CHEMICAL CHARACTERISTICS INFORMATION	STRUCTURAL FORMULA	PHYSICAL PROPERTIES	Log Kow	FATE AND PERSISTENCE
References: EPA-440,CRC,V,M,EPA-600	V,EPA-440	M,CRC,EPA-600,EPA-440	W,EPA-600	EPA-440,V,F
			SPH	
Aroclor 1232				
MW: 232.2 Distillation Range: 290-326 C VP: 4.06 E-03 mm at 25 C Sol: 1.45 mg/l d: 1.27	32% Cl by Weight	Clear oil.	4.54, 3.2	
Aroclor 1242				
MW: 268.5 Distillation Range = 325-366 C VP: 4.06 E-04 mm at 25 C Sol: 0.24 mg/l d: 1.38	42% Cl by Weight	Clear, mobile liquid. Average number of chloride atoms per molecule is 3.1.	5.68, 4.11	
Aroclor 1260				
MW: 377.5 Distillation Range = 385-420 C VP: 4.05 E-05 mm at 25 C Sol: 0.0027 mg/l d: 1.62	60% Cl by Weight	Soft, sticky, light yellow resin. Average number of chloride atoms per molecule is 6.3.	7.15, 7.14	

For explanation of terms and abbreviations, see Table 5-5.

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TABLE 5-5

Explanation of Terms and Abbreviations for Section 5

ABBREVIATIONS FOR REFERENCES

(A) = Adriano D C 1986 Trace Elements in the Terrestial Environment Springer-Verlag, New York, Inc

(B) = Brown, K W Evans, G B. and Frentrup, B. D. (eds.), 1983 Hazardous Waste Land Treatment. Butterworth Publishers, Woburn, MA

(C) = Callahan, M A et al. 1979 In, Water-Related Environmental Fate of 129 Priority Pollutants. EPA-440/4-79-029a,b.

(CRC) = Weast, R. C (ed.), 1987-1988 CRC Handbook of Chemistry and Physics 68th Ed., CRC Press, Inc., Boca Raton FL

(EPA-440) = EPA, 1979 Water Related Fate of 129 Priority Pollutants. Vols. I and [illegible] EPA-440/4-79-029b. Washington, D C

(EPA-600) = EPA, 1986 Development of Advisory Levels for Polychlorinated Biphenyls (PCBs) Cleanup. EPA/600/6-86/002. Washington D C

(F) = Faust, S D 1972 Fate of Organic Pesticides in the Aquatic Environment. American Chemical Society, Washington, D C

(M) = Windholz, M Budavari, S : Blumetti, R. F. and Otterbein, E. S (eds.) 198[illegible] The Merck Index, 10th Ed., Merck & Co Inc., Rathway N J

(MB) = Mabey W R et al. 1982. Aquatic Fate Process Data for Organic Priority Pollutants US EPA-440/4-81-014

(MR) = Moore J.W and S Ramamoorthy. 1984. Organic Chemicals in Natural Water Applied Monitoring and Impact Assessment. Springer-Verlag, N Y 289 pp.

(P) = Pimentel, David (ed). 1981. CRC Handbook of Pest Management in Agriculture Vol III. CRC Pres. Inc. Boca Raton, Florida 656 pp.

(SPH) = EPA, 1986 Superfund Public Health Evaluation Manual OSWER Directive 9285 4-1 Appendices A&B.

(T) = Klassen, C D Amdur, M. O. and Doull, J (eds.), 1986 Casarett and Doull's Toxicology The Basic Science of Poisons, 3rd Ed. Macmillan Publishing Co. New York NY

(V) = Verschuren K 1983 Handbook of Environmental Data on Organic Chemicals. Second Edition. Van Nostrand Reinhold Company, New York

(W) = Walton, W C 1985 Practical Aspects of Ground Water Modeling

ABBREVIATIONS FOR CHEMICAL & PHYSICAL PROPERTIES

AW = Atomic Weight

MW = Molecular Weight

BP = Boiling Point

MP = Melting Point

VP = Vapor Pressure in mm Hg at STP unless otherwise noted

d = Density Specific gravity (d 20/4 Specific gravity at 20 C referred to water at 4 C)

Sol = Solubility in water (g/100g water or % on a weight/weight basis) at 20 C unless otherwise noted

Kow = Log of the octanol/water partition coefficient, inversely related to mobility in water

Kd = Dispersivity coefficient (mg/l), used for metals, is similar to Kow values for organics For organics, calculated as Kd = 6.3 E-01 * foc * Kow, where foc = fraction of organic carbon (g carbon/g dry soil). For metals, data from Walton, 1985

Sp Gr = Specific Gravity

Units

kg = kilogram	ppm = parts per million
mg = milligram	ppb = parts per billion
ug = microgram	min = minute
ng = nanogram	h = hour
l = liter	d = day
m3 = cubic meter	m = month
NA = Not Available	

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6 - TOXICOLOGICAL PROPERTIES

The information on toxicological properties discussed below is summarized in Tables 6-1 through 6-4 for each constituent detected at the SDS Site and listed in Tables 5-1 through 5-4. Table 6-1 provides toxicological and exposure data for metals, Table 6-2 for volatile organics, and Table 6-3 for base/neutral/acid (semi-volatile) extractable organics. Table 6-4 provides data for pesticides and PCBs. Table 6-5 summarizes and defines symbols and abbreviations used in the tables in this section. The data were used along with other information provided in EPA's Superfund Public Health Assessment Manual (October 1986) to select the indicator chemicals as described in Section 7. The following sections provide a greater understanding of the terminology presented in the tables. A formal glossary of terms used in the text and tables of this section are presented in Appendix D. All tables in this section may be found at the end of the section. A reference page precedes the tables (Page 6-5).

6.1 Metabolism

Metabolism is defined as both 1) the sum of the processes by which a particular substance is handled in the living body, and 2) the chemical processes in living cells by which energy is provided for vital processes and activities and new material is assimilated to repair the waste products of these activities. In short, it is the process by which one form of energy (e.g., food) is metabolized (changed) to another (e.g., ATP to "power" muscle contractions).

The metabolic process to which a given compound is subjected within a given organism influences that compound's toxicological properties. For instance, while certain microbes are perfectly capable of degrading phenol and deriving all of their energy from this compound, phenol can be very toxic in high concentrations to humans and higher animals because the only mechanism of "detoxification" is removal through excretion. The chemical systems responsible for energy production and transport in microbial systems are frequently completely different than equivalent systems in multicellular organisms.

6.2 Acute Toxicity

Acute toxicity is the term applied to conditions or complications which arise immediately after exposure to a hazard. Examples are the formation of blisters and lesions on skin that has been exposed to strong acids or caustic compounds. The anesthetic effect of chloroform is an example of an acute property. Any reaction to a material or situation that is immediate or occurs

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within hours or days of an exposure which is limited to less than 24 hours is considered an acute response to an acute exposure stimulus.

Acute toxicity usually implies that the exposure to a given compound was in the form of a single, often massive dose although a series of doses are sometimes given within a 24-hour period for compounds which are only slightly toxic (Casarrett and Doull, 3rd Edition 1986). Data from "acute tests" generally informs the reader of the ability of a limited dose and limited exposure of a compound to negatively impact a test population.

6.3 Subchronic and Subacute Toxicity

As the term implies, subchronic toxicity concerns the effects of a compound on an organism in doses or time frames not immediately dangerous to life and health. Generally, data from the acute tests are used to derive dose estimates for chronic tests. Some of the experimental doses will still be above chronic tolerance levels, thereby resulting in premature death of test populations. Analysis of the organisms post-mortem allows early detection of target organs (i.e. those organs which tend to concentrate or suffer most from a specific compound) as well as establishment of early cumulative effects of a compound.

The term subacute is frequently used interchangeably with subchronic. Apart from the fractionally lower doses used in subchronic tests, there is always a control group in subchronic tests, insuring proper assessment of effects as treatment related. Subchronic tests are also classified as such because the time span of the experiment never exceeds the animals' normal life span.

6.4 Chronic Toxicity

The major difference between subchronic and chronic toxicity is the duration and concentration of exposure. Chronic toxicity usually refers to low levels of toxins that act over an entire lifetime, frequently causing complications other than death itself. Certain other tests, such as for carcinogenicity, etc. are chronic by definition, and are discussed in Section 6.5.

The abuse of alcohol over a lifetime is a classic example of an exposure with chronic complications. Hypertrophy of the liver and subsequent impairment of hepatic enzymes are well known symptoms of chronic alcoholism. Similarly, exposure to sublethal doses of a compound over a lifetime (ie. breathing of solvent fumes in the workplace) can have serious, albeit nonlethal or very slowly lethal, effects.

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6.5 Summary of Toxic Properties

As mentioned previously, tests for carcinogenicity and mutagenicity are, by definition, chronic tests. If a compound is to be classified as carcinogenic, it must be capable of causing cancer (i.e. producing a tumoregenic or "neoplastic" growth of tissue) prior to killing the host. Indeed, some compounds which have acute toxicities at high concentrations are carcinogenic at low concentrations (e.g. benzene, chloroform, lead, chromium, etc.). There are also some compounds whose carcinogenicity has not been successfully determined because they are so acutely toxic that a chronic exposure level has never been found.

If a compound alters heritable traits between generations - as opposed to causing tumors in the exposed organism - it is considered mutagenic. Carcinogenicity is experienced by the organism exposed, while mutagenicity is experienced by the progeny of the exposed organism. It should be noted here that it is possible for fetuses "in utero" to develop cancer due to transplacental migration of compounds encountered by the mother. This is carcinogenic behavior, not mutagenic.

Teratogenicity specifically addresses the ability of a compound to disrupt the normal processes of embryonic development. Absence of limbs or malformation of bodily parts are both examples of teratogenic activity, such as those caused by thalidomide.

In some cases, however, a compound will cause stillbirth or spontaneous abortion of the fetus. This is technically considered developmental toxicity, rather than teratogenicity, since the compound directly affected the viability of the fetus (acute or subacute), and did not simply deform it (chronic effect).

Other effects resulting from exposure to chemicals are also possible, including suppression of the immune system (causing susceptibility to other deleterious agents), allergic reactions (the reaction of most victims to the neurotoxin injected by formicine ants is an excellent example), neurotoxicity (interference of synaptic transmissions or destruction of nervous tissues directly), and selective toxicity to specific organs of a body system (generally in the liver, kidneys and lungs). These effects are listed in Tables 6-1 through 6-4 for each specific compound, and need not be detailed here.

6.6 Non-Human Effects and Environmental Impairment

While most standards are based upon protection of human health and life, the potential for impacting non-human target species and generally detrimental environmental effects also should be

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considered. The bioconcentration of certain heavy metals in grassland vegetation and subsequent ingestion by herbivores is an excellent example of the former. Formation of hydrocarbon slicks and foams in surface water impoundments, and subsequent contamination of both avian and piscine lifeforms is an example of the latter.

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REFERENCES FOR SECTION 6 TABLES

(CT): Water Quality Criteria for Specific Materials (Texas Proposed list for protection of aquatic species). Copy received from Region 6 EPA November 20, 1987.

(EPA-MCLs): Ratcliff, L. September 18, 1987. Risk-Specific Doses (RSDS), Reference Doses (RFDs) and Drinking Water Standards for Appendix IX Constituents. Health Assessment Section, Technical Branch, Characterization and Assessment Divisions, Office of Solid Waste U.S. EPA.

(EPA-440): EPA 440/S-80-67, October 1980. Ambient Water Quality Criteria for Phthalate Esters.

(EPA-540): EPA540/1-86/060, October 1986. Superfund Public Health Evaluation Manual. OSWR Direction 9285.4-1.

(L): Lederer, W., 1985. Regulatory Chemicals of Health and Environmental Concern, Van Nostrand - Reinhold Company Inc., New York, New York.

(K): EPA, (Draft). Ambient Aquatic Water Quality Criteria for Aluminum.

(Sax): Sax, N.I., 1984. Dangerous Properties of Industrial Chemicals, 6th ed. Van Nostrand Reinhold Co. 3124 pp.

(T): Klasssen, C.D., M.O. Amdur, and J. Doull (eds.), 1986. Casarett and Doull's Toxicology, Macmillan Publishing Company, New York. 974 pp.

(TLV): American Conference of Governmental Industrial Hygienists (ACGHI), 1987. Threshold Limit Values and Biological Exposure Indices for 1987-1988. Cincinnati, Ohio.

(V): Verschueren, K., 1983. Handbook of Environmental Data on Organic Chemicals, 2nd ed. Van Nostrand - Reinhold Company. New York. 1310 pp.

(W): Water Quality Criteria Summary. Copy received from Region 6 EPA November 20, 1987.

See Table 6-5 for terms and abbreviations used in Tables 6-1 through 6-4. See Appendix D for glossary of terms and exposure assumptions.

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TABLE 6-1

Toxicological Properties and Available Exposure Criteria For
Detected Metals at Sheridan Disposal Service Site

Constituent	Toxicological Data (Sax, T. K)			Permissible Air Exposure (TLV, I)	Water Quality Criteria (CT, W, I, K, EPA-MCL, EPA-540)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
Aluminium	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LC50	aquatic	55,500 ug/l - 3,600 ug/l	Metal + Oxide = 10 mg/m3 Pyro Powder = 5 mg/m3 Welding Fumes = 5 mg/m3 Soluble Salts = 2 mg/m3	MCL: AWC - H2O + Org: AWC - H2O: AWC - Org:	NA NA NA NA	oral = NA inh = NA	AWC - H2O + Org AWC - H2O: AWC - Org	NA NA NA	oral = E inh = E

Toxicity Category: NC
Description of Primary Mode of Toxicity

Inhalation of finely divided aluminium powder has been reported as a cause of pulmonary fibrosis May be implicated in Alzheimer's disease Acute effect is cough and shortness of breath; chronic effect is interstitial fibrosis.

Aquatic Life

AWC - FW (acute):	1,894 ug/l
AWC - FW (chronic):	146.7 ug/l
AWC SW (acute):	NA
AWC - SW (chronic):	NA

Texas Proposed

AWC - FW (acute)	NA
AWC - FW (chronic):	NA
AWC - SW (acute):	NA
AWC - SW (chronic)	NA

Arsenic	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LDLO ipr	gpg	10 mg/kg	0.2 mg/m3	MCL:	0 05 mg/l	oral - 9	AWC - H2O + Org	2 2 ng/l	oral - A
	TDLO oral	man	7857 mg/kg/55 yrs *		AWC - H2O + Org:	NA	inh - 9	AWC - H2O:	25 ng/l	inh - A
	TDLO oral	rat	605 ug/kg (35 weeks pregnant)		AWC - H2O:	NA		AWC - Org:	17 5 ng/l	
					AWC - Org	NA				

* (gastrointestinal effects)

Toxicity Category. PC/NC
Description of Primary Mode of Toxicity:

Will effect the human skin and gastrointestinal tract. High irritation effects on intra-muscular, subcutaneous and intraperitoneal. Acute effect is bronchitis; chronic effect is lung cancer bronchitis and laryngitis

Aquatic Life

AWC - FW (acute)	440 ug/l
AWC - FW (chronic)	40 ug/l
AWC - SW (acute)	508 ug/l
AWC - SW (chronic)	NA

Texas Proposed

AWC - FW (acute)	360 ug/l
AWC - FW (chronic)	190 ug/l
AWC - SW (acute)	149 ug/l
AWC - SW (chronic)	78 ug/l

See Table 6-5, Key to Abbreviations

TABLE 6-1 (Cont'd.)

Toxicological Properties and Available Exposure Criteria for Detected Metals at Sheridan Disposal Service Site

Constituent	Toxicological Data (Sax, T, K)			Permissible Air Exposure (TLV, L)	Water Quality Criteria (CT, W, I, K, EPA-MCL, EPA-540)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
Beryllium	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LD50 ivn	rat	496 ug/l	0.002 mg/m3	MCL:	NA	oral = NA	AWC - H2O + Org	3.7 ug/l	oral = B1
	TDLO ivn	rbt	20 mg/l	OSHA	AWC - H2O + Org	NA	ihl = 8	AWC - H2O	3.1 ug/l	ihl = B1
	TCLO inh	hmn	300 mg/m3 *	----	AWC - H2O:	NA		AWC - Org	64.1 ug/l	
				ceiling = 5 ug/m3	AWC - Org:	NA				
	* (pulmonary system effects)			peak = 25 ug/m3/30 mins						

Toxicity Category: NC/PC
Description of Primary Mode of Toxicity:

Causes berylliosis. Acute effect is severe pulmonary edema and pneumonia. Chronic effects are pulmonary fibrosis, progressive dyspnea interstitial granulomatosis and corpulmonale

Aquatic Life

AWC	FW (acute)	103 ug/l
AWC	FW (chronic)	5.3 ug/l
AWC -	SW (acute)	NA
AWC -	SW (chronic)	NA

Texas Proposed

AWC -	FW (acute):	NA
AWC -	FW (chronic)	NA
AWC -	SW (acute)	NA
AWC	SW (chronic)	NA

Barium	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
BaCl2:	LD50 oral	rat	118 mg/kg	0.5 mg/m3	MCL	1 mg/l	oral = 10	AWC - H2O + Org	NA	oral = E
	LDLO oral	hmn	11.4 mg/kg		AWC - H2O + Org	1 mg/l	ihl = 10	AWC - H2O	NA	ihl = E
BaCO3	LD50 oral	rat	630 mg/kg		AWC - H2O	NA		AWC - Org	NA	
	LDLO oral	hmn	57 mg/kg		AWC - Org	NA				
	TDLO oral	hmn	29 mg/kg							

Toxicity Category: NC
Description of Primary Mode of Toxicity:

Acute poisoning will cause a potassium deficiency. There are digitalis-like toxicity, muscle stimulation and central nervous system effects.

Aquatic Life

AWC	FW (acute)	NA
AWC	FW (chronic)	NA
AWC -	SW (acute):	NA
AWC:	SW (chronic)	NA

Texas Proposed

AWC -	FC (acute)	NA
AWC: -	FW (chronic)	NA
AWC -	SW (acute)	NA
AWC -	SW (chronic)	NA

See Table 6-5, Key to Abbreviations

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TABLE 6-1 (Cont'd.)

Toxicological Properties and Available Exposure Criteria for Detected Metals at Sheridan Disposal Service Site

Constituent	Toxicological Data (Sax, T, K)			Permissible Air Exposure (TLV, L)	Water Quality Criteria (CT, W, L, K, EPA-MCL, EPA-540)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
Cadmium	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LD50 oral	rat	225 mg/kg	0.05 mg/m3	MCL	0.01 mg/l	oral = 10	AWC - H2O + Org	NA	oral = NA
	LDLO oral	rbt	70 mg/kg		AWC - H2O + Org	10 ug/l	inh = 8	AWC - H2O	NA	inh = B1
	LCLO inh	hmn	39 mg/kg/20 mins		AWC - H2O	10 ug/l		AWC + Org	NA	
	TDLO oral	mus	448 mg/kg		AWC - Org.	NA				

Toxicity Category: PC/NC

Description of Primary Mode of Toxicity:

Inhalation of fumes and dust affects the respiratory tract, the kidneys may also be affected. Acute effect is cough, pneumonia and the chronic effect is emphysema or pulmonate.

Aquatic Life

AWC - FW (acute)	3.9 ug/l
AWC - FW (chronic)	1.1 ug/l
AWC - SW (acute)	43 ug/l
AWC - SW (chronic)	9.3 ug/l

Texas Proposed

AWC - FW (acute)	e(1.128[ln (hardness)]-1.6724)
AWC - FW (chronic)	e(0.7852[ln (hardness)]-3.490)
AWC - SW (acute)	45.62 ug/l
AWC - SW (chronic)	10.02 ug/l

Chromium	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
Cr+3	LD50 oral	rat	1870 mg/kg	0.5 mg/m3 Cr+3	MCL	0.05 mg/l	oral = NA	AWC - H2O + Org	Cr+3 = 170 mg/l	oral = NA
	LDLO skin	gpg	202 mg/kg	0.05 mg/m3 Cr+6	AWC - H2O + Org	NA	inh = 8	AWC - H2O	Cr+6 = 50 ug/l	inh = A
Cr+6	TDLO ivn	ham	5 mg/kg (8 days pregnant)		AWC - H2O	NA		AWC - H2O	Cr+3 = 179 mg/l	
	TCLO inh	ham	110 ug/m3		AWC - Org.	NA		AWC - Org.	Cr+6 = NA	
								AWC - Org	Cr+3 = 3433 mg/l	

Toxicity Category: NC/PC

Description of Primary Mode of Toxicity

Cr+6 acute effects are nasal irritation and bronchitis; chronic effects are lung tumors and cancers. Exposure can cause cancer of the respiratory tract

Aquatic Life

AWC	FW (acute)	1.7 mg/l Cr+3, .016 mg/l Cr+6
AWC	FW (chronic)	0.2 mg/l Cr+3, 0.011 mg/l Cr+6
AWC	SW (acute)	10,300 mg/l Cr+3, 1,100 ug/l Cr+6
AWC	SW (chronic)	50 ug/l Cr+6

Texas Proposed

AWC - FW (acute):	e(0.8190[ln (hardness)]+3.688) Cr+3, 16 ug/l Cr+6
AWC - FW (chronic)	e(0.8190[ln (hardness)]+1.561) Cr+3, 11 ug/l Cr+6
AWC - SW (acute):	NA Cr+3, 1,100 ug/l Cr+6
AWC - SW (chronic)	NA Cr+3, 50 ug/l Cr+6

See Table 6-5, Key to Abbreviations

TABLE 6-1 (Cont'd)

Toxicological Properties and Available Exposure Criteria for
Detected Metals at Sheridan Disposal Service Site

Constituent	Toxicological Data (Sax, T, K)			Permissible Air Exposure (TLV, L)	Water Quality Criteria (CT, W, E, K, EPA-MCL, EPA-540)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk level) (PC)		
	Route Of Exposure	Type Of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
Copper	TDLO oral	rat	152 mg/kg (22 wk pregnant)	TLV-TWA 0 2 mg/m3 (fume) 1 mg/m3 (dust) STEL ---- 2 mg/m3 (dust) OSHA ---- 0.1 mg/m3 (fume)	MCL	NA	oral = 5	AWC - H2O + Org	NA	oral = E
					AWC - H2O + Org.	NA	inh = 5	AWC - H2O	NA	inh = E
					AWC - H2O. *	1 mg/l		AWC - Org	NA	
	TDLO oral	ham	120 mg/kg *		AWC - Org	NA				
	*(gastrointestinal effects)				*Organoleptic					
	Toxicity Category: NC Description of Primary Mode of Toxicity: ---------- Acute effects from ingesting excessive amounts of copper salts may produce death				Aquatic Life AWC - FW (acute): 18 ug/l AWC - FW (chronic): 12 ug/l AWC - SW (acute): 2 9 ug/l AWC - SW (chronic). 2 9 ug/l Texas Proposed AWC - FW (acute) e(0.9422[ln(hardness)]-1 3844) AWC - FW (chronic: e(0.8545[ln(hardness)]-1.386) AWC - SW (acute): 4 37 ug/l AW - SW (chronic). 4.37 ug/l					
Iron	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	Iron (III) Oxide			5 mg/m3 (oxide)	MCL:	0.3 mg/l	oral = NA	AWC - H2O + Org.	NA	oral = E
	LDLO scu	dog	30 mg/kg	2 mg/m3 (soluble salts)	AWC - H2O + Org.	NA	inh = NA	AWC - H2O:	NA	inh = E
	Iron Salts			OSHA	AWC - H2O	NA		AWC - Org.	NA	
	LDLO oral	hmn	166 mg/kg	---- 10 mg/m3 (oxide fume)	AWC - Org	NA				
	Toxicity Category. NC Description of Primary Mode of Toxicity: ---------- Iron oxide exposure can cause sclerotic lung disease Acute toxicity symptoms are vomiting, liver damage and coagulation defects				Aquatic Life AWC - FW (acute). 1000 ug/l AWC - FW (chronic): NA AWC - SW (acute) NA AWC - SW (chronic) NA Texas Proposed AWC - FW (acute) NA AWC - FW (chronic). NA AWC - SW (acute) NA AWC - SW (chronic) NA					

See Table 6-5, Key to Abbreviations

TABLE 6-1 (Cont'd.)

Toxicological Properties and Available Exposure Criteria For Detected Metals at Sheridan Disposal Service Site

Constituent	Toxicological Data (Sax, T, K)			Permissible Air Exposure (TLV, L)	Water Quality Criteria (CT, W, E, K, EPA-MCL, EPA-540)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
Lead	LDLO ipr	rat	1000 mg/kg	0.15 mg/m3 (inorganic dust and fumes)	MCL:	0.05 mg/l	oral = 10	AWC - H2O + Org	NA	oral = E
	LDLO nv	ham	50 mg/kg (8 days pregnan)	STEL	AWC - H2O + Org	50 ug/l	inh = 10	AWC - H2O	NA	inh = E
	TDLO ora	wmn	450 mg/kg / 6 yr	----	AWC - H2O	50 ug/l		AWC - Org	NA	
				0.45 mg/m3 (inorganic dust and fumes)	AWC - Org	NA				
					Aquatic Life					
	Toxicity Category: NC				AWC - FW (acute)	82 ug/l				
	Description of Primary Mode of Toxicity				AWC - FW (chronic)	3.2 ug/l				
	Impairs antibody - mediated host resistance. With exposure the concerns are peripheral neuropathy and/or chronic nephropathy. Target organs are the gastrointestinal and reproductive systems.				AWC - SW (acute)	140 ug/l				
					AWC - SW (chronic)	5.6 ug/l				
					Texas Proposed					
					AWC - FW (acute)	e(1.273[ln (hardness)]-1.460)				
					AWC - FW (chronic)	e(1.273[ln (hardness)]-4.705)				
					AWC - SW (acute)	140 ug/l				
					AWC - SW (chronic)	5.6 ug/l				
Magnesium	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LDLO oral	dog	230 mg/kg	10 mg/m3 (oxide fume)	MCL:	NA	oral = NA	AWC - H2O + Org	NA	oral = E
				OSHA	AWC - H2O + Org	NA	inh = NA	AWC - H2O	NA	inh = E
				----	AWC - H2O	NA		AWC - Org	NA	
				15 mg/m3 (oxide fume)	AWC - Org	NA				
					Aquatic Life					
	Toxicity Category: NC				AWC - FW (acute)	NA				
	Description of Primary Mode of Toxicity				AWC - FW (chronic)	NA				
	Particles imbedded in the skin can produce gaseous blebs with a protracted course. Inhalation of the dust and irritant fumes can cause metal fume fever.				AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				

See Table 6-5, Key to Abbreviations

TABLE 6-1 (Cont'd.)

Toxicological Properties and Available Exposure Criteria for Detected Metals at Sheridan Disposal Service Site

Constituent	Toxicological Data (Sax, T, K)			Permissible Air Exposure (TLV, E)	Water Quality Criteria (CT, W, E, K, EPA-MCL, EPA-S40)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
Manganese	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	TCLO inh	man	2300 mg/m3	1 mg/m3 (fume)	MCL:	0.05 mg/l	oral = N	AWC - H2O + Org	NA	oral = E
	TDLO ims	rat	400 mg/kg/y-inte	STEL	AWC - H2O + Org	50 ug/l	inh = N	AWC - H2O	NA	inh = E
				----	AWC - H2O:	NA		AWC - Org:	NA	
				3 mg/m3 (fume)	AWC - Org:	100 ug/l				
				OSHA						
				----						
				ceiling = 5 mg/m3						
					Aquatic Life					
					AWC - FW (acute):	NA				
					AWC - FW (chronic):	NA				
					AWC - SW (acute):	NA				
					AWC - SW (chronic):	NA				
	Toxicity Category: NC				Texas Proposed					
	Description of Primary Mode of Toxicity:				AWC - FC (acute):	NA				
	Symptoms: languor, sleepiness, weakness, emotional disturbance, spastic gait paralysis. Can cause manganese pneumonia. Acute effect is acute pneumonia, often fatal and chronic effect is recurrent pneumonia.				AWC - FW (chronic):	NA				
					AWC - SW (acute):	NA				
					AWC - SW (chronic):	NA				
Nickel	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	TDLO ora	rat	158 mg/kg	1 mg/m3 (metal)	MCL	0.632 mg/l	oral=10	AWC - H2O + Org	NA	oral = A
	TDLO inh	gpg	15 mg/kg	0.1 mg/m3 (soluble compounds)	AWC H2O + Org:	13.4 ug/l	inh=10	AWC - H2O	NA	inh = A
	LDLO ora	gpg	5 mg/kg	STEL	AWC H2O:	13.4 ug/l		AWC - Org	NA	
	LDLO ivn	mus	50 mg/kg	----	AWC Org:	0.1 mg/l				
				0.3 mg/m3 (soluble compounds)						
				OSHA						
				----						
				1 mg/m3 (soluble compounds)						
					Aquatic Life					
					AWC - FW (acute):	1400 ug/l				
					AWC - FW (chronic):	160 ug/l				
					AWC - SW (acute):	75 ug/l				
					AWC - SW (chronic):	8.3 ug/l				
	Toxicity Category: PC/NC				Texas Proposed					
	Description of Primary Mode of Toxicity:				AWC - FW (acute):	e(0.8460[ln (hardness)]+3.3612)				
	Acute effect is pulmonary edema, and chronic effect is squamous cell carcinoma of nasal cavity and lung. Causes lung and nasal cancer.				AWC - FW (chronic):	e(0.8460[ln (hardness)]+1.1645)				
					AWC - SW (acute):	119 ug/l				
					AWC - SW (chronic):	13.2 ug/l				

See Table 6-5, Key to Abbreviations

TABLE 6-1 (Cont'd.)

Toxicological Properties and Available Exposure Criteria for Detected Metals at Sheridan Disposal Service Site

Constituent	Toxicological Data (Sax, T, K)			Permissible Air Exposure (ELV, L)	Water Quality Criteria (CF, W, C, K, EPA-MCL, EPA-540)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
Silver	TCLO ihl	hmn	1 mg/m3 *	0.1 mg/m3 (metal)	MCL:	0.05 mg/l	oral = 1	AWC - H2O + Org	NA	oral = E
	TDLO imp	mus	11 gm/kg	0.01mg/m3 (soluble compounds)	AWC - H2O + Org:	50 ug/l	ihl = 1	AWC - H2O:	NA	ihl = E
					AWC - H2O:	NA		AWC - Org:	NA	
					AWC - Org:	NA				
	* skin effected				Aquatic Life					
					AWC - FW (acute):	4.1 ug/l				
	Toxicity Category: NC				AWC - FW (chronic):	0.12 ug/l				
	Description of Primary Mode of Toxicity:				AWC - SW (acute):	2.3 ug/l				
	Major effect of excessive absorption is local or generalized impregnation of the tissues where it remains as silver sulfide, which forms an insoluble complex in elastic fibers resulting in argyria.				AWC - SW (chronic):	NA				
					Texas Proposed					
					AWC - FW (acute):	e(1.72[ln (hardness)]-6.52)				
					AWC - FW (chronic):	0.12 ug/l				
					AWC (acute):	2.3 ug/l				
					AWC - SW (chronic):	NA				
Vanadium	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
Dust	LD50 oral	rat	10 mg/kg	0.05 mg/m3 (respirable dust + fume)	MCL:	NA	oral = 1	AWC - H2O + Org:	NA	oral = E
	LDLO ivn	rbt	10 mg/kg		AWC - H2O + Org:	NA	ihl = 1	AWC - H2O:	NA	ihl = E
	LCLO ihl	rat	70 mg/m3/2hr		AWC - H2O	NA		AWC - Org	NA	
	TCLO ih	hmn	346 mg/m3 *		AWC - Org	NA				
	* pulmonary system effects				Aquatic Life					
					AWC - FW (acute):	NA				
	Toxicity Category: NC				AWC - FW (chronic):	NA				
	Description of Primary Mode of Toxicity:				AWC - SW (acute):	NA				
	Acute effect is upper airway irritation and mucus production while the chronic effect is chronic bronchitis. Mainly effects respiratory tract. May cause gastrointestinal distress, nausea and kidney damage				AWC - SW (chronic):	NA				
					Texas Proposed					
					AWC - FW (acute):	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic):	NA				

See Table 6-5, Key to Abbreviations

TABLE 6-1 (Cont'd.)

Toxicological Properties and Available Exposure Criteria For Detected Metals at Sheridan Disposal Service Site

Constituent	Toxicological Data (Sax, T, K)			Permissible Air Exposure (TLV, I)	Water Quality Criteria (CI, W, L, K, EPA-MCL, EPA 540)						
					Non-Carcinogenic (NC)				Potential Carcinogenic (10-6 Risk Level) (PC)		
Zinc	Route Of Exposure	Type Of Receptor	Concentration	TLV - TWA	Human Health			EPA Severity Rating	Human Health		EPA Carcinogenic Class
Oxide	TCLO inh	hmn	124 mg/m3/5 mins	5 mg/m3 (oxide fume)	MCL		NA	oral = 8	AWC - H2O + Org	NA	oral = E
	TDLO oral	rat	6846 mg/kg (1-22 pregn	STEL ----	AWC	H2O + Org	5 mg/l *	inh = 8	AWC - H2O	NA	inh = E
					AWC	H2O	7.5 mg/l		AWC - Org	NA	
	TCLO inh	hmn	600 mg/m3 *	10 mg/m3 (oxide fume)	AWC	Org	7.5 *				

* primonary system effects

* (organoleptic

Toxicity Category: NC

Description of Primary Mode of Toxicity.

Freshly formed fumes as from welding may cause metal fume fever (oxide).

Aquatic Life

AWC - FW (acute):	120 ug/l
AWC - FW (chronic):	110 ug/l
AWC - SW (acute):	95 ug/l
AWC - SW (chronic)	96 ug/l

Texas Proposed

AW - FW (acute):	e(0.8473[ln (hardness)]+0.8604)
AW - FW (chronic)	e(0.8473[ln (hardness)]+0.7614)
AW - SW (acute):	98 ug/l
AW - SW (chronic)	89 ug/l

See Table 6-5, Key to Abbreviations

TABLE 6-2

Toxicological Properties and Available Exposure Criteria For
Detected Volatile Organics at Sheridan Disposal Service Site

Constituent	Toxicological Data (SAX, [illegible])			Permissible Air Exposure (TVL [illegible])	Water Quality Criteria (EPA-MCLS, EPA-540 [illegible]) Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
	Route of Exposure	Type of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
Acetone	LD50 oral	mus	3000 mg/kg	TLV-TWA = 750 ppm	MCL:	NA	Oral = NA	AWC - H2O + Org	NA	Oral = NA
	LD50 oral	rat	9750 mg/kg	= 1780 mg/m3	AWC - H2O + Org	NA	Inh = NA	AWC - H2O	NA	Inh = NA
	[illegible]	hum	500 ppm*	STEL = 1000 ppm	AWC - H2O	NA		AWC - Org	NA	
	[illegible]	man	12000 ppm/4hr**	= 2375 mg/m3	AWC - Org	NA				
	TDLO inh	man	10 mg/m3/6hr	OSHA = 1000 ppm						
				= 2400 mg/m3	Aquatic Life					
	* eye effects				AWC = FW (acute)	NA				
	** central nervous system effects				AWC - FW (chronic)	NA				
	Toxicity Category: NC				AWC = SW (acute)	NA				
	Description of Primary Mode of Toxicity				AWC = SW (chronic)	NA				
	Headaches after prolonged inhalation. It is narcotic in high concentrations.				Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
Benzene	Route of Exposure	Type of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LD50 oral	mus	4700 mg/kg	TLV-TWA = 10 ppm	MCL:	0.005 mg/l	Oral = 5	AWC-H2O+Org	0.66 ug/l	Oral = A
	LD50 oral	rat	3800 mg/kg	= 30 mg/m3	AWC - H2O + Org	NA	Inh = 10	AWC - H2O	0.67 ug/l	Inh = A
	TCLO inh	hum	100 ppm	STEL = 25 ppm	AWC - H2O:	NA		AWC - Org	40 ug/l	
	LC50 inh	mus	9980 ppm	= 75 mg/m3	AWC Org:	NA				
	LCLO inh	man	20000 ppm/5 mins	OSHA = 10 ppm/8hr						
				ceiling = 25 ppm	Aquatic Life					
				peak = 50 ppm/10min	AWC FW (acute):	5.3 mg/l				
	Toxicity Category: NC/PC				AWC FW (chronic):	NA				
	Description of Primary Mode of Toxicity.				AWC SW (acute):	5.1 mg/l				
	Poisoning occurs most commonly though inhalation of the vapor, through benzene can penetrate the skin and poison that way. Strong irritant effect can produce erythema and burning and in most severe cases, edema and even blistering. It is a recognized leukemogen				AWC SW (chronic)	7 mg/l				
					Texas Proposed					
					AWC - FW (acute):	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				

See Table 6-5 for key to abbreviations

011306

TABLE 6-2 (cont'd.)

Toxicological Properties and Available Exposure Criteria of Detected Volatile Organics at Sheridan Disposal Service Site

Constituent	Toxicological Data (SAX, TI)			Permissible Air Exposure (TVL, L)
	Route of Exposure	Type of Receptor	Concentration	
Carbon Disulfide	LD50 oral	human	14 mg/kg	TLV - TWA = 10 ppm
	LCLO inh	human	4000 ppm/30 min	= 30 mg/m3
	TCLO inh	rat	100 mg/m3/8 hr (1-21 days pregnant)	OSHA = 20 ppm 8 hr ceiling = 30 ppm peak = 100 ppm/30 min
Chlorobenzene	LD50 oral	rat	2910 mg/kg	TLV - TWA = 75 ppm
	LD50 oral	rat	2830 mg/kg	= 350 mg/m3
	LCLO inh	mus	15 g/m3	

Toxicity Category: NC

Description of Primary Mode of Toxicity

Chief toxic effect is on the central nervous system. It acts as a narcotic and anesthetic in acute poisoning with death following respiratory failure. Chronic poisoning effect on nervous system is one of central and peripheral damage.

Toxicity Category: NC

Description of Primary Mode of Toxicity

Acute exposure symptoms are somnolence, loss of consciousness, twitchings of the extremities, deep rapid respirations and a small irregular pulse. It is a fairly strong narcotic and posesses only slight irritant qualities.

Water Quality Criteria (E. EPA-MCLS, EPA-540 CT WI)

Constituent	Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Levels) (PC)		
	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
Carbon Disulfide	MCL	NA	oral = 7	AWC - H2O + Org	NA	oral = E
	AWC - H2O + Org	NA	inh = 7	AWC - H2O	NA	inh = E
	AWC - H2O	NA		AWC - Org	NA	
	AWC - Org	NA				
	Aquatic Life					
	ACW - FW (acute)	NA				
	AWC - FW (chronic)	NA				
	AWC - SW (acute)	NA				
	AWC - SW (chronic)	NA				
	Texas Proposed					
	AWC - FW (acute)	NA				
	AWC - FW (chronic)	NA				
	AWC - SW (acute)	NA				
	AWC - SW (chronic)	NA				
Chlorobenzene	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	MCL	NA	oral = 4	AWC - H2O + Org	NA	oral = E
	AWC - H2O + Org	488 ug/l	inh = E	AWC - H2O	NA	inh = E
	AWC - H2O	488 ug/l		AWC - Org	NA	
	AWC - Org	NA				
	Aquatic Life					
	ACW - FW (acute)	0.2 mg/l				
	AWC - FW (chronic)	.05 mg/l				
	AWC - SW (acute)	0.1 mg/l				
	AWC - SW (chronic)	0.1 mg/l				
	Texas Proposed					
	AWC - FW (acute)	NA				
	AWC - FW (chronic)	NA				
	AWC - SW (acute)	NA				
	AWC - SW (chronic)	NA				

See Table 6-5 for key to abbreviations.

TABLE 6-2 (Cont'd.)

Toxicological Properties and Available Exposure Criteria for
Detected Volatile Organics at Sheridan Disposal Service Site

Constituent	Toxicological Data (MAX E)			Permissible Air Exposure (TVL E)	Water Quality Criteria (E, EPA-MCLS, EPA-540 CT WI)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
1-2 Dichloroethane	Route Of Exposure	Type Of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
				TLV - TWA = 10 ppm 40 mg/m3	MCL	0.005 mg/l	oral = 10	AWC - H2O + Org	0.94 ug/l	oral = B2
					AWC - H2O + Org	NA	inh = 6	AWC - H2O	NA	inh = B2
			NA	STEL = 15 ppm 60 mg/m3	AWC - H2O	NA		AWC - Org	243 ug/l	
					AWC - Org	NA				
				OSHA = 50 ppm/8 hr ceiling = 100 ppm peak = 200 ppm/5 min in any 3 hrs	Aquatic Life					
	Toxicity Category: NC/PC				AWC - FW (acute)	118,000 ug/l				
	Description of Primary Mode of Toxicity				AWC - FW (chronic)	20,000 ug/l				
	Powerful liver and kidney toxin				AWC - SW (acute)	113,000 ug/l				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
1,1-Dichloroethylene	Route Of Exposure	Type Of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LD50 oral	rat	200 mg/kg	TLV - TWA = 5 ppm 40 mg/m3	MCL	007 mg/l	oral = 7	AWC-H2O+Org.	0.033 ug/l	oral = C
	LCLO inh	rat	10000 ppm/24 hr		AWC - H2O + Org	NA	inh = 5	AWC - H2O	33 ug/l	inh = C
	TDLO oral	rat	200 mg/kg	STEL = 20 ppm 80 mg/m3	AWC - H2O	NA		AWC - Org	1.85 ug/l	
	TCLO inh	man	25 ppm		AWC - Org	NA				
	*systemic effects				Aquatic Life					
	Toxicity Category NC/PC				AWC - FW (acute)	11,600 ug/l				
	Description of Primary Mode of Toxicity				AWC - FW (chronic)	NA				
	At order mutagen equivocal tumorigenic agent has neoplastic and carcinogenic effects				AWC - SW (acute)	224,000 ug/l				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				

See Table 6-5 for key to abbreviations.

TABLE 6-2 (Cont'd.)

Toxicological Properties and Available Exposure Criteria for
Detected Volatile Organics at Sheridan Disposal Service Site

Constituent	Toxicological Data (SAX, TI)			Permissible Air Exposure (TVL, TI)	Water Quality Criteria (E, EPA-MCLS, EPA-540, CE, WI)			
					Non-Carcinogenic (NC)		Potential Carcinogenic (10-6 Risk level) (PC)	
	Route Of Exposure	Type Of Receptor	Concentration		Human Health	EPA Severity Rating	Human Health	EPA Carcinogenic Class
Ethyl Benzene	LD50 oral	rat	3500 mg/kg	TLV - TWA = 100 ppm	MCL: NA	oral = 4	AWC - H2O + Org NA	oral = E
	LD50 skin	rbt	5000 mg/kg	435 mg/m3	AWC - H2O + Org 1.4 mg/l	inhl = 4	AWC - H2O NA	inhl = E
	LC50 inhl	rat	4000 ppm/4 hr	STEL = 125 ppm	AWC - H2O 2.4 mg/l		AWC - Org NA	
	LC50 inhl	rat	9600ppm/7 hr (1-19 days pregnant)	545 mg/m3	AWC - Org 3.2 mg/l			
	Toxicity Category: NC Description of Primary Mode of Toxicity Erythema and inflammation of the skin may result from contact w/liquid. Exposure to vapor causes lacrymation and irritation of the nose and throat, dizziness and a sense of constriction of the chest. Liquid is an irritant to skin and mucous membranes				Aquatic Life AWC - FW (acute) 32,000 ug/l AWC - FW (chronic) NA AWC - SW (acute) 430 ug/l AWC - SW (chronic) NA Texas Proposed AWC FW (acute) NA AWC FW (chronic) NA AWC SW (acute) NA AWC SW (chronic) NA			
2-Hexanone	Route Of Exposure	Type Of Receptor	Concentration		Human Health	EPA Severity Rating	Human Health	EPA Carcinogenic Class
	LD50 oral	rat	2590 mg/kg	TLV - TWA = 5 ppm	MCL: NA	oral: NA	AWC - H2O + Org NA	oral NA
	LD50 oral	mus	1000 mg/kg	20 mg/m3	AWC - H2O + Org: NA	inhl : NA	AWC - H2O NA	inhl NA
	LC50 inhl	rat	8000 ppm/4 hr	OSHA = 100 ppm	AWC - H2O: NA		AWC - Org. NA	
				410 mg/m3	AWC - Org NA			
	Toxicity Category NC Description of Primary Mode of Toxicity. Moderate irritation effects through oral, inhalation and intraperitoneal exposure				Aquatic Life AWC - FW (acute) NA AWC - FW (chronic) NA AWC - SW (acute) NA AWC - SW (chronic) NA Texas Proposed AWC - FW (acute) NA AWC - FW (chronic) NA AWC - SW (acute) NA AWC - SW (chronic) NA			

See Table 6-5 for key to abbreviations

TABLE 6-2 (Cont'd.)

Toxicological Properties and Available Exposure Criteria of
Detected Volatile Organics at Sheridan Disposal Service Site

Methylene Chloride

Toxicological Data (SAX, TP)

Route of Exposure	Type of Receptor	Concentration
LD50 oral	rat	167 mg/kg
LDLO oral	dog	3000 mg/kg
LC50 inh	mus	14400 ppm/7 hr
TCLO inh	hum	500 ppm/8 hr*

*central nervous system effects

Toxicity Category: PC/NC

Description of Primary Mode of Toxicity

Very dangerous to the eyes. Induces narcosis. Can cause dermatitis upon prolonged skin contact.

Permissible Air Exposure (TLV, ...)

TLV - TWA = 100 ppm
360 mg/m3
STEL = 500 ppm
1700 mg/m
OSHA = 500 ppm/8 hr
ceiling = 1000 ppm
peak = 2000 ppm/5 mins
in any 2 hrs

Water Quality Criteria (IL, EPA-MCLS, EPA-540, CT, W)

Non-Carcinogenic (NC)

Human Health		EPA Severity Rating
MCL	NA	oral 10
AWC - H2O + Org	NA	inh 10
AWC - H2O	NA	
AWC - Org	NA	

Aquatic Life *

AWC - FW (acute)	11 000 ug/l
AWC - FW (chronic)	NA
AWC - SW (acute)	12,000 ug/l
AWC - SW (chronic)	8,400 ug/l

Texas Proposed

AWC - FW (acute)	NA
AWC - FW (chronic)	NA
AWC - SW (acute)	NA
AWC - SW (chronic)	NA

Potential Carcinogenic (10-6 Risk Level) (PC)

Human Health *		EPA Carcinogenic Class
AWC - H2O+Org	0.19 ug/l	oral B2
AWC - H2O	0.19 ug/l	inh B2
AWC - Org	15.7 ug/l	

* Values for halomethanes as a class

Methyl Ethyl Ketone

Toxicological Data (SAX, TP)

Route of Exposure	Type of Receptor	Concentration
LD50 oral	rat	3400 mg/kg
LD50 skn	rbt	13 mg/kg
LCLO inh	rat	2000 ppm/4 hr
TCLO inh	hum	100 ppm/5 mins *

*irritant effects (systemic)

Toxicity Category: NC

Description of Primary Mode of Toxicity:

Affects peripheral nervous system and central nervous system. Can irritate the eyes.

Permissible Air Exposure (TLV, ...)

TLV - TWA = 200ppm
590mg/m3
STEL = 300ppm
885mg/m3

Water Quality Criteria (IL, EPA-MCLS, EPA-540, CT, W)

Non-Carcinogenic (NC)

Human Health		EPA Severity Rating
MCL	NA	oral = 10
AWC - H2O + Org	NA	inh = 10
AWC - H2O	NA	
AWC - Org	NA	

Aquatic Life

AWC - FW (acute)	NA
AWC - FW (chronic)	NA
AWC - SW (acute)	NA
AWC - SW (chronic)	NA

Texas Proposed

AWC - FW (acute)	NA
AWC - SW (chronic)	NA
AWC - SW (acute)	NA
AWC - SW (chronic)	NA

Potential Carcinogenic (10-6 Risk Level) (PC)

Human Health		EPA Carcinogenic Class
AWC - H2O + Org	NA	oral = E
AWC - H2O	NA	inh = E
AWC - Org	NA	

See Table 6-5 for key to abbreviations

TABLE 6-2 (Cont'd.)

Toxicological Properties and Available Exposure Criteria for
Detected Volatile Organics at Sheridan Disposal Service Site

Constituent	Toxicological Data (SAX, T)			Permissible Air Exposure (TVC, L)	Water Quality Criteria (L, EPA-MCLS, EPA-540, CT, W)			
					Non-Carcinogenic (NC)		Potential Carcinogenic (10 6 Risk Level) (PC)	
4-Methyl 2-Pentanone	Route Of Exposure	Type Of Receptor	Concentration		Human Health	EPA Severity Rating	Human Health	EPA Carcinogenic Class
	LD50 oral	rat	2080 mg/kg	TLV - TWA = 50 ppm	MCL NA	oral NA	AWC - H2O + Org NA	oral E
	LDLO oral	mus	2850 mg/kg	205 mg/m3	AWC - H2O + Org NA	ihl NA	AWC - H2O NA	ihl E
	LC50 ihl	mus	23300 mg/m3	STEL = 75 ppm	AWC - H2O NA		AWC - Org NA	
	TCLO ihl	hmn	200 ppm*	300 mg/m3	AWC - Org NA			
				OSHA = 100 ppm				
				410 mg/m3				
	*Irritant effects (systemic)				Aquatic Life			
					AWC - FW (acute) NA			
	Toxicity Category NC				AWC - FW (chronic) NA			
	Description of Primary Mode of Toxicity				AWC - SW (acute) NA			
					AWC - SW (chronic) NA			
	A skin and eye irritant. High intraperitoneal, moderate oral, inhalation. Moderate via oral and inhalation routes and high irritant to eyes and mucous membranes				Texas Proposed			
					AWC - FW (acute) NA			
					AWC - FW (chronic) NA			
					AWC - SW (acute) NA			
					AWC - SW (chronic) NA			
Tetrachloroethylene	Route Of Exposure	Type Of Receptor	Concentration		Human Health	EPA Severity Rating	Human Health	EPA Carcinogenic Class
	LD50 oral	mus	8100 mg/kg	TLV - TWA = 50 ppm	MCL NA	oral : 7	AWC-H2O+Org 0.8 ug/l	oral = B2
	LD50 oral	rat	8850 mg/kg	335 mg/m3	AWC - H2O + Org NA	ihl : 10	AWC - H2O : 0.88 ug/l	ihl = B2
	LDLO oral	dog	4000 mg/kg	STEL = 200 ppm	AWC - H2O NA		AWC - Org : 8.85 ug/l	
	TCLO ihl	man	600 ppm/10 mins*	1340 mg/m3	AWC - Org NA			
				OSHA = 100 ppm/8 hr				
	*Central nervous system effects			ceiling = 200 ppm	Aquatic Life			
				peak = 300 ppm/5 mins				
	Toxicity Category: NC/PC			in any 3 hrs	AWC - FW (acute): 5280 ug/l			
	Description of Primary Mode of Toxicity				AWC - FW (chronic): 840 ug/l			
					AWC - SW (acute): 10200 ug/l			
	Not corrosive or dangerously acutely reactive, but toxic by inhalation, by prolonged or repeated contact with skin or mucous membranes or when ingested by mouth. Symptoms of acute intoxication are its effects upon the nervous system. Can cause dermatitis with repeated or prolonged contact w/skin.				AWC - SW (chronic): 450 ug/l			
					Texas Proposed			
					AWC - FW (acute): NA			
					AWC - FW (chronic): NA			
					AWC - SW (acute) NA			
					AWC - SW (chronic): NA			

See Table 6-5 for key to abbreviations

011311

TABLE 6-2 (Cont'd.)

Toxicological Properties and Available Exposure Criteria for
Detected Volatile Organics at Sheridan Disposal Service Site

Constituent	Toxicological Data (SAX, T)			Permissible Air Exposure (TVL, L)	Water Quality Criteria (L, EPA-MCLS, EPA-540, CT, W)			
					Non-Carcinogenic (NC)		Potential Carcinogenic (10-6 Risk Level) (PC)	
	Route Of Exposure	Type Of Receptor	Concentration		Human Health	EPA Severity Rating	Human Health	EPA Carcinogenic Class
Toluene	LD50 oral	rat	5000 mg/kg	TLV - TWA = 100 ppm (skin)	MCL NA	oral 7	AWC - H2O + Org. NA	oral 1
	LCLO ihl	rat	4000 ppm/4 hr	375 mg/m3 (skin)	AWC - H2O + Org 14.3 mg/l	ihl 7	AWC - H2O NA	ihl 1
	LC50 ihl	mus	5320 ppm/8 hr	STEL = 150 ppm (skin)	AWC - H2O 15 mg/l		AWC - Org NA	
	TCLO ihl	man	100 ppm*	560 mg/m3 (skin)	AWC - Org 424 mg/l			
				OSHA = 200 ppm/8 hr				
				ceiling = 300 ppm	Aquatic Life			
				peak = 500 ppm/10 mins	AWC - FW (acute) 17 500 ug/l			
					AWC - FW (chronic) NA			
					AWC - SW (acute) 6300 ug/l			
					AWC - SW (chronic) 5000 ug/l			
					Texas Proposed			
					AWC - FW (acute) NA			
					AWC - FW (chronic) NA			
					AWC - SW (acute) NA			
					AWC - SW (chronic) NA			
Trichloroethylene	Route Of Exposure	Type Of Receptor	Concentration		Human Health	EPA Severity Rating	Human Health	EPA Carcinogenic Class
	LD50 oral	rat	4920 mg/kg	TLV - TWA = 50 ppm	MCL 005 mg/l	oral = 5	AWC-H2O+Org: 2.7 ug/l	oral = B2
	LDLO oral	dog	5860 mg/kg	270 mg/m3	AWC - H2O + Org NA	ihl = 4	AWC - H2O 2.8 ug/l	ihl = B2
	LCLO ihl	rat	8000 ppm/4 hr	STEL = 150 ppm	AWC - H2O NA		AWC - Org 80.7 ug/l	
	LCLO ihl	man	2900 ppm	805 mg/m3	AWC - Org NA			
	TDLO ihl	hmn	812 mg/kg*	OSHA = 100 ppm/8 hr				
	TCLO ihl	hmn	110 ppm/8 hr**	ceiling = 200 ppm	Aquatic Life			
				peak = 300 ppm/5 mins	AWC - FW (acute) 45,000 ug/l			
				in any 2 hrs	AWC - FW (chronic) 21 900 ug/l			
					AWC - SW (acute) 2000 ug/l			
					AWC - SW (chronic) NA			
					Texas Proposed			
					AWC - FW (acute) NA			
					AWC - FW (chronic) NA			
					AWC - SW (acute) NA			
					AWC - SW (chronic) NA			

*systemic effects
**irritant effects (systemic)

Toxicity Category
Description of Primary Mode of Toxicity:

Acute exposure has been attributed to ventricular fibrillation resulting in cardiac failure. Chronic exposure causes damage to the liver and other organs.

See Table 6-5 for key to abbreviations.

011312

TABLE 6-2 (Cont'd.)

Toxicological Properties and Available Exposure Criteria for Detected Volatile Organics at Sheridan Disposal Service Site

Constituent	Toxicological Data (SAX, E)			Permissible Air Exposure (TVL, L)	Water Quality Criteria (IL, EPA-MCLS, EPA-540, CT, WI)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Levels) (PC)		
Xylenes (O, M and P isomers)	Route Of Exposure	Type Of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LD50 oral	rat	4300 mg/kg	TLV - TWA = 100 ppm (skin)	MCL	NA	oral = NA	AWC - H2O + Org	NA	oral = E
	LC50 inh	rat	5000 ppm/4 hr	435 mg/m3 (skin)	AWC - H2O + Org	NA	inh = NA	AWC - H2O	NA	inh = E
	LCLO inh	man	10000 ppm/6 hr	STEL = 150 ppm (skin)	AWC - H2O	NA		AWC - Org	NA	
	TCLO inh	hmn	200 ppm	655 mg/m3 (skin)	AWC - Org	NA				

Toxicity Category: NC

Description of Primary Mode of Toxicity

Some temporary corneal effects are noted as well as some conjunctival irritation by instillation. Very little dermal toxicity

Aquatic Life

AWC - FW (acute)	NA
AWC - FW (chronic)	NA
AWC - SW (acute)	NA
AWC - SW (chronic)	NA

Texas Proposed

AWC - FW (acute)	NA
AWC - FW (chronic)	NA
AWC - SW (acute)	NA
AWC - SW (chronic)	NA

See Table 6-5 for key to abbreviations.

B992

TABLE 6-3

Toxicological Properties and Available Exposure Criteria for
Detected Base/Neutral/Acid Extractable Organics at the Sheridan Disposal Services Site

Constituent	Toxicological Data (SAX)			Permissible Air Exposure (TVL, L, SAX)	Water Quality Criteria (L, EPA-440, EPA-MCLs, EPA 540, CW, T)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
	Route Of Exposure	Type Of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
Acenaphthene					MCL	NA	oral = NA	AWC - H2O + Org	NA	oral = t
					AWC - H2O + Org	20 ug/l*	ihl = NA	AWC - H2O	NA	ihl = t
					AWC - H2O	20 ug/l*		AWC - Org	NA	
					AWC - Org	NA				
					* organleptic					
					Aquatic Life					
					AWC - FW (acute)	1700 ug/l				
					AWC - FW (chronic)	520 ug/l				
					AWC - SW (acute)	970 ug/l				
					AWC - SW (chronic)	710 ug/l				
					Texas Proposed					
					AWC - FW (acute)	1700 ug/l				
					AWC - FW (chronic)	520 ug/l				
					AWC - SW (acute)	970 ug/l				
					AWC - SW (chronic)	710 ug/l				
Anthracene	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	TDLO oral	rat	20 000 mg/kg/79 wk	0.2 mg/m3 (exposures for coal tar pitch volatiles which include anthracene)	MCL	NA	oral = NA	AWC - H2O + Org	NA	oral = t
					AWC - H2O + Org	NA	ihl = NA	AWC - H2O	NA	ihl = t
					AWC - H2O	NA		AWC - Org	NA	
					AWC - Org	NA				
					Aquatic Life					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				

Toxicity Category NC
Description of Primary Mode of Toxicity

A skin and mucous membrane irritant may cause acute vomiting if swallowed in large quantities

Toxicity Category NC
Description of Primary Mode of Toxicity

A skin irritant, allergen and an equivocal tumorigenic agent will cause neoplastic effects

See table 6-5 for key to abbreviations

011314

8992

TABLE 6-3 (Cont'd.)

Toxicological Properties and Available Exposure Criteria for
Detected Base/Neutral/Acid Extractable Organics at the Sheridan Disposal Services Site

Constituent	Toxicological Data (SAX)			Permissible Air Exposure (TVL, L, SAX)	Water Quality Criteria (L, EPA-440, EPA-MCLs, EPA-540, CW, T)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
Bis-2-(ethylhexyl) phthalate	LD50 oral	rat	31 000 mg/kg	5 ppm	MCL	NA	oral = NA	AWC - H2O + Org	NA	oral = B2
	LD50 oral	mus	30 000 mg/kg	STEL	AWC - H2O + Org	15 mg/l	ihl = NA	AWC - H2O	NA	ihl = B2
	LC50 ihl	mam	30 000 mg/m3	----	AWC - H2O	21 mg/l		AWC - Org	NA	
	TDLO oral	man	143 mg/kg*	10 ppm	AWC - Org	50 mg/l				

*gastrointestinal tract effects

Toxicity Category NC/PC
Description of Primary Mode of Toxicity

Mild irritation for skin and eyes
Effects the gastrointestinal tract

Aquatic Life (1)

AWC - FW (acute)	940 ug/l
AWC - FW (chronic)	3 ug/l
AWC - SW (acute)	2944 ug/l
AWC - SW (chronic)	3.4 ug/l

Texas Proposed

AWC - FW (acute)	NA
AWC - FW (chronic)	NA
AWC - SW (acute)	NA
AWC - SW (chronic)	NA

(1) values are for ester form

Constituent	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
Butyl Benzene phthalate	LD50 ipr	mus	3160 mg/kg	NA	MCL	NA	oral = NA	AWC - H2O + Org	NA	oral = B2
	LC50 ihl	mam	13 100 mg/m3		AWC - H2O + Org	NA	ihl = NA	AWC - H2O	NA	ihl = B2
					AWC - H2O	NA		AWC - Org	NA	
					AWC - Org	NA				

Toxicity Category NC
Description of Primary Mode of Toxicity

Moderate irritation effects through intraperitoneal and inhalation

Aquatic Life (1)

AWC - FW (acute)	940 ug/l
AWC - FW (chronic)	3 ug/l
AWC - SW (acute)	2944 ug/l
AWC - SW (chronic)	3.4 ug/l

Texas Proposed

AWC - FW (acute)	NA
AWC - FW (chronic)	NA
AWC - SW (acute)	NA
AWC - SW (chronic)	NA

(1) values are for ester form

See Table 6-5 for key to abbreviations

011315

TABLE 6-3 (Cont'd.)

Toxicological Properties and Available Exposure Criteria for
Detected Base/Neutral/Acid Extractable Organics at the Sheridan Disposal Services Site

Constituent	Toxicological Data (SAX)			Permissible Air Exposure (TVL, L, SAX)	Water Quality Criteria (L, EPA-440, EPA-MCLs, EPA-540, CW, T)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
Chrysene	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
				0.2 mg/m3	MCL	NA	oral = NA	MCL	NA	oral = B2
				(exposure limits are for coal	AWC - H2O + Org	NA	ihl = NA	AWC - H2O + Org	NA	ihl = B2
		NA		tar pitch volatiles which	AWC - H2O	NA		AWC - H2O	NA	
				include chrysene)	AWC - Org	NA		AWC - Org	NA	
	Toxicity Category NC/PC									
	Description of Primary Mode of Toxicity									
	Risk of lung and skin cancer				Aquatic Life					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
Dibenzofuran	Route Of Exposure	Type Of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
					MCL	NA	oral = NA	AWC - H2O + Org	NA	oral = NA
				NA	AWC - H2O + Org	NA	ihl = NA	AWC - H2O	NA	ihl = NA
		NA			AWC - H2O	NA		AWC - Org	NA	
					AWC - Org	NA				
	Toxicity Category NC				Aquatic Life					
	Description of Primary Mode of Toxicity				AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
		NA			AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				

See Table 6-5 for key to abbreviations

011316

8992

TABLE 6-3 (Cont'd)

Toxicological Properties and Available Exposure Criteria for
Detected Base/Neutral/Acid Extractable Organics at the Sheridan Disposal Services Site

Constituent	Toxicological Data (SAX)			Permissible Air Exposure (TVL L SAX)	Water Quality Criteria (L EPA-440 EPA-MCLs EPA-540 CW T)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
Diethyl phthalate	LD50 oral	rat	9 000 mg/kg	5 mg/m3	MCL	NA	oral = 4	AWC - H2O + Org	NA	oral = E
	LD50 oral	mus	6 172 mg/kg	STEL	AWC - H2O + Org	350 mg/l	ihl = 4	AWC - H2O	NA	ihl = E
	LC50 ihl	mam	8 240 mg/m3	----	AWC - H2O	434 mg/l		AWC - Org	NA	
	TCLO ihl	hmn	1 000 mg/m3*	10 mg/m3	AWC - Org	1 800 mg/l				

*Irritant effects

Toxicity Category NC

Description of Primary Mode of Toxicity

An eye irritant Moderate irritation effects through oral pathways Narcotic in high concentrations and mucous membrane irritant

Aquatic Life (1)

AWC - FW (acute)	940 ug/l
AWC - FW (chronic)	3 ug/l
AWC - SW (acute)	2944 ug/l
AWC - SW (chronic)	3 4 ug/l

Texas Proposed

AWC - FW (acute)	NA
AWC - FW (chronic)	NA
AWC - SW (acute)	NA
AWC - SW (chronic)	NA

(1) values are for ester form

Constituent	Route Of Exposure	Type Of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
Di-n-octyl phthalate	LD50 oral	mus	6 513 mg/kg	5 mg/m3	MCL	NA	oral = NA	AWC - H2O + Org	NA	oral = NA
	LC50 ihl	mus	5 000 ug/m3	STEL	AWC - H2O + Org	NA	ihl = NA	AWC - H2O	NA	ihl = NA
	TDLO ipr	rat	5 000 mg/kg	----	AWC - H2O	NA		AWC - Org	NA	
			(5-15 days pregnan	10 mg/m3	AWC - Org	NA				

Toxicity Category NC

Description of Primary Mode of Toxicity

A skin and eye irritant Acute effects are intraperitoneal

Aquatic Life (1)

AWC - FW (acute)	940 ug/l
AWC - FW (chronic)	3 ug/l
AWC - SW (acute)	2944 ug/l
AWC - SW (chronic)	3 4 ug/l

Texas Proposed

AWC - FW (acute)	NA
AWC - FW (chronic)	NA
AWC - SW (acute)	NA
AWC - SW (chronic)	NA

(1) values are for ester form

See Table 6-5 for key to abbreviations

011317

TABLE 6-3 (Cont'd.)

Toxicological Properties and Available Exposure Criteria for
Detected Base/Neutral/Acid Extractable Organics at the Sheridan Disposal Services Site

Constituent	Toxicological Data (SAX)			Permissible Air Exposure (TVL - SAX)	Water Quality Criteria (EPA-440, EPA-MCLs, EPA-540, CW-1)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10^{-6} Risk Level) (PC)		
					Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
2-4-Dimethyl Phenol (Xylenol)	Route of Exposure	Type of Receptor	Concentration	NA	NC	NA	oral - NA	AWC - H2O + Org	NA	oral - NA
	Range of values for 5 of 6 xylenol isomers				AWC - H2O + Org	NA	inh - NA	AWC - H2O	NA	inh - NA
					AWC - H2O	NA		AWC - Org	NA	
					AWC - Org	NA				
	LD50 oral	rat	200-608 mg/kg		Aquatic Life					
		rbt	700-1 303 mg/kg		AWC - FW (acute)	2 820 ug/l				
		mus	381-980 mg/kg		AWC - FW (chronic)	NA				
	LDLO ivn	mus	56 mg/kg		AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
	Toxicity Category NC				Texas Proposed					
	Description of Primary Mode of Toxicity				AWC - FW (acute)	NA				
	NA				AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
Fluoride	Route of Exposure	Type of Receptor	Concentration	NA	NC	NA	oral - NA	AWC - H2O + Org	NA	oral - NA
					AWC - H2O + Org	NA	inh - NA	AWC - H2O	NA	inh - NA
	NA				AWC - H2O	NA		AWC - Org	NA	
					AWC - Org	NA				
	Toxicity Category NC				Aquatic Life					
	Description of Primary Mode of Toxicity				AWC - FW (acute)	NA				
	NA				AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				

See Table 6-5 for Key to abbreviations

TABLE 6-1 (Cont'd)

Toxicological Properties and Available Exposure Criteria for
Detected Base/Neutral/Acid Extractable Organics at the Sheridan Disposal Services Site

Constituent	Toxicological Data (SAX)			Permissible Air Exposure (TVL, L SAX)	Water Quality Criteria (L EPA-440 EPA-MCLs EPA-540 CW I)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
Isophorone	Route of Exposure	Type of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LD50 oral	rat	2 330 mg/kg	ceiling = 5 ppm	MCL	NA	oral = NA	AWC - H2O + Org	NA	oral = NA
	LCLO inh	rat	1 840 ppm/4 hrs	ceiling = 25 mg/m3	AWC - H2O + Org	5 2 mg/l	inh = NA	AWC - H2O	NA	inh = NA
	TCLO inh	human	25 ppm	OSHA	AWC - H2O	5 2 mg/l		AWC - Org	NA	
				----	AWC - Org	520 mg/l				
	*(systemic irritant effects)			25 ppm (140 mg/m3)	Aquatic Life					
					AWC - FW (acute)	117 000 ug/l				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	12 900 ug/l				
					AWC - SW (chronic)	NA				
	Toxicity Category NC				Texas Proposed					
	Description of Primary Mode of Toxicity: A skin and eye irritant It is chiefly a kidney poison It can cause lachrymation possible opacity of the cornea and necrosis of the cornea				AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
2-methyl naphthalene	Route of Exposure	Type of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LDLO oral	cat	5,000 mg/kg	NA	MCL	NA	oral = NA	AWC - H2O + Org	NA	oral = NA
					AWC - H2O + Org	NA	inh = NA	AWC - H2O	NA	inh = NA
					AWC - H2O	NA		AWC - Org	NA	
					AWC - Org	NA				
	Toxicity Category NC				Aquatic Life					
	Description of Primary Mode of Toxicity: Low irritation effect by oral pathways				AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				

See Table 6-5 for key to abbreviations

TABLE 6-3 (cont'd.)

Toxicological Properties and Available Exposure Criteria for
Detected Base/Neutral/Acid Extractable Organics at the Sheridan Disposal Services Site

Constituent	Toxicological Data (SAX)			Permissible Air Exposure (TVL & SAX)	Water Quality Criteria (EL, EPA-440, EPA-MCLs, EPA 540, CW, T)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10^{-6} Risk Level) (PC)		
	Route of Exposure	Type of Receptor	Concentration	TLV TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
2 methyl phenol and 4 methyl phenol	2 methyl phenol			5 ppm	AWC	NA	oral = 4	AWC - H2O + Org	NA	oral = NA
	LD50 oral	rat	121 mg/kg	55 mg/m3	AWC - H2O + Org	NA	thl = 4	AWC - H2O	NA	thl = NA
	LDLO oral	rbt	940 mg/kg	OSHA	AWC - H2O	NA		AWC - Org	NA	
				----	AWC - Org	NA				
	4 methyl phenol			55 ppm						
	LD50 oral	rat	207 mg/kg	22 mg/m3						
	LDLO oral	rbt	620 mg/kg	(exposure limits are for skin)						
	Toxicity Category NC				Aquatic Life					
	Description of Primary Mode of Toxicity				AWC - FW (acute)	NA				
	Has corrosive action on the skin and mucous membranes, will produce severe chemical burns and dermatitis. Possible damage to kidneys, liver and nervous system through absorption				AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
Naphthalene	Route of Exposure	Type of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LD50 ipr	mus	650 mg/kg	10 ppm	NC	NA	oral = NA	AWC - H2O + Org	NA	oral = NA
	LD50 oral	rat	1,780 mg/kg	50 mg/m3	AWC - H2O + Org	NA	thl = NA	AWC - H2O	NA	thl = NA
	LDLO oral	chd	100 mg/kg	STEL	AWC - H2O	NA		AWC - Org	NA	
	LDLO oral	rbt	3,000 mg/kg	----	AWC - Org	NA				
				15 ppm						
				75 mg/m3						
	Toxicity Category NC				Aquatic Life					
	Description of Primary Mode of Toxicity				AWC - FW (acute)	2,300 ug/l				
	Poisoning may occur by ingestion of large doses, inhalation or skin absorption. Some systemic reactions are convulsions, liver damage, anemia				AWC - FW (chronic)	620 ug/l				
					AWC - SW (acute)	2,350 ug/l				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				

See Table 6-5 for key to abbreviations

TABLE 6-3 (Cont'd.)

Toxicological Properties and Available Exposure Criteria for
Detected Base/Neutral/Acid Extractable Organics at the Sheridan Disposal Services Site

Constituent	Toxicological Data (SAX)			Permissible Air Exposure (TVL - SAX)	Water Quality Criteria (EPA-440, EPA-MCLs, EPA-540, FW, T)					
					Non-carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Levels) (PC)		
	Route of Exposure	Type of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
N-nitrosodiphenylamine	LD50 oral	rat	1850 mg/kg	NA	MCL	NA	oral - NA	AWC - H2O + Org	4900 ng/l	oral - NA
	LD50 oral	mus	3850 mg/kg		AWC - H2O + Org	NA	inh - NA	AWC - H2O	NA	inh - NA
					AWC - H2O	NA		AWC - Org	16 100 ng/l	
					AWC - Org	NA				
	Toxicity Category: NC/PC				Aquatic Life (for all nitrosamines)					
	Description of Primary Mode of Toxicity				AWC - FW (acute)	NA				
	moderate irritation through oral				AWC - FW (chronic)	NA				
	an eye irritant				AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
Phenanthrene	Route of Exposure	Type of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LD50 oral	mus	700 mg/kg	0.2 mg/m3	MCL	NA	oral - NA	AWC - H2O + Org	NA	oral - NA
	LD50 ivn	mus	56 mg/kg	(exposure limits are for coal	AWC - H2O + Org	NA	inh - NA	AWC - H2O	NA	inh - NA
	TDLO skn	mus	71 mg/kg*	tar pitch volatiles which	AWC - H2O	NA		AWC - Org	NA	
				include phenanthrene)	AWC - Org	NA				
	* neoplastic effects				Aquatic Life					
	Toxicity Category: NC				AWC - FW (acute)	NA				
	Description of Primary Mode of Toxicity				AWC - FW (chronic)	NA				
	A human skin photosensitizer; moderate				AWC - SW (acute)	NA				
	irritation through oral pathways; high				AWC - SW (chronic)	NA				
	irritation through intravenous pathways				Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				

See Table 6-5 for key to abbreviations

TABLE 6-3 (Cont'd.)

Toxicological Properties and Available Exposure Criteria for
Detected Base/Neutral/Acid Extractable Organics at the Sheridan Disposal Services Site

Constituent	Toxicological Data (SAX)			Permissible Air Exposure (TLVs & SAX)	Water Quality Criteria (EPA-440/5-80-069, EPA-440/5-86-001, EPA-540/1-86-060)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
Phenol	Route of Exposure	Type of Receptor	Concentration	TLV-TWA	Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
LD50	oral	mus	300 mg/kg	5 ppm	MCL	NA	oral = 3	AWC - H2O + Org	NA	oral = E
LD50	skin	rat	669 mg/kg	19 mg/m3	AWC - H2O + Org	3.5 mg/l	inh = 10	AWC - H2O	NA	inh = E
LDLO	oral	human	140 mg/kg	STEL	AWC - H2O	3.5 mg/l		AWC - Org	NA	
LDLO	oral	dog	420 mg/kg	- -	AWC - Org	NA				
				60 ppm						
				38 mg/m3						
	Toxicity Category: NC			(exposure limits are for skin)						
	Description of Primary Mode of Toxicity				Aquatic Life					
	A skin and eye irritant. In acute poisoning, the main effect is on the central nervous system. Absorption on skin can be rapid and death can occur quite quickly. Chronic poisoning results in digestive disturbances, nervous disorders and may be terminal in cases where there is extensive damage to the kidneys or liver. Dermatitis is quite common.				AWC - FW (acute)	10 200 ug/l				
					AWC - FW (chronic)	2 560 ug/l				
					AWC - SW (acute)	5 800 ug/l				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				

See Table 6-5 for key to abbreviations

TABLE 6-4

Toxicological Properties and Available Exposure Criteria (1)
Detected Pesticides and PCBs at Sheridan Disposal Service Site

Constituent	Toxicological Data (SAX V EPA-540)			Permissible Air Exposure (TLV (2))	Water Quality Criteria (1) EPA-540 EPA-841 (3), (4)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Levels) (PC)		
	Route of Exposure	Type of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
Aroclor 1016 (2)	NA			OSHA = 1 mg/m3	MCL	NA	oral = NA	AWC - H2O + Org	0.079 ug/l	oral = B2
					AWC - H2O + Org	NA	ihl = NA	AWC - H2O	>12.6 ug/l	ihl = B2
					AWC - H2O	NA		AWC - Org	0.079 ug/l	
					AWC - Org	NA				
	Toxicity Category NC/PC Description of Primary Mode of Toxicity Has a skin effect and a toxic action on the liver is a suspected human carcinogen				Aquatic Life AWC - FW (acute) 2.0 ug/l AWC - FW (chronic) 0.014 ug/l AWC - SW (acute) 10 ug/l AWC - SW (chronic) 0.030 ug/l Texas Proposed AWC - FW (acute) 2.0 ug/l AWC - FW (chronic) 0.014 ug/l AWC - SW (acute) 10 ug/l AWC - SW (chronic) 0.030 ug/l					
Aroclor 1232 (2)	Route of Exposure	Type of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LD50 oral	rat	4.470 mg/l	OSHA = 1 mg/m3	MCL	NA	oral = NA	AWC - H2O + Org	0.079 ug/l	oral = B2
	LDLO skn	rbt	2,000 mg/l		AWC - H2O + Org	NA	ihl = NA	AWC - H2O	>12.6 ug/l	ihl = B2
					AWC - H2O	NA		AWC - Org	0.079 ug/l	
					AWC - Org	NA				
	Toxicity Category NC/PC Description of Primary Mode of Toxicity A suspected human carcinogen Has moderate irritation effect on the skin and low irritation effect through oral pathway Has a toxic action on the liver				Aquatic Life AWC - FW (acute) 2.0 ug/l AWC - FW (chronic) 0.014 ug/l AWC - SW (acute) 10 ug/l AWC - SW (chronic) 0.030 ug/l Texas Proposed AWC - FW (acute) 2.0 ug/l AWC - FW (chronic) 0.014 ug/l AWC - SW (acute) 10 ug/l AWC - SW (chronic) 0.030 ug/l					

NOTES

(1) The permissible air exposure and the water quality criteria reported are for PCBs in general not for each individual congener

(2) The permissible air exposure is for DDT and its relatives (not for each compound individually

See table 6-5 for key to abbreviations

011323

TABLE 6-4 (Continued)

Toxicological Properties and Available Exposure Criteria for
Detected Pesticides and PCBs at Sheridan Disposal Service Site

Constituent	Toxicological Data (SAX, V, EPA-540)			Permissible Air Exposure (TLV, L)	Water Quality Criteria (L, EPA-540, EPA-MCL, CT, W)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
	Route Of Exposure	Type Of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
Aroclor 1242 (1)	LD50 oral	rat	4,250 mg/kg	TLV = 1 mg/m3	MCL	NA	oral = NA	AWC - H2O + Org	0.079 mg/l	oral = B2
	LDLO scu	gpg	356 mg/kg	OSHA = 1 mg/m3	AWC - H2O + Org	NA	ihl = NA	AWC - H2O	>12.6 ng/l	ihl = B2
	TCLO ihl	hmn	10 mg/m3		AWC - H2O	NA		AWC - Org	0.079 mg/l	
					AWC - Org	NA				
	Toxicity Category NC/PC Description of Primary Mode of Toxicity Suspected human carcinogen. Human inhalation causes irritation. Has high subcutaneous irritation effects. Has a toxic action on the liver				Aquatic Life AWC - FW (acute) 2.0 ug/l AWC - FW (chronic) 0.014 ug/l AWC - SW (acute) 10 ug/l AWC - SW (chronic) 0.030 ug/l					
					Texas Proposed AWC - FW (acute) 2.0 ug/l AWC - FW (chronic) 0.014 ug/l AWC - SW (acute) 10 ug/l AWC - SW (chronic) 0.030 ug/l					
Aroclor 1260 (1)	Route Of Exposure	Type Of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LD50 oral	rat	1,315 mg/kg	OSHA = 1 mg/m3	MCL	NA	oral = NA	AWC - H2O + Org	0.079 mg/l	oral = B2
	LDLO skn	rbt	2,000 mg/kg		AWC - H2O + Org	NA	ihl = NA	AWC - H2O	>12.6 ng/l	ihl = B2
	TDLO oral	rat	1,675 mg/kg		AWC - H2O	NA		AWC - Org	0.079 mg/l	
					AWC - Org	NA				
	Toxicity Category NC/PC Description of Primary Mode of Toxicity A suspected human carcinogen. Has moderate irritation effects through oral and skin pathways. Has a toxic action on the liver				Aquatic Life AWC - FW (acute) 2.0 ug/l AWC - FW (chronic) 0.014 ug/l AWC - SW (acute) 10 ug/l AWC - SW (chronic) 0.030 ug/l					
					Texas Proposed AWC - FW (acute 2.0 ug/l AWC - FW (chronic) 0.014 ug/l AWC SW (acute) 10 ug/l AWC SW (chronic) 0.030 ug/l					

NOTES:
(1) The permissible air exposure and the water Quality Criteria reported are for PCBs in general, not for each individual congener
(2) The permissible air exposure is for DDT and its relatives not for each compound individually
See Table 6-5 for key to abbreviations

011324

Table 6-4 (continued)

Toxicological Properties and Available Exposure Criteria for
Detected Pesticides and PCBs at Sheridan Disposal Service Site

Constituent	Toxicological Data (SAX V EPA-540)			Permissible Air Exposure (TLV (1))	Water Quality Criteria (1, EPA-540, EPA-MCL, CT WS)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
	Route Of Exposure	Type Of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
alpha-BHC	TDLO oral	rat	20 000 mg/kg/40 wks continuous*	NA	MCL	NA	oral = NA	AWC - H2O + Org	9 2 mg/l	oral = B2
	TDLO oral	mus	5 000 mg/kg/24 wks continuous**		AWC - H2O + Org	NA	ihl = NA	AWC - H2O	13 mg/l	ihl = B2
	TD50 oral	rat	504-667 mg/kg		AWC - H2O	NA		AWC - Org	NA	
	TD50 oral	gpg	90 mg/kg		AWC - Org	NA				
	*neoplastic effects									
	**carcinogenic effects									
	Toxicity Category NC/PC				Aquatic Life					
	Description of Primary Mode of Toxicity				AWC - FW (acute)	NA				
	Has neoplastic effects and carcinogenic effects. Central nervous system (CNS) toxin				AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
gamma-BHC	Route Of Exposure	Type Of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LD50 oral	rat	76 mg/kg	TLV-TWA = 0 5 mg/m3 (skin)	MCL	004 mg/l	oral = NA	AWC - H2O + Org	12 3 mg/l	oral = B2/C
	LDLO ipr	rat	35 mg/kg	STEL = 1 5 mg/m3 (skin)	AWC - H2O + Org	NA	ihl = NA	AWC - H2O	17 4 mg/l	ihl = B2/C
	LD50 oral	mus	86 mg/kg		AWC - H2O	NA		AWC - Org	NA	
	LDLO oral	chd	180 mg/kg		AWC - Org	NA				
	TDLO oral	chd	111 mg/kg*							
	* systemic effects									
	Toxicity Category NC/PC				Aquatic Life					
	Description of Primary Mode of Toxicity				AWC - FW (acute)	2 0 ug/l				
	Has systemic neoplastic and carcinogenic effects Has high irritation effects on humans through oral pathways Possible hematotoxic agent CNS toxin				AWC - FW (chronic)	0 06 ug/l				
					AWC - SW (acute)	0 16 ug/l				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	2 0 ug/l				
					AWC - FW (chronic)	0 06 ug/l				
					AWC - SW (acute)	0 16 ug/l				
					AWC - SW (chronic)	NA				

NOTES:
(1) The permissible air exposure and the Water Quality Criteria reported are for PCBs in general not for each individual congener
(2) The permissible air exposure is for DDT and its relatives not for each compound individually
See Table 6-5 for key to abbreviations

TABLE 6-4 (Continued)

Toxicological Properties and Available Exposure Criteria for
Detected Pesticides and PCBs at Sheridan Disposal Service Site

Constituent	Toxicological Data (SAX V. P EPA-540)			Permissible Air Exposure (TLV 1)	Water Quality Criteria (1 EPA-540 EPA-MCL CT W) Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
	Route Of Exposure	Type Of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
4 4-DDD (2)	LC50	crustaceans	10 0 ug/l	TLV-TWA = 1 mg/m3 (skin)	MCL	NA	oral = NA	AWC - H2O + Org	NA	oral = B2
			0 88 ug/l/96 hr	STEL = 3 mg/m3 (skin)	AWC - H2O + Org	NA	ihl = NA	AWC - H2O	NA	ihl = B2
	LC50	crustaceans	4 5 ug/l		AWC - H2O	NA		AWC - Org	NA	
			3 2 ug/l/48 hr		AWC - Org	NA				
	LD50 oral	rat	3 4 g/kg							
	Toxicity Category NC/PC				Aquatic Life					
	Description of Primary Mode of Toxicity				AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
	Similar to DDT				AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				
4 4-DDE (2)	Route Of Exposure	Type Of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
		NA		TLV-TWA = 1 mg/m3 (skin)	MCL	NA	oral = NA	AWC - H2O + Org	NA	oral = B2
				STEL = 3 mg/m3 (skin)	AWC - H2O + Org	NA	ihl = NA	AWC - H2O	NA	ihl = B2
					AWC - H2O	NA		AWC - Org	NA	
					AWC - Org	NA				
	Toxicity Category NC/PC				Aquatic Life					
	Description of Primary Mode of Toxicity				AWC - FW (acute)	1050 ug/l				
					AWC - H2O + Org	NA				
	Similar to DDT				AWC - SW (acute)	14 ug/l				
					AWC - SW (chronic)	NA				
					Texas Proposed					
					AWC - FW (acute)	NA				
					AWC - FW (chronic)	NA				
					AWC - SW (acute)	NA				
					AWC - SW (chronic)	NA				

NOTES:
(1) The permissible air exposure and the water Quality Criteria reported are for PCBs in general not for each individual congener
(2) The permissible air exposure is for DDT and its relatives not for each compound individually
See Table 6-5 for key to abbreviations

011326

TABLE 6-4 (continued)

Toxicological Properties and Available Exposure Criteria for
Detected Pesticides and PCBs at Sheridan Disposal Service Site

Constituent	Toxicological Data (SAX, V, P EPA-540)			Permissible Air Exposure (TLV (1))	Water Quality Criteria (EPA-540 EPA-MCL CT WI)					
					Non-Carcinogenic (NC)			Potential Carcinogenic (10-6 Risk Level) (PC)		
4,4-DDT (2)	Route Of Exposure	Type Of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LD50 oral	rat	113 mg/kg	TLV-TWA = 1 mg/m3 (skin)	MCL	NA	oral = NA	AWC - H2O + Org	0.024 ng/l	oral - B2
	LD50 skin	rat	1931 mg/kg	STEL = 3 mg/m3 (skin)	AWC - H2O + Org	NA	inh = NA	AWC - H2O	>1.2 ng/l	inh = B2
	LDLO ivn	cat	40 mg/kg		AWC - H2O	NA		AWC - Org	0.024 ng/l	
	LDLO oral	inf	150 mg/kg		AWC - Org	NA				
	LDLO oral	hum	6 mg/kg*							
	*central nervous system effects									
	Toxicity Category NC/PC				Aquatic Life					
	Description of Primary Mode of Toxicity				AWC - FW (acute)	1.1 ug/l				
	High irritation effects via oral and dermal routes Large doses cause nausea CNS toxin, reproduction toxin via induction of mixed function oxidases in many animals which induces metabolism of steroids Tumorogenic				AWC - FW (chronic)	0.001 ug/l				
					AWC - SW (acute)	0.13 ug/l				
					AWC - SW (chronic)	0.001 ug/l				
					Texas Proposed					
					AWC - FW (acute)	1.1 ug/l				
					AWC - FW (chronic)	0.001 ug/l				
					AWC - SW (acute)	0.13 ug/l				
					AWC - SW (chronic)	0.001 ug/l				
Dieldrin	Route Of Exposure	Type Of Receptor	Concentration		Human Health		EPA Severity Rating	Human Health		EPA Carcinogenic Class
	LD50 oral	rat	46 mg/kg	TLV-TWA = 0.25 mg/m3 (skin)	MCL	NA	oral = NA	AWC - H2O + Org	0.071 ng/l	oral = B2
	LD50 ihl	rat	43 mg/kg/4 hr	STEL = 0.75 mg/m3 (skin)	AWC - H2O + Org	NA	inh = NA	AWC - H2O	1.1 ng/l	inh = B2
	LDLO ipr	mus	26 mg/kg		AWC - H2O	NA		AWC - Org	0.076 ng/l	
	TDLO oral	mus	15 mg/kg (9 days pregnant)		AWC - Org	NA				
	Toxicity Category NC/PC				Aquatic Life					
	Description of Primary Mode of Toxicity				AWC - FW (acute)	2.5 ug/l				
	It acts as a central nervous system stimulant, toxin in sufficient quantity it also greatly reduces or eliminates appetite Will cause nausea, headache and dizziness; may also cause chronic and tonic convulsions Tumorogenic				AWC - FW (chronic)	0.0019 ug/l				
					AWC - SW (acute)	0.71 ug/l				
					AWC - SW (chronic)	0.0019 ug/l				
					Texas Proposed					
					AWC - FW (acute)	2.5 ug/l				
					AWC - FW (chronic)	0.0019 ug/l				
					AWC - SW (acute)	0.71 ug/l				
					AWC - SW (chronic)	0.0019 ug/l				

NOTES:
(1) The permissible air exposure and the water quality criteria reported are for PCB's in general, not for each individual congener
(2) The permissible air exposure is for DDT and its relatives not for each compound individually
See table 6-5 for key to abbreviations

TABLE 6-5

Explanation of Terms and Abbreviations for Tables 6-1 through 6-4

UNITS

kg = kilogram
mg = milligram
ug = microgram
ng = nanogram
l_3 = liter
m^3 = cubic meter
N/A = Not Available

min = minute
h = hour
d = day
m = month
ppm = parts per million
ppb = parts per billion

NC = EPA Non-carcinogen toxicity category
PC = EPA Potential carcinogen toxicity category
EPA Carcinogen Class = See Table 7-6
EPA Severity Rating = See Table 7-5
MCL = Maximum Concentration Limit for protection of human health.

Texas Proposed = Criteria Proposed for Protection of Aquatic Species

Ambient Water Quality Criteria (AWC) for Human Health

AWC is the concentration in drinking water derived from ADI values which provide for protection of human health from potential effects due to the consumption of contaminated water and/or contaminated organisms. Published values are calculated for a 70 kg man consuming two liters of water and 6.5 g of fish and shellfish, or two liters of water only, or 6.5 g of fish only per day from the source for a lifetime of 70 years.
AWC-Org. + H_2O: AWC for consumption of organisms and water
AWC-Org.: AWC for consumption of organisms only
AWC-H_2O: AWC for consumption of water only

Ambient Water Quality Criteria (AWC) for Protection Of Aquatic Life

AWC values for acute (not to exceed) water concentrations are the concentrations set to prevent acute toxicity to aquatic life.
AWC values for chronic (24-hour average) water concentrations are the concentrations set to prevent chronic toxicity to aquatic life.
AWC-FW: Fresh Water Life
AWC-SW: Saltwater Life

See Page 6-5 for a list of reference for Table 6-1 through 6-4.

PERMISSIBLE AIR EXPOSURE

OSHA = Occupational Safety and Health Administration
TLV-TWA = Threshhold Limit Value for the Time-Weighted Average concentration for a 40-hour work week.
STEL = Short-term Exposure Limit
Ceiling = OSHA/ACGIH-defined concentrations which should not be exceeded at any time within an 8 or 10 hour work period.
Peak = Concentration not to be exceeded at any time, usually with a specified time limit (e.g., 5 minutes) for the peak concentration within a broader time period of total exposure (e.g., 4 hours).

TOXICITY & HEALTH EFFECTS

LD_{50} = Dosage of substance at which 50% or more of the test population die after a single dose. Expressed as mg/kg of body weight.
LC_{50} = Limiting concentration (usually in ppm for air or mg/l for water) which causes 50% (or more) mortality in the population. Commonly used in evaluating exposures for aquatic organisms or for inhalation studies on terrestrial vertebrate.
LD_{LO} = Lowest published lethal dose. The lowest dose of a substance introduced by any route other than inhalation, over any given period of time in one or more divided portions, and reported to have caused death in humans or animals.
TC_{LO} = Lowest published toxic concentration. The lowest concentration of a substance in air to which humans or animals have been exposed for any given period of time that has produced any toxic effect in humans or produced tumorogenic or reproductive effects in animals.
TD_{LO} = Toxic dose low. The lowest dose of a substance introduced by any route, other than inhalation, over any given period of time and reported to produce any toxic effect in humans or to produce tumorogenic (carcinogenic) or reproductive effects in animals.

inh = inhalation
orl = oral
dermal = dermal
rbt = rabbit
mus = mouse
gpg = guinea pig
scu = subcutaneous
ims = intramuscular
inf = infant

ivn = intravenous
imp = implant
ipr = intraperitoneal
cld = child
hmn = human (sex not specified)
ham = hamster
wmn = woman
mam = mammal (species unspecified)

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7 - SELECTION OF INDICATOR CHEMICALS

Indicator chemicals were selected in accordance with the guidelines set forth in EPA's "Superfund Public Health Evaluation Manual", Section 3 (OSWER Directive 9285.4-1, October 1986). The primary purpose of the indicator selection process in the context of this Risk Assessment is to identify the chemicals most useful for assessing worst-case migration rates at the site for suites of chemicals (i.e. volatiles, semi-volatiles, PCBs and metals). Therefore, not all of the indicator chemicals selected necessarily represent the most toxic or most abundant chemicals present at the site.

7.1 Development of Initial Indicator Chemical List

In accordance with EPA guidance, the initial indicator chemical list was developed on the basis of site concentration data (Tables 4-1 and 4-2), physical properties, fate and persistence information (Tables 5-1 through 5-4; EPA Exhibits A-1 and A-2),[1] toxicity information (Tables 6-1 through 6-4; EPA Exhibits A-3, A-4, A-5, A-6, D-1 and D-2), and environmental mobility (Tables 5-1 through 5-4; EPA Exhibit A-1). The data are presented in Table 7-1 (organics) and Table 7-2 (metals). The tables summarize the range and representative concentrations of chemicals found in each of four environmental "compartments" or "media" (ground water, surface water, soils and air) at the site. CAS numbers for each chemical are also presented, along with available partition coefficients Koc (organic carbon partition coefficient) and Kow (octanol water partition coefficient). Where a published Koc was not available for a given chemical, it was calculated using the following formula:

$$\text{Log Koc} = (-0.55 * \text{Log}(S)) + 3.64$$

where S = solubility in mg/l

The compounds listed in Tables 7-1 and 7-2 were derived from Tables 4-1 and 4-2, respectively. All compounds listed in Table 4-1 appear in Table 7-1. The only compounds which do not appear

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[1] This EPA Exhibit reference and all other EPA Exhibit and EPA Worksheet references refer to the following EPA document, "Superfund Public Health Evaluation Manual", Section 3 (OSWER Directive 9285.4-1, October 1986). EPA Appendix A tables are provided in Appendix C to this report.

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TABLE 7-1

Summary of Organic Chemical Data Concentration and Koc Values for Organics
in Various Environmental Media for Indicator Chemical Selection

Chemical Name	CAS Number	Koc (ml/g)	Log Kow	Shallow Ground Water (mg/l) Range	Shallow Ground Water (mg/l) Repres	Surface Water (mg/l) (Main Pond) Range	Surface Water (mg/l) (Main Pond) Repres	Soil/Sludge (mg/kg) Range	Soil/Sludge (mg/kg) Repres	Air Range (ppm)	Air Range (mg/cu m)	Air Repres (mg/cu m)
VOLATILE ORGANICS												
Acetone	(67-64-1)	2.2	-0.24	NT	NT	<0.025	ND	<0.625-19	9.51	BMDL-0.0027	BMDL-0.00641	0.0064
Benzene	(71-43-2)	63	2.13	NT	NT	<0.005-<0.50	ND	<0.005-<2500	1250.00	0.0037-0.004	0.0113-0.0128	0.0123
2-Butanone (MEK)	(78-93-3)	4.5	0.26	NT	NT	<0.025	ND	<0.025-9	4.51	BMDL	BMDL	dl not reported
Carbon disulfide	(75-15-0)	54	2.16	NT	NT	<0.005	ND	<0.085-19	9.50	ND	ND	dl not reported
Chlorobenzene	(108-90-7)	330	2.84	NT	NT	<0.005-<0.50	ND	<0.005-4.1	2.05	ND	ND	dl not reported
1,2-Dichloroethane (EDC)	(107-06-2)	14	1.79	NT	NT	<0.005-<0.50	ND	<0.005-44	22.00	NR	NR	NR
1,1-Dichloroethylene	(75-35-4)	65	1.48	NT	NT	<0.005-<0.50	ND	<0.005-0.57	0.29	BMDL	BMDL	dl not reported
Ethylbenzene	(100-41-4)	1100	3.15	NT	NT	<0.005-<0.50*	ND	<0.005-<3450	1000.00	BMDL	BMDL	dl not reported
2-Hexanone	(591-78-6)	13.8	1.38	NT	NT	<0.01	ND	<0.01-1.2	0.61	ND	ND	dl not reported
Methylene chloride	(75-09-2)	8.80	1.25	NT	NT	<0.025-<0.50	ND	<0.025-33	16.51	<0.000001*-0.0087	<0.000035-0.03045	0.0152
4-Methyl-2-Pentanone (MIBK)	(108-10-1)	20.6	NA	NT	NT	<0.01	ND	<0.01-77	38.51	ND	ND	dl not reported
Styrene	(100-42-5)	189	NA	NT	NT	<0.005	ND	<0.005-500	250.00	ND	<0.000009	ND
Tetrachloroethylene	(127-18-4)	364	2.88	NT	NT	<0.005-0.51	0.26	<0.005-251	125.50	ND-BMDL	ND-BMDL	dl not reported
Toluene	(108-88-3)	300	2.69	NT	NT	0.0081-1.61	0.81	<0.005-<36.600	2000.00	0.0030-0.0046	0.0147-0.0173	0.0160
Trichloroethylene	(79-01-6)	126	2.29	NT	NT	<0.005-2.91	1.46	<0.005-100	50.00	ND	ND	NR
Xylene (mixed)	(1330-20-7)	240	3.26	NT	NT	<0.005	ND	<0.005-.700	1350.00	0.0019-0.0038	0.008205-0.0165	0.0124
ACID FRACTION ORGANICS												
2,4-Dimethylphenol (Xylenol)	(105-67-9)	20.6	2.50	NT	NT	<0.015-<0.50*	ND	<0.09-580	290.05	NT	NT	NT
2-Methylphenol (2-Cresol)	(1319-77-3)	500	1.97	NT	NT	<0.015	ND	<0.33-349	170.17	NT	NT	NT
4-Methylphenol (4-Cresol)	(1319-77-3)	500	1.92	NT	NT	<0.015	ND	<0.33-850	425.17	NT	NT	NT
Phenol	(108-95-2)	14.2	1.46	NT	NT	<0.015-13.84	1.75	<0.05-1500	750.03	NT	NT	NT

ND = Not detected
NT = Not tested
NA = Not available/not applicable
NR = Not reported
BMDL = Tentatively identified below sample detection limit

Log Kow = Log of the octanol water partition coefficient

Koc = Organic carbon partition coefficient from EPA, October 1986 If not published calculated as:
$10^{((-0.55*LOG(S))+3.64)}$ where S = solubility in mg/l

* = Compound is BMDL. Asterisk denotes detection limit of sample

UNIT EQUIVALENT CONCENTRATIONS FOR AIR

Acetone	1 ppm = 2.373 mg/cu m
Benzene	1 ppm = 3.194 mg/cu m
Methylene chloride	1 ppm = 3.500 mg/cu m
Styrene	1 ppm = 4.25 mg/cu m
Toluene	1 ppm = 3.767 mg/cu m
Xylenes	1 ppm = 4.35 mg/cu m

Maximum = maximum concentration detected at the site for the environmental medium listed
When concentration = BMDL, maximum = sample detection limit (dl)

Repres = representative concentration, calculated as "(max+min)/2" where "max" = maximum detected value "min" = minimum detected value or detection limit
Exceptions: for phenol in water and toluene and ethylbenzene in soil/sludge Repres = approximate median of range of detected values
Where only one sample has been analyzed for a constituent repres = max or ND as appropriate

TABLE 7-1 (Cont'd)

Summary of Organic Chemical Data (concentrations and RfD Values for Organics) in Various Environmental Media for Indicator Chemical Selection

Chemical Name	CAS Number	Koc (ml/g)	Log Kow	Shallow Ground Water (mg/l) Range	Shallow Ground Water (mg/l) Repres	Surface Water (mg/l) (Main Area) Range	Surface Water (mg/l) (Main Area) Repres	Soil/Sludge (mg/kg) Range	Soil/Sludge (mg/kg) Repres	RfD Range (mg/kg/day)	RfD Range (mg/cu m)	RfD Repres (mg/cu m)
BASE-NEUTRAL FRACTION ORGANICS												
Acenaphthene	(83-32-9)	4600	4 33	NT	NT	<0 015-<0 050	ND	<0 061 170	85 03	NT	NT	NT
Anthracene	(120-12-7)	14000	5 30	NT	NT	<0 015-<0 050	ND	<0 33-33	16 67	NT	NT	NT
Bis-(2-ethylhexyl) phthalate	(117-81-9)	7225	8 73	NT	NT	<0 015-<0 050	ND	<0 33 160**	90 17	NT	NT	NT
Butyl benzyl phthalate	(85-68-7)	2410	5 88	NT	NT	<0 015-<0 050	ND	<0 33-110**	55 17	NT	NT	NT
Chrysene	(218-01-9)	200000	5 61	NT	NT	<0 015-<0 050	ND	<0 061-4 7	2 39	NT	NT	NT
Dibenzofuran	(132-64-9)	NA	4 12	NT	NT	<0 015	ND	<0 33-140	78 17	NT	NT	NT
Diethyl phthalate	(84-66-2)	142	2 23	NT	NT	<0 015-<0 050	ND	<0 033 23	11 52	NT	NT	NT
Di-N-octyl phthalate	(117-84-0)	2386	9 20	NT	NT	<0 015-<0 050	ND	<0 33-40	20 17	NT	NT	NT
Fluorene	(86-73-7)	7300	4 18	NT	NT	<0 015-<0 050	ND	<0 033-55 4	27 73	NT	NT	NT
Isophorone	(78-59-1)	25	1 70	NT	NT	<0 015-0 077	0 046	<0 073-99 8	49 94	NT	NT	NT
2-Methylnaphthalene	(91-57-6)	NA	NA	NT	NT	<0 015	ND	<0 33-660	330 17	NT	NT	NT
Naphthalene	(91-20-3)	574	3 25	NT	NT	<0 015-<0 05*	ND	<0 053-410	205 03	NT	NT	NT
N-Nitrosodiphenylamine	(62-75-9)	NA	2 57	NT	NT	<0 015-<0 050	ND	<0 063-190	95 03	NT	NT	NT
Phenanthrene	(85-01-8)	14000	4 46	NT	NT	<0 015-<0 050	ND	<0 180-42 8	21 40	NT	NT	NT
PESTICIDES AND PCBS												
alpha-BHC	(319-84-6)	3800	3 81	NT	NT	<0 005-<0 050	ND	<0 006-1 4	0 70	NT	NT	NT
gamma-BHC (Lindane)	(58-89-9)	1060	4 14	NT	NT	<0 005-<0 050	ND	<0 006-0 49	0 25	NT	NT	NT
4,4'-DDD	(75-99-0)	770000	5 99	NT	NT	<0 010-<0 050	ND	<0 016-1 2	0 61	NT	NT	NT
4 4'-DDE	(72-55-9)	4400000	5 69	NT	NT	<0 010-<0 050	ND	<0 016-0 76	0 46	NT	NT	NT
4 4'-DDT	(50-29-3)	243000	6 19	NT	NT	<0 010-<0 050	ND	<0 016-2 1	1 06	NT	NT	NT
Dieldrin	(60-57-1)	1700	3 50	NT	NT	<0 010-<0 050	ND	<0 016-0 75	0 38	NT	NT	NT
Aroclor 1016	(1336-36-3)	7034	4 38	NT	NT	<0 05	ND	<0 08-55	27 54	NT	NT	NT
Aroclor 1232	(1336-36-3)	3558	3 20	NT	NT	<0 05	ND	<0 008-11	5 50	NT	NT	NT
Aroclor 1242	(1336-36-3)	9569	5 58	NT	NT	<0 05	ND	<0 08-219	109 54	NT	NT	NT
Aroclor 1260	(1336-36-3)	112915	7 14	NT	NT	<0 05-<0 1	ND	<0 16-76	38 05	NT	NT	NT

ND = Not detected
NT = Not tested
NA = Not available/Not applicable
NR = Not reported
BMDL = Tentatively identified below sample detection limit

Log Kow = Log of the octanol water partition coefficient
Koc = Organic carbon partition coefficient, from EPA October 1986 (if not published) calculated as
(10^((-0 55*log(S))+3 64)) where S = solubility in mg/l
* = Compound is BMDL Asterisk denotes detection limit of sample
** = High data is from 967 sample of floating oil/emulsion layer

Maximum = maximum concentration detected at the site for the environmental medium listed
when concentration = BMDL maximum = sample detection limit (dl)
Repres = representative concentration, calculated as "(max+min)/2" where "max" = maximum detected value "min"=minimum detected value or detection limit
exception where only one sample has been analyzed for the constituent repres = max or ND as appropriate

TABLE 7-2

Summary of Inorganic Chemical Data
Concentrations and Kd Values for Metals in Various Environmental Media
for Indicator Chemical Selection

Chemical Name	CAS Number	Kd Value	Shallow Ground Water (mg/l) Range	Shallow Ground Water (mg/l) Repres	Surface Water (mg/l) Range	Surface Water (mg/l) Repres	Soil/Sludge (mg/kg) Range	Soil/Sludge (mg/kg) Repres	Air (mg/cu m) Range	Air (mg/cu m) Repres
Aluminum	NA	10	NT	NT	0.02-0.15	0.085	2300-8790	5545	NT	NT
Arsenic	(7440-38-2)	10	NT	NT	<0.01-0.041	0.0165	<1.43-20	10.715	NT	NT
Barium	(7440-39-3)	10	NT	NT	0.16-1.6	0.88	40-820	410	NT	NT
Beryllium	(7440-41-7)	10	NT	NT	<0.001	ND	<0.1-0.5	0.3	NT	NT
Cadmium	(7440-43-9)	10	NT	NT	<0.005-0.090	0.0475	0.15-31.4	15.775	NT	NT
Chromium	(7440-47-3)	10	NT	NT	<0.01-2.27	1.14	<1.43-302	151.715	NT	NT
Copper	(7440-50-8)	10	NT	NT	0.006-2.99	1.498	5.388	196.5	NT	NT
Iron	(15438-31-0)	10	NT	NT	0.36-35.2	17.78	1040-9010	5025	NT	NT
Lead	(7439-92-1)	10	NT	NT	<0.008-0.60	0.304	<2-1200	601	NT	NT
Manganese	(7439-96-5)	10	NT	NT	0.29-2.97	1.63	71-244	157.5	NT	NT
Mercury	(7439-97-6)	10	NT	NT	<0.0002-0.001	0.0006	0.06-<1	0.03	NT	NT
Nickel	(7440-02-0)	10	NT	NT	<0.010-1.24	0.625	<1.43-90	45.715	NT	NT
Selenium	(7782-49-2)	10	NT	NT	<0.004-0.041	0.0225	0.2-0.6	0.4	NT	NT
Silver	(7440-22-4)	10	NT	NT	<0.005-0.11	0.0575	<2-<50	ND	NT	NT
Vanadium	(7440-62-2)	10	NT	NT	<0.01-0.01	0.01	20-25	22.5	NT	NT
Zinc	(7440-66-6)	10	NT	NT	0.01-9.0	4.[illegible]	10-13800	3500	NT	NT

NA = Not Available
ND = Not Detected (for purposes of the selection process, ND = 0)
NT = Not Tested
Kd = distribution coefficient for ground water model WMPLUM2D Assumed conservative value based on Walton, 1984

Maximum = maximum concentration detected at the site for the environmental medium listed
when concentration = BMDL, maximum = sample detection limit (dl)
Repres = representative concentration, calculated as (max+min)/2 where "max" = maximum detected value, "min"=minimum detected value or detection limit
Exceptions for zinc, Repres = approximate median of range
where only one sample has been analyzed for a constituent, repres = max (or ND) as appropriate

on Table 7-2 that are in Table 4-2 are six elements which are not listed hazardous materials and which do not appear to be present on-site in sufficient quantity to effect transport properties of other constituents (calcium, potassium, sodium, boron, cobalt and magnesium).

7.2 Definition of Maximum and Representation Concentration

The range of concentration values (including ranges of detection limits) found for each compound in each tested environmental medium are summarized in Tables 7-1 and 7-2. Maximum (max) concentrations for each of the compounds is the maximum above-detection-limit value for all media in which a detection occurs. However, some compounds had no values above detection limits for one or more media (e.g., acetone in surface water). In such cases, the maximum detection limit reported for the compound becomes the "max" concentration for that environmental media.

Representative values were calculated for each medium using the following formula to determine the mean of the reported range:

Repres. value = (max+min)/2

where min = lowest detected value or detection limit

A representative value was used (rather than an arithmetic or geometric mean) to determine the concentration of each constituent examined in the ranking of indicator chemicals because of the variation in sampling within a particular medium. Sampling locations were not evenly distributed throughout the site; therefore, the mean of the range is not completely influenced by the selection and number of sampling locations, but rather it yields a value that is one-half the maximum or higher.

For example, note that for the medium "soil/sludge", data from five distinct site compartments are represented by a range of values given in Tables 7-1 and 7-2. These compartments are: 1) soils in the evaporation system, 2) sludges in the evaporation system, 3) soils in the dike, 4) visibly affected soils in the dike, and 5) sludges in the main pond. The "representative" values for each of these compartments are quite different (see Table 9-2, Section 9). However, due to the way the indicator selection process is structured in EPA's "Superfund Public Health Evaluation Manual", only the "worst-case" compartment "counts" in the ranking process. Because of differences in the distribution and frequency of sampling within five distinct site compartments in the "soil/sludge" medium, an arithmetic average of all data was considered inappropriate for the ranking process. Therefore, the mean of the range was considered to be representative of the "soil/sludge" medium.

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The only compounds for which this formula was not used were phenol in water, toluene and ethylbenzene in soil/sludge, and zinc in soil/sludge. In each of these instances, an extremely high outlying value was obtained in 1984/85 that could not be reproduced in the Source Control Feasibility Study field investigation. In order not to skew the values for these constituents to unreasonably high levels, the actual median of the detected values was used as the representative concentration for these constituents. Finally, where no above-detection limit values occurred, the representative concentration is not detected (ND) and is treated as zero for the purpose of the calculations in Tables 7-7, 7-8 and 7-9 (Section Section 7.3.2).

7.3 Scoring Indicator Chemicals

The next step in the procedure is to score the initial indicator species using the following algorithm:

$$IS_i = SUM[(C_{ij})*(T_{ij})]$$

where

IS_i = indicator score for chemical i (unitless)

C_{ij} = concentration of chemical i in medium j at the site based on monitoring data (units must be mg/l in water, mg/kg in soil or mg/m^3 in air)

T_{ij} = a toxicity constant for chemical i in medium j (units are the inverse of the above concentration units).

7.3.1 Toxicity Constants

EPA derived toxicity constants (T-Values) for each environmental medium and two types of toxic effects (carcinogenicity and other chronic effects) are summarized in Exhibit 3-2 of the 1986 EPA guidance. Toxicity constants for noncarcinogens (Tn) were derived from the minimum effective dose (MED) for chronic effects, a severity of effects factor and standard factors for body weight and oral or inhalation intake (e.g., 70 kg body weight, 2 liters/day of drinking water, 20 cubic meters/day of air). Toxicity constants for potential carcinogens (Tc) were based on the dose at which a 10 percent incremental carcinogen response is observed (ED_{10}) and the same standard intake and body weight factors. The intake factor for soil toxicity constants was based on an assumption of 100 milligrams of soil ingested per day for 2- to 6-year-olds.

Toxicity constants are medium-specific, with wT, aT and sT representing water, air and soil, respectively. Values for these constants are provided for each indicator parameter in Tables 7-3 and 7-4 (organics and metals, respectively).

011334

TABLE 7-3

Scoring for Organic Indicator Chemical Selection
Toxicity Information

CHEMICAL	TOXICOLOGICAL CLASS	RATING VALUE/ EPA CATEGORY	TOXICITY CONSTANTS wT	sT	aT
VOLATILE ORGANICS					
Acetone	NC	NA	NA	NA	NA
Benzene	PC	A	7 71E-03	3 86E-07	7 71E-02
	NC	5(oral)	1 17E-01	5 85E-06	
		10 (inhalation)			1 18E-02
2-Butanone (MEK)	NC	10(oral)	7 75E-03	3 87E-07	
		10 (inhalation)			7 75E-02
Carbon disulfide	NC	7 (oral)	4.24E-01	2 12E-05	
		7 (inhalation)			4 24E+00
Chlorobenzene	NC	4 (oral)	1.43E-01	7 14E-06	
		1 (inhalation)			2 79E-01
1,2-Dichloroethane	PC	B2	5 86E-02	2 93E-06	5 86E-01
	NC	10 (oral)	1 76E-02	8 80E-07	
		8 (inhalation)			1 10E+00
1,1-Dichloroethylene	PC	C	1 23E-01	6 14E-06	1 23E+00
	NC	7 (oral)	3 71E-01	1 86E-05	
		5 (inhalation)			5 65E+00
Ethylbenzene	NC	4 (oral)	1 10E-02	5 52E-07	
		4 (inhalation)			1 10E-01
Methylene chloride	PC	B2	NA	NA	NA
	NC	10 (oral)	9 20E-04	4 60E-08	
		10 (inhalation)			9 20E-03
4-Methyl-2-pentanone (MIBK)	NC	NA	NA	NA	NA
Styrene	NC	NA	NA	NA	NA
Tetrachloroethylene	PC	B2	8 86E-03	[illegible]	8 86E-02
	NC	7 (oral)	9 62E-03	4 81E-07	
		10 (inhalation)			2 75E-02
Toluene	NC	7 (oral)	5.20E-03	2 60E-07	
		7 (inhalation)			5 20E-02
Trichloroethylene	PC	B2	4 29E-03	2 14E-07	4 29E-02
	NC	5 (oral)	1 05E+00	5 26E-05	
		4 (inhalation)			2 96E+01
Xylene (mixed)	NC	NA	NA	NA	NA

PC = Potential Carcinogen
NC = Non-Carcinogen Effects
NA = Not Available or Not Applicable

wT = EPA toxicity constant for water
sT = EPA toxicity constant for soils
aT = EPA toxicity constant for air

Rating Value = RVe = EPA weight of evidence rating for noncarcinogen toxicity (see Table 7-5)
EPA Category = EPA weight of evidence category for carcinogens (see Table 7-6)

All values from EPA's Superfund Public Health Evaluation Manual, October 1986, Exhibits C-3, C-4 and C-5 (See Appendix C, this report)

011335

TABLE 7-3 (Continued)

Scoring for Organic Indicator Chemical Selection
Toxicity Information

CHEMICAL	TOXICOLOGICAL CLASS	RATING VALUE/ EPA CATEGORY	TOXICITY CONSTANTS wT	sT	aT
ACID FRACTION ORGANICS					
2,4-Dimethylphenol (xylenol)	NA	NA	NA	NA	NA
2-methylphenol (2-Cresol)	NC	4 (oral)	5.97E+00	2.99E-04	
		4 (inhalation)			5.97E+01
4-methylphenol (4-Cresol)	NC	4 (oral)	5.97E+00	2.99E-04	
		4 (inhalation)			5.97E+01
Phenol	NC	3 (oral)	1.00E-01	5.02E-06	
		10 (inhalation)			2.49E+00
BASE-NEUTRAL FRACTION ORGANICS					
Acenaphthene	PC	NA	NA	NA	NA
	NC	NA	NA	NA	NA
Anthracene	PC	D	NA	NA	NA
	NC	NA	NA	NA	NA
Bis-(2-ethylhexyl) phthalate	PC	B2	5.71E-04	2.86E-08	5.71E-03
	NC	NA	NA	NA	NA
Butyl benzyl phthalate	NA	NA	NA	NA	NA
Dimethyl phthalate	NA	NA	NA	NA	NA
Di-N-octyl phthalate	NA	NA	NA	NA	NA
Chrysene	PC	NA	NA	NA	NA
	NC	NA	NA	NA	NA
Dibenzofuran	NA	NA	NA	NA	NA
Fluorene	PC	D	NA	NA	NA
	NC	NA	NA	NA	NA
Isophorone	NC	NA	NA	NA	NA
2-methylnaphtalene	NA	NA	NA	NA	NA
Napthalene	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine	NA	NA	NA	NA	NA
Phenanthrene	PC	D	NA	NA	NA
	NC	NA	NA	NA	NA

PC = Potential Carcinogen
NC = Non-Carcinogen Effects
NA = Not Available or Not Applicable

wT = EPA toxicity constant for water
sT = EPA toxicity constant for soils
aT = EPA toxicity constant for air

Rating Value = Rve = EPA weight of evidence rating for noncarcinogen toxicity (see Table 7-5)
EPA Category = EPA weight of evidence category for carcinogens (see Table 7-6)

All values from EPA's Superfund Public Health Evaluation Manual, October 1986, Exhibits C-3, C-4 and C-5 (See Append x C, this report).

011336

TABLE 7-3 (Continued)

Scoring for Organic Indicator Chemical Selection
Toxicity Information

CHEMICAL	TOXICOLOGICAL CLASS	RATING VALUE/ EPA CATEGORY	TOXICITY CONSTANTS wT	sT	aT
PESTICIDES AND PCBS					
alpha-BHC	PC	B2	1.56E+00	7.79E-05	1.56E+01
	NC	NA	NA	NA	NA
gamma-BHC	PC	B2/C	5.23E-02	2.61E-06	5.23E-01
	NC	NA	NA	NA	NA
4,4'-DDD	PC	B2	3.71E-03	1.86E-06	3.71E-01
	NC	NA	NA	NA	NA
4,4'-DDE	PC	B2	1.13E-01	5.64E-06	1.13E+00
	NC	NA	NA	NA	NA
4,4'-DDT	PC	B2	1.59E-01	7.97E-06	1.59E+00
	NC	NA	NA	NA	NA
Dieldrin	PC	B2	3.66E+00	1.83E-04	3.66E+00
	NC	NA	NA	NA	NA
Aroclor 1016	PC	B2	5.71E-01	2.86E-05	5.71E+00
	NC	NA	NA	NA	NA
Aroclor 1232	PC	B2	5.71E-01	2.86E-05	5.71E+00
	NC	NA	NA	NA	NA
Aroclor 1242	PC	B2	5.71E-01	2.86E-05	5.71E+00
	NC	NA	NA	NA	NA
Aroclor 1260	PC	B2	5.71E-01	2.86E-05	5.71E+00
	NC	NA	NA	NA	NA

PC = Potential Carcinogen
NC = Non-Carcinogen Effects
NA = Not Available or Not Applicable

wT = EPA toxicity constant for water
sT = EPA toxicity constant for soils
aT = EPA toxicity constant for air

Rating Value = RVe = EPA weight of evidence rating for noncarcinogen toxicity (see Table 7-5)
EPA Category = EPA weight of evidence category for carcinogens (see Table 7-6)

All values from EPA's Superfund Public Health Evaluation Manual, October 1986, Exhibits C-3, C-4 and C-5 (see Appendix C, this report)

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TABLE 7-4

Scoring for Inorganic Indicator Chemical Selection
Toxicity Information

CHEMICAL	TOXICOLOGICAL CLASS	RATING VALUE/ EPA CATEGORY	TOXICITY CONSTANTS wT	sT	aT
Aluminum	NC	NA	NA	NA	NA
Arsenic	PC	A	4.07E+00	2.03E-04	4.07E+01
	NC	9 (oral)	1.80E+01	9.00E-04	
	NC	9 (inhalation)			1.80E+02
Barium	NC	10 (oral)	4.08E+00	2.04E-04	
		10 (inhalation)			4.08E+01
Beryllium	PC	B1	NA	NA	2.28E+01
	NC	8 (inhalation)	NA	NA	1.45E+04
Cadmium	PC	B1	NA	NA	1.65E+01
	NC	10 (oral)	4.45E+00	2.23E-04	
		8 (inhalation)			3.59E+02
Chromium (as Cr+VI)	PC	A	NA	NA	1.11E+02
	NC	8 (inhalation)	NA	NA	2.50E+01
Copper	NC	5 (oral)	7.14E-01	3.57E-05	
		5 (inhalation)			7.14E+00
Iron	NC	NA	NA	NA	NA
Lead	NC	10 (oral)	8.93E-01	4.46E-05	
		10 (inhalation)			8.93E+00
Manganese	NC	NA	NA	NA	NA
Mercury (inorganic)	NC	7 (oral)	1.84E+01	9.21E-04	
		8 (inhalation)			1.86E+02
Nickel	PC	A	NA	NA	2.85E+00
	NC	10 (oral)	4.26E+00	2.13E-04	
		10 (inhalation)			5.57E+02
Selenium	NC	10 (oral)	1.05E+02	5.26E-03	
		10 (inhalation)			1.05E+03
Silver	NC	1 (oral)	2.00E+01	1.00E-03	
		1 (inhalation)			2.00E+02
Vanadium	NC	1 (oral)	1.43E-01	7.14E-06	
		1 (inhalation)			1.43E+00
Zinc	NC	8 (oral)	1.07E-01	5.33E-06	
		8 (inhalation)			1.07E+00

PC = Potential Carcinogen
NC = Non-Carcinogen Effects
NA = Not Available

wT = EPA toxicity constant for water
sT = EPA toxicity constant for soils
aT = EPA toxicity constant for air

Rating Value = RVe = EPA weight of evidence rating for noncarcinogen toxicity (see Table 7-5)
EPA Category = EPA weight-of-evidence category for carcinogens (see Table 7-6)
All values from EPA's Superfund Health Evaluation Manual, October 1986, Exhibits C-3, C-4 and C-5. See Appendix C, this report.

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Tables 7-3 and 7-4 also provide toxicological class (PC or NC), along with severity rating value (RVe) for noncarcinogens and weight-of-evidence category (EPA category) for carcinogens. Because of probable differences in dose-response mechanisms (non-threshold versus threshold), potential carcinogens (PCs) and noncarcinogens (NCs) are scored and selected independently. Indicator scores for carcinogens and noncarcinogens are not comparable scales and should never be compared.

Rating constants for noncarcinogens are provided in Table 7-5 and weight-of-evidence catagories for potential carcinogens are provided in Table 7-6. Where chemicals belong to both PC and NC toxicity classes, toxicity constants and severity/weight-of-evidence values are provided for each toxicity class.

7.3.2 Calculating IS Values

To provide a relative scale of potential health risk for the chemicals at a given site, IS values are calculated and ranked from highest (rank 1) to lowest (rank 10). The IS value was calculated by summing the appropriate media columns for maximum and representative CT values.

Because of the large number of chemicals to be evaluated at the Sheridan Site, these work sheets have been split into organic (Table 7-7) and inorganic (Table 7-8) chemicals. Both carcinogenic and non-carcinogenic toxicity classes are presented on each of these two tables.

Next, the chemicals were ranked separately for PC and NC classes, keeping organic and inorganic chemicals separate. This resulted in "tentative ranks" for the compounds, based on representative concentrations. Those chemicals for which toxicity constants are not listed in the Superfund Manual were not included in this tentative ranking process. For NC organics, trichloroethylene ranked No.1 at the site, closely followed by phenol and the two cresols. Benzene and toluene ranked No. 5 and No. 6, respectively.

For PC organics, based on representative values, trichloroethylene ranked No. 1, Aroclor 1242 was No. 2, tetrachloroethylene was No. 3, benzene was No. 4 and Aroclors 1260, 1016 and 1232 were Nos. 5, 6 and 7, respectively. The lowest ranked were 2-butanone (MEK) for NC organics and Lindane for PC organics, based on representative concentrations.

For NC metals, based on representative concentrations, barium ranked No. 1, followed by nickel, silver and copper. The lowest

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TABLE 7-5

EPA'S EXHIBIT B-1
RATING CONSTANTS (RVe) FOR NONCARCINOGENS[1]

Effect	Severity Rating (RVe)
Enzyme induction or other biochemical change with no pathologic changes and no change in organ weights.	1
Enzyme induction and subcellular proliferation or other changes in organelles but no other apparent effect.	2
Hyperplasia, hypertrophy or atrophy, but no change in organ weights.	3
Hyperplasia, hypertrophy or atrophy with changes in organ weights.	4
Reversible cellular changes: cloudy swelling, hydropic change, or fatty changes.	5
Necrosis, or metaplasia with no apparent decrement of organ function. Any neuropathy without apparent behavioral, sensory, or physiologic changes.	6
Necrosis, atrophy, hypertrophy, or metaplasia with a detectable decrement of organ functions. Any neuropathy with a measurable change in behavioral, sensory, or physiologic activity.	7
Necrosis, atrophy, hypertrophy, or metaplasia with definitive organ dysfunction. Any neuropathy with gross changes in behavior, sensory, or motor performance. Any decrease in reproductive capacity, any evidence of fetotoxicity.	8
Pronounced pathologic changes with severe organ dysfunction. Any neuropathy with loss of behavioral or motor control or loss of sensory ability. Reproductive dysfunction. Any teratogenic effect with maternal toxicity.	9
Death or pronounced life-shortening. Any teratogenic effect without signs of maternal toxicity.	10

[1]Rating scale identical to that used by EPA in the RQ adjustment process as described in EPA (1983).

Source: EPA Superfund Public Health Evaluation Manual, Appendix B (October, 1986).

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TABLE 7-6

EPA'S EXHIBIT B-2
EPA WEIGHT-OF-EVIDENCE CATEGORIES
FOR POTENTIAL CARCINOGENS

EPA Category	Description of Group	Description of Evidence
Group A	Human Carcinogen	Sufficient evidence from epidemiologic studies to support a causal associaton between exposure and cancer.
Group B1	Probable Human Carcinogen	Limited evidence of carcinogenicity in humans from epidemiologic studies.
Group B2	Probable Human Carcinogen	Sufficient evidence of carcinogenicity in animals, inadequate evidence of carcinogenicity in humans
Group C	Possible Human Carcinogen	Limited evidence of carcinogenicity in animals.
Group D	Not Classified	Inadequate evidence of carcinogenicity in animals.
Group E	No Evidence of Carcinogenicity in Humans	No evidence for carcinogenicity in at least two adequate animal tests or in both epidemiologic and animal studies

Source: EPA Superfund Public Health Evaluation Manual, Appendix B (October 1986).

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TABLE 7-7

Scoring for Organic Indicator Chemical Selection
Calculation of CT and IS Values and Ranks

CHEMICAL	GROUND WATER CT		SURFACE WATER CT		SOIL CT		AIR CT		IS VALUE		TENTATIVE RANK	
	Maximum	Repres	Maximum	Repres	Maximum	Repres	Maximum	Repres	Maximum	Repres	Maximum	Repres
CT-Values for Non-Carcinogenic Toxicological Properties												
VOLATILE ORGANICS												
Benzene	NT	NT	5.85E-02	ND	1.46E-02	7.31E-03	1.51E-04	1.51E-04	7.33E-02	7.46E-03	6	5
2-Butanone (MEK)	NT	NT	1.94E-04	ND	3.48E-06	1.75E-06	2.29E-06	BMDL	2.00E-04	1.75E-06	14	14
Carbon disulfide	NT	NT	NT	NT	4.03E-04	2.01E-04	ND	ND	4.03E-04	2.01E-04	12	10
Chlorobenzene	NT	NT	7.15E-02	ND	2.93E-05	1.46E-05	ND	ND	7.15E-02	1.46E-05	7	12
1,2-Dichloroethane	NT	NT	8.80E-03	ND	3.87E-05	1.94E-05	NT	NT	8.84E-03	1.94E-05	10	11
1,1-Dichloroethylene	NT	NT	1.86E-01	ND	1.06E-05	5.39E-06	2.23E-04	BMDL	1.86E-01	5.39E-06	5	13
Ethylbenzene	NT	NT	5.50E-03	ND	4.63E-03	5.52E-04	4.77E-06	BMDL	1.02E-02	5.52E-04	9	8
Methylene chloride	NT	NT	2.30E-05	ND	1.52E-06	7.59E-07	2.80E-04	2.80E-04	3.05E-04	2.81E-04	13	9
Tetrachloroethylene	NT	NT	4.91E-03	2.50E-03	1.2[illegible]E-04	6.04E-05	1.86E-06	BMDL	5.03E-03	2.56E-03	11	7
Toluene	NT	NT	8.37E-03	4.21E-03	9.52E-03	5.20E-04	9.01E-04	7.64E-04	1.88E-02	5.50E-03	8	6
Trichloroethylene	NT	NT	3.06E+00	1.53E+00	5.2[illegible]E-03	2.63E-03	NT	NT	3.06E+00	1.54E+00	1	1
ACID FRACTION ORGANICS												
2-Methylphenol (2-Cresol)	NT	NT	8.96E-02	ND	1.22E-01	5.09E-02	NT	NT	1.91E-01	5.09E-02	4	4
4-Methylphenol (4-Cresol)	NT	NT	8.96E-02	ND	2.54E-01	1.27E-01	NT	NT	3.44E-01	1.27E-01	3	3
Phenol	NT	NT	1.38E+00	1.75E-01	7.53E-03	3.77E-03	NT	NT	1.39E+00	1.79E-01	2	2
CT-Values for Carcinogenic Toxicological Properties												
VOLATILE ORGANICS												
Benzene	NT	NT	3.86E-03	ND	9.35E-04	4.83E-04	9.84E-04	9.84E-04	5.80E-03	1.47E-03	11	4
1,2-Dichloroethane	NT	NT	2.93E-02	ND	1.29E-04	6.45E-05	NT	NT	2.94E-02	6.45E-05	7	9
1,1-Dichloroethylene	NT	NT	6.15E-02	ND	3.50E-06	1.78E-06	4.86E-05	BMDL	6.16E-02	1.78E-06	3	14
Tetrachloroethylene	NT	NT	4.52E-03	2.24E-03	1.11E-04	5.56E-05	6.01E-06	BMDL	4.64E-03	2.29E-03	13	3
Trichloroethylene	NT	NT	1.25E-02	6.26E-03	2.14E-05	1.07E-05	NT	NT	1.25E-02	6.27E-03	9	1
BASE/NEUTRAL FRACTION ORGANICS												
Bis-(2-ethylhexyl) phthalate	NT	NT	2.86E-05	ND	5.15E-06	2.58E-06	NT	NT	3.37E-05	2.58E-06	16	12
PESTICIDES AND PCBS												
alpha-BHC	NT	NT	7.80E-02	ND	1.09E-04	5.45E-05	NT	NT	7.81E-02	5.45E-05	2	10
gamma-BHC (Lindane)	NT	NT	2.62E-03	ND	1.[illegible]E-06	6.53E-07	NT	NT	2.62E-03	6.53E-07	14	16
4,4'-DDD	NT	NT	1.86E-04	ND	2.23E-06	1.13E-06	NT	NT	1.88E-04	1.13E-06	15	15
4,4'-DDE	NT	NT	5.65E-03	ND	4.40E-06	2.26E-06	NT	NT	5.65E-03	2.26E-06	12	11
4,4'-DDT	NT	NT	7.95E-03	ND	1.[illegible]E-05	8.45E-06	NT	NT	7.97E-03	8.45E-06	10	11
Dieldrin	NT	NT	1.83E-01	ND	1.[illegible]E-04	6.95E-05	NT	NT	1.83E-01	6.95E-05	1	8
Aroclor 1016	NT	NT	2.86E-02	ND	1.57E-03	7.88E-04	NT	NT	3.01E-02	7.88E-04	6	6
Aroclor 1232	NT	NT	2.86E-02	ND	3.1[illegible]E-04	1.57E-04	NT	NT	2.89E-02	1.57E-04	8	7
Aroclor 1242	NT	NT	2.86E-02	ND	6.26E-03	3.13E-03	NT	NT	3.48E-02	3.13E-03	5	2
Aroclor 1260	NT	NT	5.71E-02	ND	2.17E-03	1.09E-03	NT	NT	5.93E-02	1.09E-03	4	5

NT = Not Tested ND = Not Detected or Identified Below Method Detection Limit (BMDL) CT = C (Concentration) / T (Toxicity Constant)
Maximum = maximum concentration (see Table 7-1) IS Value = Indicator Score (see text Section 7.2)
Repres = representative concentration (see Table 7-1)
Number reported is the CT or IS value corresponding to maximum concentration

TABLE 7-8

Scoring for Inorganic Indicator Chemical Selection
Calculation of CT and IS Values and Ranks

CHEMICAL	GROUND WATER CT		SURFACE WATER CT		SOIL CT		AIR CT		IS VALUE		TENTATIVE RANK	
	Maximum	Repres	Maximum	Repres	Maximum	Repres	Maximum	Repres	Maximum	Repres	Maximum	Repres
CT - Values for Non-Carcinogenic Toxicological Properties												
Aluminum	NT	NT	NA	NA	NA	NA	NT	NT	NA	NA	NA	NA
Arsenic	NT	NT	7.38E-01	2.97E-01	1.80E-02	9.64E-03	NT	NT	7.56E-01	3.07E-01	7	6
Barium	NT	NT	6.53E+00	3.59E+00	1.67E-01	8.77E-02	NT	NT	6.70E+00	3.68E+00	1	1
Beryllium	NT	NT	NA	ND	NA	NA	NT	NT	NA	NA	NA	NA
Cadmium	NT	NT	4.01E-01	2.11E-01	7.00E-03	3.52E-03	NT	NT	4.08E-01	2.15E-01	9	9
Chromium	NT	NT	NA	NA	NA	NA	NT	NT	NA	NA	NA	NA
Copper	NT	NT	2.13E+00	1.07E+00	1.39E-02	7.02E-03	NT	NT	2.15E+00	1.08E+00	5	4
Iron	NT	NT	NA	NA	NA	NA	NT	NT	NA	NA	NA	NA
Lead	NT	NT	5.36E-01	2.71E-01	5.35E-02	2.68E-02	NT	NT	5.89E-01	2.98E-01	8	7
Manganese	NT	NT	NA	NA	NA	NA	NT	NT	NA	NA	NA	NA
Mercury	NT	NT	1.84E-03	1.10E-03	5.53E-05	2.76E-05	NT	NT	1.90E-03	1.13E-03	10	11
Nickel	NT	NT	5.28E+00	2.66E+00	1.92E-02	9.74E-03	NT	NT	5.30E+00	2.67E+00	2	2
Selenium	NT	NT	4.31E+00	2.36E+00	3.16E-03	2.10E-03	NT	NT	4.31E+00	2.36E+00	3	8
Silver	NT	NT	2.20E+00	1.15E+00	5.00E-02	ND	NT	NT	2.25E+00	1.15E+00	4	3
Vanadium	NT	NT	1.43E-03	1.43E-03	1.79E-04	1.61E-04	NT	NT	1.61E-03	1.59E-03	11	10
Zinc	NT	NT	9.63E-01	4.82E-01	7.36E-02	1.33E-02	NT	NT	1.04E+00	4.95E-01	6	5
CT - Values for Carcinogenic Toxicological Properties												
Arsenic	NT	NT	1.67E-01	6.72E-02	4.06E-03	2.18E-03	NT	NT	1.71E-01	6.93E-02	1	1
Beryllium	NT	NT	NA	NA	NA	NA	NT	NT	NA	NA	NA	NA
Cadmium	NT	NT	NA	NA	NA	NA	NT	NT	NA	NA	NA	NA
Chromium	NT	NT	NA	NA	NA	NA	NT	NT	NA	NA	NA	NA
Nickel	NT	NT	NA	NA	NA	NA	NT	NT	NA	NA	NA	NA

IS = Indicator Score (see text, Section 7.2)
NA = Not available or not applicable
NT = Not Tested
ND = Not Detected or Below Minimum Detection Limit (BMDL)
CT = C (concentration of metal) * T (toxicity constant)
Maximum = maximum observed concentration (See Table 7-2)
Repres = Representative concentration (See Table 7-2)

ranking NC metals at the site were vanadium (10) and mercury (11). Only arsenic could be evaluated among the PC chemicals because of the lack of T-values for the other four PC metals.

7.4 Selection of Final Indicator Chemicals

The next step in the selection process is to select the final indicator chemicals. First, the top ranking chemicals for which toxicity constants are available are listed in rank order by representative concentrations (lowest to highest rank number), as shown in Table 7-9. For the Sheridan Site, there are five detected organics (benzene, trichloroethylene, tetrachloroethylene, 1,2-dichloroethane and 1,1-dichloroethylene) and five metals (arsenic, beryllium, cadmium, chromium and nickel) that appear in both PC and NC toxicity classes. The four PCBs (Aroclors 1016, 1232, 1242 and 1260), the six detected pesticides and bis-2-ethylhexyl phthalate were the remaining PC chemicals. The remaining NC organic compounds and metals are also separately listed in Table 7-9 by rank order.

In accordance with EPA guidance, the original list of detected compounds was reviewed in order to pick up any potential indicators for which T-values are not available. Seventeen compounds were identified and added to Table 7-9, 15 organics and two metals. These compounds are present in variable concentrations throughout the source area, particularly in sludges and therefore might represent a potentially significant load or useful indicator species.

Table 7-9 provides a summary of physical characteristics important for evaluating the fate and persistence of the candidate indicator chemicals. These characteristics include data for solubility, vapor pressure, Henry's Law constant, Koc, and half life values for ground water, surface water, soil and air from EPA Appendix A tables. To assist in the selection of the final indicator chemicals, available or calculated log Kow, Kd, Rd and BCF data were also tabulated for each candidate indicator chemical. Log Kow, Kd (distribution coefficient, see footnotes Table 7-9) and Rd (retardation coefficient, see footnotes Table 7-9) values were tabulated primarily for use in the ground water models (Section 9). BCF is the bioconcentration factor and relates to surface water and food-chain up-take pathways.

A relative site load factor (H=High, M=Medium, L=Low,) was included as a means of identifying compounds which have the highest relative "Load" (concentration and/or frequency), at the site. Finally, a relative "quality of data" category was added

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TABLE 7-9

Scoring for indicator chemical selection: evaluation of exposure factors and final chemical selection

Parameter	Non-Carcinogen (NC) IS-Value (Repres)	Non-Carcinogen (NC) Rank (Rep/Max)	Potential Carcinogen (PC) IS-Value (Repres)	Potential Carcinogen (PC) Rank (Rep/Max)	Relative Site Load Factor	Data Base	Water Solubility (mg/l)	Vapor Pressure (mm Hg)	Henry's Law Constant (atm-m3/mole)	Log Kow	Sludge Related Mobility Koc	Kd	Rd	Half-Life (days) GW	SW	Soil	Air	BCF	Final IC
							(1)/(2)	(1)/(2)		(1)/(2)									
ORGANIC COMPOUNDS LISTED AS BOTH "PC" AND "NC"																			
Tetrachloroethylene	1.54E+00	1/1	6.27E-03	1/19	L	G	1100	57.9	9.10E-03	2.29/2.38	126	1.23	7.55	NA	1-90	NA	3.7	10.6	Yes
Benzene	7.46E-03	5/6	1.47E-03	4/11	M-H	G	1780/1750	75/95.2	5.59E-03	2.13	63	0.85	5.53	NA	1-6	NA	6	5.2	Yes
Tetrachloroethylene	2.56E-03	7/11	2.29E-03	3/13	M	G	150	14/17.8	2.59E-02	2.88/2.6	364	4.78	20.49	NA	1-30	NA	47	31	Yes
1,2-Dichloroethane	1.94E-05	11/10	6.45E-05	9/17	L-M	G	8690/8520	61/64	9.78E-04	1.79/1.46	14	0.39	3.07	NA	0.17	NA	30-127	1.2	No
1,1-Dichloroethylene	5.39E-06	13/5	1.78E-06	14/13	VL	G	22500	600	1.40E-02	1.48/1.84	65	0.19	2.01	NA	1-6	NA	2	5.6	No
ORGANIC COMPOUNDS LISTED ONLY AS "PC"																			
Aroclor 1242	NA	NA	3.13E-03	2/5	M	G	0.24	4.06E-04	NA	4.61/5.58	9569	81	434	NA	2-12.9	NA	58	100000	Yes
Aroclor 1260	NA	NA	1.09E-03	5/4	M	G	0.0027	4.00E-05	NA	7.14	112915	55964	463810	NA	2-12.9	NA	58	100000	Yes
Aroclor 1016	NA	NA	7.58E-04	6/6	M	G	0.42	NA	NA	4.38	7034	151	807	NA	2-12.9	NA	58	100000	Yes
Aroclor 1232	NA	NA	1.57E-04	7/8	L	G	1.45	4.06E-03	NA	3.2/4.54	3558	10	54	NA	2-12.9	NA	58	100000	Yes
Dieldrin	NA	NA	6.95E-05	8/1	VL	G	0.195	6.78E-07	4.68E-07	3.5	1700	20	107	NA	NA	NA	NA	4760	No
alpha-BHC	NA	NA	5.45E-05	10/2	L	G	1.4/1.63	2.50E-05	5.76E-06	3.81/3.9	3600	41	218	NA	NA	NA	NA	130	No
4,4'-DDT	NA	NA	8.45E-06	11/10	L	G	0.003/0.005	1.9E-07/5.5E-0	5.3E-04	6.19	240000	9758	52041	NA	56-110	1000-5500	NA	54000	No
Bis-(2-ethylhexyl)phthalate	NA	NA	2.58E-06	12/16	VL-M	G	0.4	1.20E+00	NA	5.3/8.73	7225	1257	6705	NA	NA	NA	NA	NA	No
4,4'-DDD	NA	NA	2.26E-06	13/12	VL	G	0.04	6.50E-06	6.0E-05	4.28/5.69	4440000	120	641	NA	NA	NA	NA	5100	No
4,4'-DDE	NA	NA	1.13E-06	15/15	L	G	0.16	1.02/1.89E-0	7.46E-06	5.99/6.2	770000	6157	32836	NA	NA	NA	NA	NA	No
gamma-BHC (Lindane)	NA	NA	6.53E-07	16/14	VL	G	17/7.8	9.4E-06/1.6E-0	7.85E-06	4.14/3.9	1080	87	465	NA	NA	NA	NA	130	No
ORGANIC COMPOUNDS LISTED ONLY AS "NC"																			
Phenol	1.79E-01	2/2	NA	NA	H-VH	VG	93000	0.341	4.54E-07	1.46	14.2	0.18	1.97	NA	NA	NA	0.6-9	1.4	Yes
4-methylphenol (4-Cresol)	1.27E-01	3/3	NA	NA	M	G	24000	0.04	1.0E-06	1.92	500	0.52	3.79	NA	NA	NA	NA	0	No
2-methylphenol (2-Cresol)	5.09E-02	4/4	NA	NA	M	G	31000	0.24	1.10E-06	1.97	500	0.59	4.14	NA	NA	NA	NA	0	No
Toluene	5.50E-03	6/8	NA	NA	VH	VG	515/535	28.7	6.77E-03	2.69/2.73	300	1.09	17.46	NA	NA	NA	1.3	10.7	Yes
Ethylbenzene	5.52E-04	8/9	NA	NA	VH	VG	152	7	6.43E-03	3.15	1100	8.90	48.45	NA	NA	NA	1.45	37.5	Yes
Methylene chloride	2.81E-04	9/11	NA	NA	L	G	20000	362	2.33E-03	1.25/1.3	8.8	0.11	1.60	NA	NA	NA	53.2	5	No
Carbon disulfide	2.01E-04	10/12	NA	NA	L	G	2300/2940	260/360	1.73E-02	1.64/2.16	54	0.44	3.32	NA	NA	NA	NA	NA	No
Chlorobenzene	1.46E-05	12/7	NA	NA	VL	G	500/0.56	8.6/11.7	3.72E-03	2.84	330	4.36	24.25	NA	NA	NA	3.5	10	No
2-Butanone (MEK)	1.75E-06	14/14	NA	NA	L	G	353000	77.7/77.5	2.74E-05	0.26	4.5	0.01	1.06	NA	NA	NA	0.58	0	No

NA = Not available or Not applicable
IC = Indicator Chemical
IS-Value = Indicator Score (see tables 7-7 and 7-8) based on representative (Repres) concentrati
Rank = ranking for IS-values from highest (1) to lowest (or (Repres) and maximum (Max) concentra
Log Kow = octanol water partition coefficient (unitless)
Koc = organic carbon partition coefficient Log Koc=(-0.55*log(S))+3.64
Kd = distribution coefficient used in ground water models (ml/g)
= (0.65)*(foc)*(Kow) where foc = fraction (g carbon/g soil or sludge) 5% assumed entered a
Rd = retardation coefficient for ground water models (unitless)
= 1+[(1.6 g/cm3)/0.3]*(Kd) where 1.6 g/cm3 = bulk soil density and 0.3 = porosity

(1) = data from Section 5 tables, this report
(2) = data from EPA Exhibit C tables (Appendix C, this re

Load Factor = qualitative rating based on the apparent frequency and concentration detected
L = Low (e.g., in soil/sludge <10 mg/kg)
M = Medium (e.g., in soil/sludge >10 and <300 mg/kg)
H = High (e.g., in soil/sludge >300 and <1000 mg/kg)
VL = Very Low (e.g., in soil/sludge <1 mg/kg)
VH = Very High (e.g., in soil/sludge >1000 mg/kg)

Data Base = qualitative assessment of the reliability of the data base for each detected compound
P = Poor (only 1 detection reported for all samples in all media)
F = Fair (more than 1 but less than 3 detections reported for all samples from all media)
G = Good (most media have at least 1-3 detections reported)
VG = Very Good (many detections in all or most media)
BCF = Bioconcentration factor (see Appendix C, EPA Exhibit C-2)

(1) = values from Section 5 tables
(2) = values from Appendix C, 1986 EPA tables

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TABLE 7-9 (cont'd)

Scoring for Indicator Chemical Selection Evaluation of Exposure Factors and Final Chemical Selection

Parameter	Non-Carcinogen (NC) IS-Value (Repres)	Non-Carcinogen (NC) Rank (Repr/Max)	Potential Carcinogen (PC) IS-Value (Repres)	Potential Carcinogen (PC) Rank (Repr/Max)	Relative Site Load Factor	Data Base	Water Solubility (mg/l)	Vapor Pressure (mm Hg)	Henry's Law Constant (atm-m3/mole)	Log Kow	Koc	Kd	Rd	Half-Life (days) GW	SW	Soil	Air	BCF	Final Ind
METALS							(1/2)	(1/2)											
Barium	3.08E+00	1/1	NA	NA	M-H	G	NA	NA	NA	NA	NA	10	54	PERS	PERS	PERS	4-6	NA	No
Nickel	2.67E+00	2/2	*	*	H	VG	NA	0	NA	NA	NA	10	54	PERS	PERS	PERS	NA	47	Yes
Silver	1.15E+00	3/3	NA	NA	VL	F	NA	0	NA	NA	NA	10	54	PERS	PERS	PERS	NA	1050	No
Copper	1.08E+00	4/4	NA	NA	H	G	NA	0	NA	NA	NA	10	54	PERS	PERS	PERS	NA	200	No
Zinc	4.95E-01	5/6	NA	NA	VH	VG	NA	NA	NA	NA	NA	10	54	PERS	PERS	PERS	4.8-20	47	Yes
Arsenic	2.68E-01	6/7	6.93E-02	1/1	L	F	NA	0	NA	NA	NA	10	54	PERS	PERS	PERS	5	44	No
Lead	2.98E-01	7/8	NA	NA	M-VH	VG	NA	0	NA	NA	NA	10	54	PERS	PERS	PERS	4-8	49	Yes
Selenium	2.30E-03	8/5	NA	NA	VL	F	NA	NA	NA	NA	NA	10	54	PERS	PERS	PERS	NA	16	No
Cadmium	2.15E-01	9/9	*	*	L-M	G	NA	0	NA	NA	NA	10	54	PERS	PERS	PERS	4-8	81	No
Vanadium	5.59E-03	10/11	NA	NA	VL	G	NA	0	NA	NA	NA	10	54	PERS	PERS	PERS	NA	NA	No
Mercury	1.13E-03	11/10	NA	NA	VL	G	NA	2.00E-03	NA	NA	NA	10	54	PERS	PERS	PERS	NA	5500	No
Other Potential Indicator Chemicals For Which I-Values Not Available																			
Acenaphthene	NA	NA	NA	NA	M	G	3.42	1.55E-03	9.20E-05	4.33/4.00	4600	134.69	719.36	NA	NA	NA	NA	242	No
Anthracene	NA	NA	*	*	VL	P	0.05-0.07	1.95E-04	NA	5.3/4.45	15845	1257.02	6705.08	NA	0.5	NA	0.02	NA	No
Butyl benzyl phthalate	NA	NA	NA	NA	M	G	1.2-2.9	8.60E-06	NA	4.8-5.8	2430	397.50	2121.02	NA	NA	NA	NA	NA	No
Chrysene	NA	NA	*	*	VL	G	0.006/1.8E-03	6.30E-09	1.05E-05	5.61	200000	2566.50	13688.98	NA	0.2	NA	5.5	NA	No
Dibenzofuran	NA	NA	NA	NA	M	G	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	No
2,4-Dimethylphenol	NA	NA	NA	NA	H	VG	17000	6.20E-02	NA	2.5	21	1.99	11.63	NA	NA	NA	NA	NA	Yes
Diethyl phthalate	NA	NA	NA	NA	L	G	1000	3.50E-03	1.14E-06	3.22/2.5	142	10.46	56.76	NA	NA	NA	NA	NA	No
Di-N-octyl phthalate	NA	NA	NA	NA	L	G	3	<2.00E-01	NA	9.2	2386	9984827	53252412	NA	NA	NA	NA	NA	No
Fluorene	NA	NA	*	*	L-M	G	1.9/1.69	7.10E-04	6.13E-05	4.2	7300	99.85	533.52	NA	1-2	NA	5.5	1300	No
2-Hexanone	NA	NA	NA	NA	VL	G	35000	2.00E+00	*	1.36	14	0.15	1.80						
Isophorone	NA	NA	NA	NA	M	G	12000	3.80E-01	*	1.7	25	0.32	2.68	NA	NA	NA	NA	NA	No
2-Methylnaphthalene	NA	NA	NA	NA	M-H	VG	"insoluble"	NA	*	NA	NA	NA	NA	NA	NA	NA	NA	NA	No
Naphthalene	NA	NA	NA	NA	M-H	VG	30-40/35	4.92E-02	*	3.0/3.45	574	6.30	34.60	NA	NA	NA	NA	NA	Yes
N-Nitrosodiphenylamine	NA	NA	NA	NA	L-M	G	"insoluble"	NA	*	2.57	NA	2.34	13.46	NA	NA	NA	NA	NA	No
Phenanthrene	NA	NA	NA	NA	L	G	1.0-1.3	6.80E-04	1.95E-04	4.46	14000	181.69	970.03	NA	NA	NA	NA	2630	No
Styrene	NA	NA	NA	NA	M-H	G	300	NA	*	NA	NA	NA	1.00	NA	NA	NA	NA	NA	No
Xylenes	NA	NA	NA	NA	H	G	175-198	5-7/10	0.45-0.3	2.8-3.2/3.26	240	3.98	22.20	NA	1.5-9	NA	0.5	NA	No
Beryllium	NA	NA	*	*	VL	P	NA	0.00E+00	*	NA	NA	10.00	54.00	NA	NA	NA	NA	NA	No
Chromium	NA	NA	*	*	M-H	VG	NA	0.00E+00	*	NA	NA	10.00	54.00	NA	3	NA	4.8	16	Yes

NA = Not available or Not applicable (1) = data from Section 5 tables this report
IC = Indicator Chemical (2) = data from EPA Exhibit C tables (Appendix C this re
IS-value = Indicator Score (see Tables 7-7 and 7-8) based on representative (Repres) concentrati
Rank = ranking for IS-values from highest (1) to lowest for (Repres) and maximum (Max) concentra
Log Kow = octanol water partition coefficient (unitless)
Kd = distribution coefficient used in ground water models (ml/g)
= (0.63)*(foc)*(Kow), where foc = percent carbon in soil or sludge (1% assumed here)
Rd = retardation coefficient for ground water models (unitless)
= ((1+(1.6 g/cm3)/0.33*(Kd)) where 1.6 g/cm3 = bulk soil density and 0.3 = total porosity
Koc = organic carbon partition coefficient, (log Koc) (-0.55*(log(S)))+3.64

Load Factor = qualitative rating based on the apparent frequency and concentration detected
L = low (e.g. in soil/sludge <10 mg/kg) VL = very low (e.g. in soil/sludge <1 mg/kg)
M = medium (e.g. in soil/sludge >10 and <300 mg/kg) VH = very high (e.g. in soil/sludge >1000 mg/kg)
H = high (e.g. in soil/sludge >300 and <1000 mg/kg)
Data Base = qualitative assessment of the reliability of the data base for each detected compound
P = Poor (only 1 detection reported for all samples in all media)
F = Fair (more than 1 but less than 3 detections reported for all samples from all media)
G = Good (most media have at least 1-5 detections reported)
VG = Very Good (many detections in all or most media) (1/2) (1) = values from Section 5 tables
BCF = Bioconcentration factor (see Appendix C EPA Exhibit C-4) (2) = values from Appendix C EPA tox tables
PERS = Persistent
* = Potential carcinogen no I-value available

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to indicate qualitatively how representation of the available data are for the actual presence and concentration of each compound at the site. The use of these factors in the designation of final indicators chemicals is detailed in the following section.

7.4.1 Rationale for Final Selection of Indicator Chemicals

As previously mentioned in the introduction to this section, the indicator selection process was designed to identify the compounds or elements most useful to the risk assessment processes performed in Sections 9 through 11 and Appendix F. The results of the ranking process (based on representative concentrations) described in Sections 7.1 through 7.3 were used as a point of departure for the final selection, as follows:

1. At least one of the top three ranked chemicals in each of the following toxicity classes would be selected:
   - PC/NC organic
   - PC organic
   - NC organic
   - PC/NC metal
   - NC metal

2. At least one chemical representative of each of the following organic chemical classes would be selected:
   - volatile organic
   - polynuclear aromatic (PNA) organic
   - Pesticide/PCB organic
   - acid fraction organic

3. The compound within each class (toxicity or chemical) which had the most reliable data base and the largest probable total site load would be given preference within each class.

4. If not already selected for other reasons within a toxicity or chemical class, the most mobile and/or most persistent detected compound within each class would be included for worst-case transport modeling.

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This rationale resulted in the following selection of chemicals based on toxicity class:

1. PC/NC organics - trichloroethylene, benzene and tetrachloroethylene, which were the top three ranked organic chemicals detected at the site which have both PC and NC T-values.
2. PC organics - all detected Aroclors (1242, 1260, 1016 and 1232) which were the top four organics with PC only T-values.
3. NC organics - phenol, toluene and ethylbenzene which were top-ranked, high site load and high site load respectively, for the NC class.

The application of the rationale resulted in the following selections based on chemical class:

1. PNAs - since no T-values are available for this chemical class, it was not possible to rank organics in this category. Therefore, the most prevalent and mobile PNA detected at the site for which fate and transport data are available was chosen: naphthalene.
2. Acid fraction organics - dimethylphenol was chosen as the least mobile of the detected acid fraction organics. The most mobile - phenol - was already included as the top-ranked NC organic.
3. Pesticides/PCBs - since all the detected PCBs had already been selected and because PCBs represent the most persistent and are about the same mobility as the pesticides in this organic chemical class, no other compounds were selected in this class.

The application of the rationale to metals resulted in the following selections:

1. PC/NC metals - nickel and chromium, the two most prevalent metals of this class at the site.
2. NC metals - lead and zinc, the two most prevalent metals of this class at the site.

The only high-ranked chemicals that were not chosen as indicator chemicals were barium (ranked No. 1 for NC metals) and arsenic (the only PC/NC metal for which T-values are available). Barium was not chosen because it is ubiquitous in coastal soils and is hazardous only as a chloride salt: this form is highly unlikely

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to occur at the site and it is not felt that the concentrations detected at the site would ever constitute a human health risk. Arsenic was not selected because nickel and chromium are much more common at the site and therefore represent a more conservative (i.e., worst-case) choice for modeling purposes.

7.4.2 Final Indicator Chemicals

The final indicator chemicals selected are:

	Toxicity Class
Benzene	PC/NC
Ethylbenzene	NC
Naphthalene	NC
PCBs	PC
Phenol	NC
Tetrachloroethylene	PC/NC
Toluene	NC
Trichloroethylene	PC/NC
2,4-dimethylphenol	NC
Chromium	PC/NC
Lead	NC
Nickel	PC/NC
Zinc	NC

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8 - DESCRIPTION OF ENVIRONMENTAL SETTING

The information in the following subsections provides an overview of the environmental setting of the SDS Site. This information provides a reference to the environmental factors and known conditions at the site which are relevant to the pathway evaluation and exposure analyses in Sections 9 through 11. The environmental factors most pertinent to the assessment of exposure are ones which influence the fate, transport and resulting pathway by which an exposure at a receptor location may or may not take place. These factors determine - or at least influence - whether an exposure pathway is complete or incomplete. Relevant environmental factors include:

- climate (8.1)
- site topography and surface water (8.2)
- site hydrogeology (8.3)
- site habitats, landuse and species (8.4)

The information summarized in the following subsections is utilized in Section 9 to determine which pathways are complete (i.e., that have or may have human receptors). For completed pathways, these factors are further utilized in the exposure assessment.

8.1 Climatic Factors Affecting Transport

The primary climatological factors affecting the fate and transport of constituents on site are:

1. Rainfall (annual, daily and monthly totals, frequency, intensity and distribution or date of occurrence on a year-specific basis).

2. Net evapotranspiration, which is a function of ground cover, rainfall, potential evaporation, runoff, soil type, recharge status, and season. In the case of open water, net evaporation is a function primarily of wind speed, temperature and surface conditions (e.g., oiled or not oiled).

3. Wind speed and direction (prevailing, minimum and maximum).

4. River stage and aquifer recharge status.

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The climate in the area of the SDS Site is primarily maritime, characterized by long hot summers, high humidity, and short, mild winters. Average monthly precipitation is fairly uniformly distributed based on long term records (Figure 8-1), but is much more variable on a daily or monthly basis for a given year (Table 8-1). Evaporation tends to follow average temperature maxima and minima (Figure 8-2), as would be expected.

In general, the site is located in a zone where evaporation off open-pond surfaces would tend to exceed precipitation. However, care must be taken in deriving net evaporation or net infiltration from data such as those presented in Figures 8-1 and 8-2 because the use of averages can drastically underestimate either or both of these values. Table 8-1 details the monthly rainfall and evaporation data for the site area. Monthly averages (long term) for precipitation and rainfall are provided in Figure 8-1 (reproduced from the SCRI). Both data sets indicate evaporation rates that exceed precipitation in the site area. Numerous other examples are available in the literature, including maps for the State of Texas (Climatic Atlas of Texas, TDWR #LP-192, December 1983) which provide contours of evaporation and precipitation based on all the evaporation/precipitation stations in the state. This data base has limitations when applied to specific sites, particularly natural or man-made impoundments, because the data are generated primarily from pan evaporimeters or lake data. The former do not get runoff inputs, and the latter are corrected for runoff inputs. Impoundments, such as the main pond at the site, receive runoff from the surrounding dikes (an effective area equal to at least half of the pond area). In addition, the pond is oiled. Numerous studies in the literature have shown that even a monomolecular layer of oil is a very effective retardant for evaporation from a water surface. It is not at all surprising that the pond accumulates water, even though it might appear that it should be dry because yearly rainfall is as much as 20 inches lower than the apparent evaporation rate for the area.

Wind speed and direction for the site area are provided in Figure 8-3 based on a wind rose for Hobby Airport in Houston. Data from the Hobby Airport station was used in the air model to calculate maximum 8-hour average exposure levels (Section 8.4) because neither Houston-IAH nor Austin-based data bases have the hourly wind data necessary for eight-hour exposure models.

8.2 Site Topography, Surface Waters and Drainage Routes

The SDS Site is located on a cut bank above the Brazos River. The overall slope on the site is less than 0.3% to the south-southwest away from the Brazos River (Figure 8-4).

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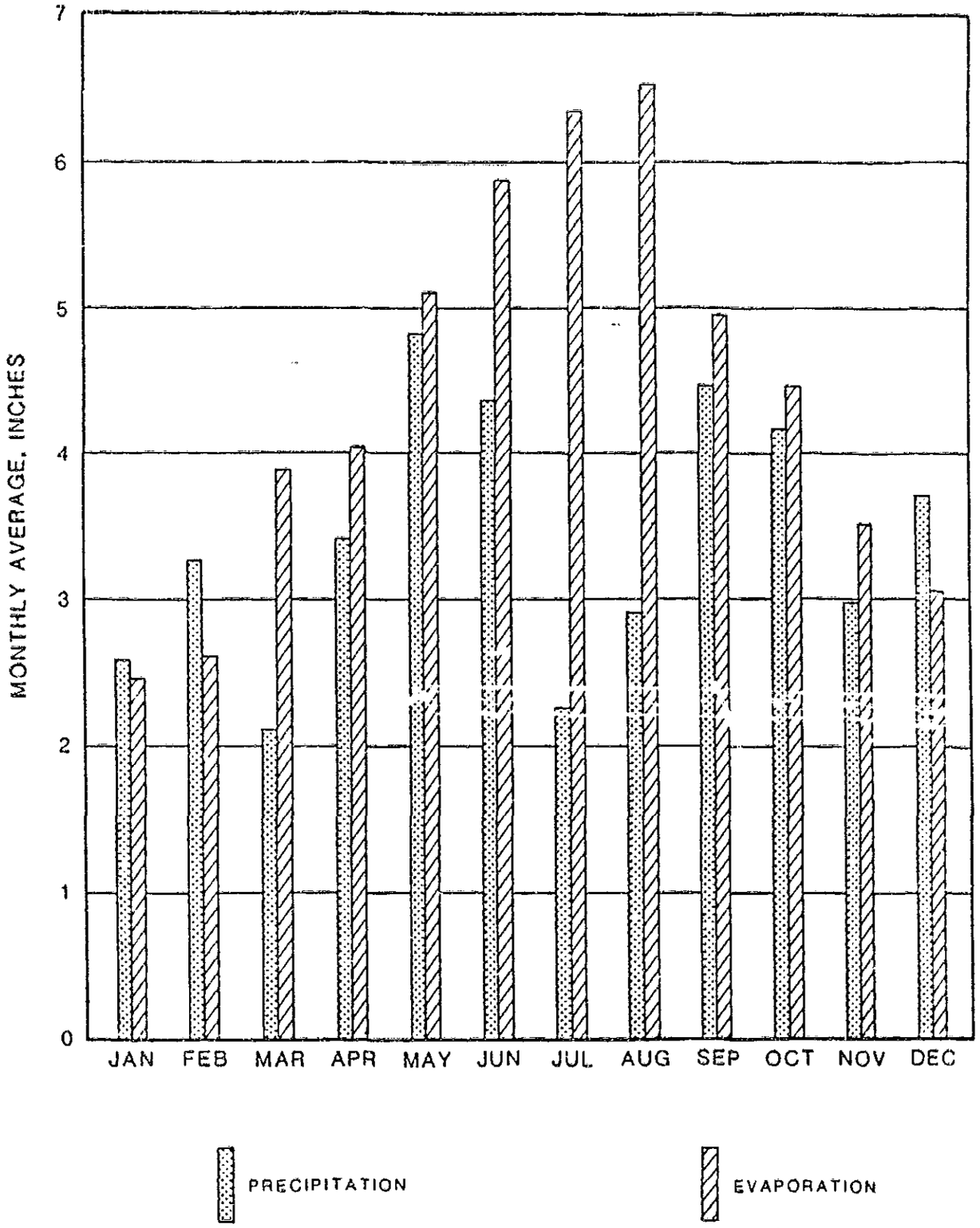

SOURCE: U.S.D.A., 1984 AND T.W.D.B., 1975

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DATE	7/23/87	W.O.NO.	9101A009

FIGURE 8-1

PRECIPITATION & EVAPORATION

At Sealy, Texas

TABLE 8-1

Major Climatic Factors for a Representative Year (1985)
Sheridan Disposal Service Site

Month	Daily Rainfall (Inches)[a]				Temperature °F[a]		Average Daily[b] Evaporation (Inches)		
	Min.	Max	Total	# Events	Min.	Max.	Min.	Max.	Total
January	.01	1.10	4.41	9	14	73	-	-	-
February	-	-	4.48	-	-		-	-	-
March	.01	2.15	5.51	11	39	84	.01	.28	4.45
April	.01	.63	1.37	11	44	92	.05	.29	5.50
May	.05	.85	2.00	6	52	95	.06	.35	7.69
June	.05	2.10	4.15	7	58	100	.10	.43	8.79
July	.02	.48	0.67	4	65	101	.08	.48	9.95
August	.03	.31	0.34	2	66	104	.23	.47	11.82
September	.30	3.58	5.19	4	52	104	.05	.43	8.47[c]
October	.04	1.39	5.57	9	44	90	.02	.31	4.94[c]
November	.04	1.44	5.29	11	41	83	.01	.29	2.82
December	.24	.85	1.80	3	21	77	-	-	-
TOTAL			40.78						63.43
Annual Extremes	.01	3.58		77	14	104	.01	.48	

[a] Washington State Park Measuring Station (11 miles from SDS Site).

[b] Somerville Dam Measuring Station (25 miles from SDS Site).

[c] Estimated Total.

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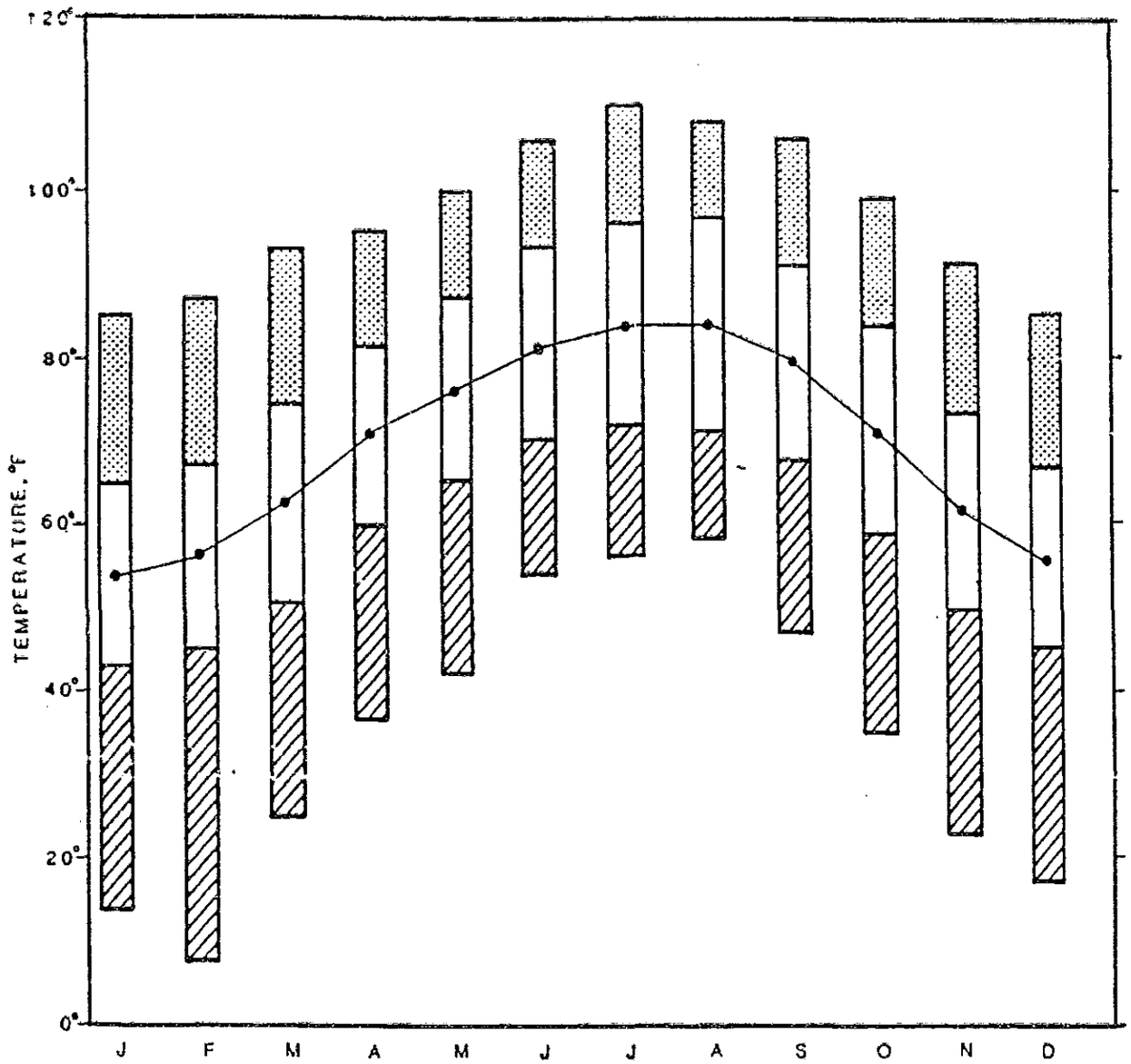

RANGE FROM MAXIMUM TEMPERATURE TO MAXIMUM MEAN

MEAN TEMPERATURE

RANGE FROM MINIMUM MEAN TO MINIMUM TEMPERATURE

SOURCE: SOIL SURVEY, 1984 AND NOAA, 1982.

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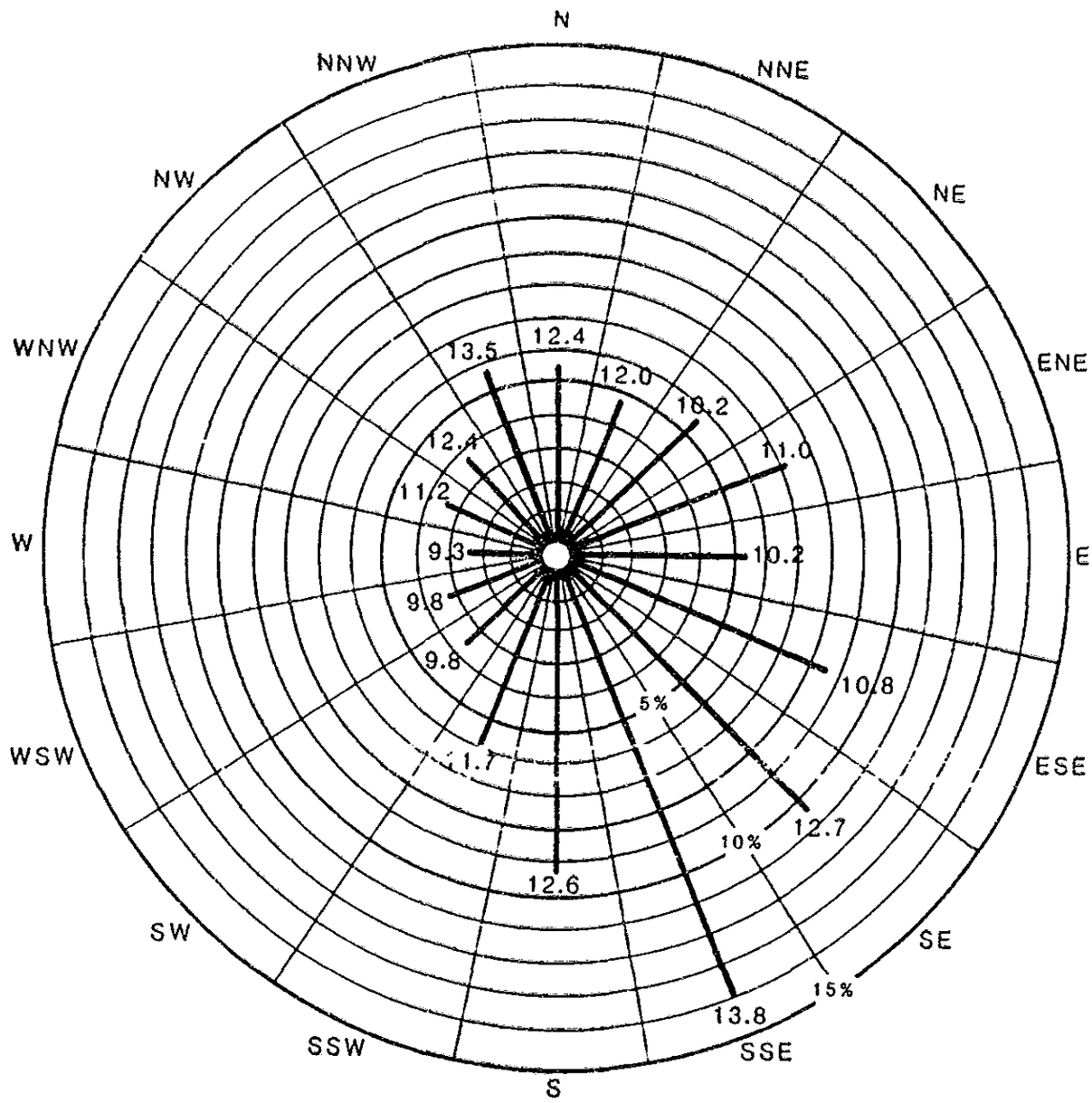
FIGURE 8-2

TEMPERATURE RANGES

At Sealy, Texas



NOTES:

1. LENGTH OF BAR INDICATES PERCENT FREQUENCY OF OCCURENCE OF WIND FROM THAT DIRECTION.

2. NUMBER IS THE AVERAGE SPEED IN M.P.H.

3. NUMBERS ARE BASED ON RECORDS FOR THE PERIOD 1951 THRU 1960 AT HOUSTON INTERNATIONAL AIRPORT (HOBBY AIRPORT).

SOURCE: SCRI, SECTION 2.4 . MARCH 1987

ERM-Southwest, Inc.
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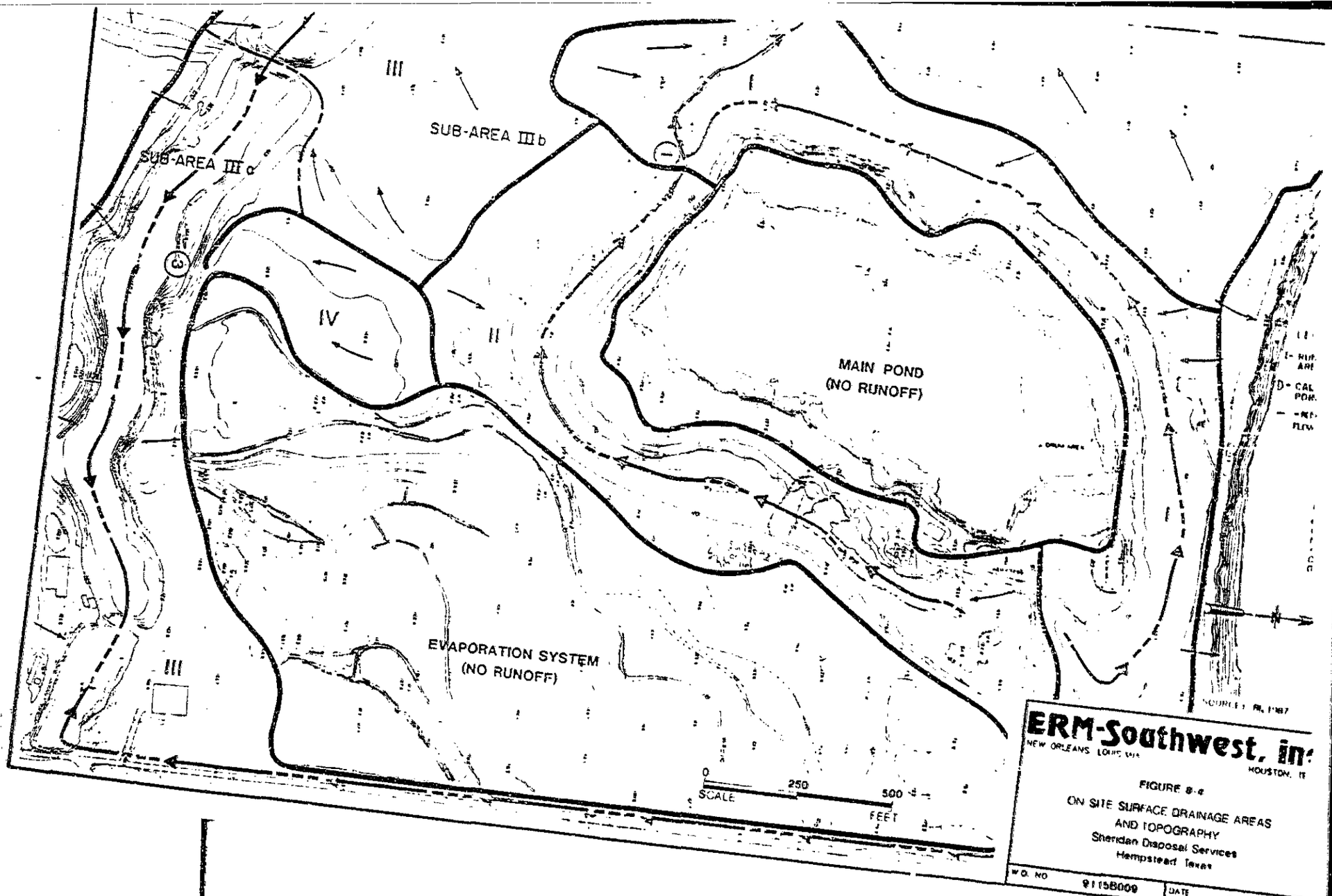
DATE	7/23/87	W.O.NO.	9101A007

FIGURE 8-3

ANNUAL WIND ROSE

Hobby Airport



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NEW ORLEANS, LOUISIANA
HOUSTON, TX

FIGURE 8-e
ON SITE SURFACE DRAINAGE AREAS
AND TOPOGRAPHY
Sheridan Disposal Services
Hempstead, Texas

W.O. NO 91158009 | DATE 9/2/87

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Clark Lake is a series of three pools separated by three artificial dikes (Figure 8-4) and is probably an old oxbow of the Brazos River. Based on old aerial photographs, the dikes are not necessary to maintain the presence of the lake. Clark Lake borders the SDS Site on the south and is used as a water supply for livestock. Scattered throughout a four-mile radius around the site are several other small lakes and stock ponds, including a small lake on Donahoe Creek to the southeast of the SDS Site.

During high water stage, Clark Lake discharges into a drainage ditch that flows southwest into Donahoe Creek and then west into the Brazos River about three stream miles from the site (Figure 8-5). During normal flow (i.e., during small storms), runoff flows into Clark Lake from both sides of the lake.

Six streams are located within a four-mile radius of the SDS property, but none of the creeks except Donahoe have any surface connection to runoff from the site (Figure 8-5). Donahoe Creek is located 1.3 miles south of the site. Beason and Cedar Creeks are located 3.2 miles northeast of the facility and Walnut Bayou borders the four-mile radius to the south. All four of these streams flow from east to west and discharge into the Brazos River. Doe Run, 1.2 miles northwest of the SDS Site, discharges into the Brazos River on the opposite bank. Jackson Creek lies approximately 3.5 miles west of the facility on the opposite side of the Brazos. This stream flows south into Red Gully which discharges to New Years Creek and eventually into the Brazos River south of the site.

Figure 8-4 provides site specific contours, drainage flow directions and "watershed" areas for the SDS Site. These data were used in the SCRI to calculate stormwater runoff and determine peak flow and total runoff volume from a localized 100-year, 24-hour storm of 11.9 inches for four points at the site (Figure 8-4). The total calculated runoff was almost the same for each of the four points (30.5, 33.55, 27.54 and 30.79 acre-feet for points 1, 2, 3 and 4, respectively), resulting in a total unadjusted areal runoff of about 122 acre-feet. Peak flows at the four points were more variable, ranging from a low of 63 cfs (at Point 4) to a high of 97 cfs (at Point 1).

The site lies within segment 1202 of the Brazos River drainage. Available water quality criteria and usage classification are provided for the nearest monitored station in Table 8-2. This table also provides discharge data for the four nearest stations, including Hempstead (downstream) and Washington (upstream). Additional available chemical and water quality data are provided in Tables 8-3 and 8-4 and are used in Section 10 to determine existing river load for site constituents.

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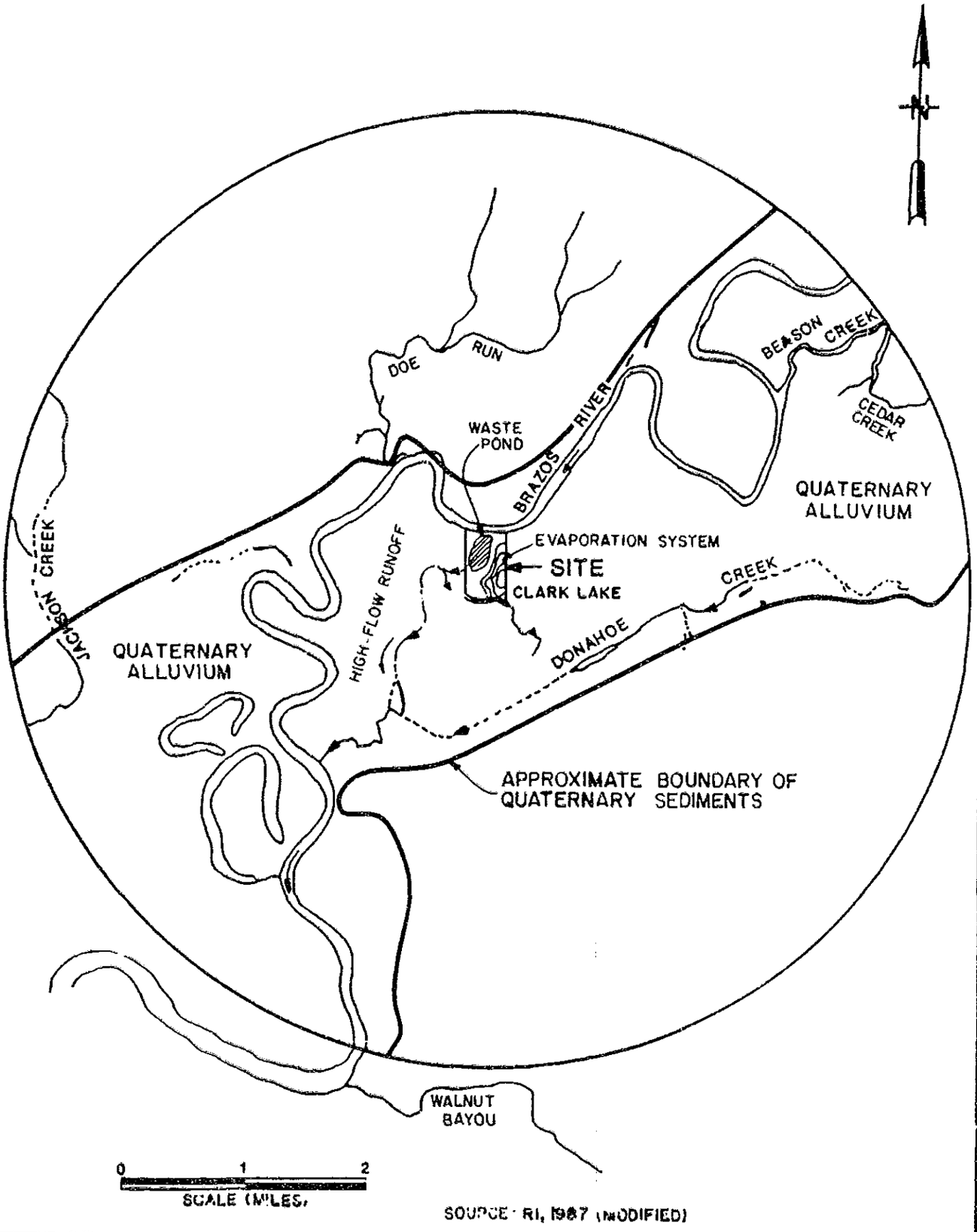

SOURCE: RI, 1987 (MODIFIED)

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DATE	9/2/87	W.O.NO.	9115A006

FIGURE 8-5

SURFACE WATERS WITHIN A FOUR MILE RADIUS

Sheridan Disposal Services
Hempstead, Texas

TABLE B-2

Brazos River Water Quality Criteria, Available Data and Use Classification

Parameter	Criteria for Segment 1202	Downstream Stations: At Hempstead (Mile 193.8)	Downstream Stations: At Richmond (Mile 92.0)	Upstream Stations: At College Station (Miles 281.1* and 271.9**)	Upstream Stations: At Washington (Mile 228.8)
AVAILABLE CHEMICAL DATA					
Chloride (mg/l)	300[a]	NR	21-320	52-300	NR
Sulfate (mg/l)	200[a]	NR	18-160	64-180	NR
TDS (mg/l)	750[a]	NR	150-911	320-870	NR
DO (mg/l)	≥5.0	NR	7.0-11.5	NR	NR
pH	6.5-9.0	NR	7.5-8.5	NR	NR
Coliform (#/100ml)	200	NR	80-410,000	NR	NR
Temperature	≤95 (°F)	NR	3-31°C	1-32°C	NR
FLOW DATA					
Average discharge for period of record		6,471 cfs	7,209 cfs[b] 7,165 cfs[c]	5,652 cfs[b] 4,798 cfs[c]	5,151 cfs
Maximum discharge for period of record		143,000 cfs	123,000 cfs	Not Determined	82,500 cfs
Minimum discharge for period of record		137 cfs	35 cfs	89 cfs	170 cfs
Maximum gauge hgt. for period of record		44.2[c]/56.1[b,d] ft.	43.6[c]/51.2[b,d] ft.	54 feet	36.7[c]/62[b,d] ft.

RI Data, 6/28/84: No priority pollutant organics detected in upstream or downstream samples. Metals not tested.

STREAM CLASSIFICATION: Segment 1202
CR (Contact Recreation)
H (High Quality Aquatic Habitat)
PS (Public Water Supply)

a Annual Average not to exceed
b Unregulated (that is, before upstream dams constructed)
c Regulated
d Extreme outside period of record
* Flow Data
** Chemical Data
NR No records

SOURCES: - Texas Surface Water Quality Standards, Texas Water Commission, December 1986
- Water Resources Data: Texas, Vol 2. USGS Water-Data Report TX-78-2.
Periods of Record: Hempstead = 1938-1986; 1903-1986 (intermittent gauge heights available)
Richmond = 1903-1906; 1922-1986; 1941-1986 (regulated)
College Station = 1899-1902; 1918-1926; 1926-1986; 1941-1986 (regulated)
Washington = 1965-1986; 1983-1986 (stage only); 1915-1986 gauge heights available

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TABLE 8-3

Available Specific Constituent Analysis for the Brazos River

Parameter	River at Richmond (Mile 92.0)	
WATER QUALITY DATA (ug/L)		
	TOTAL	DISSOLVED
Arsenic	2-4	2-3
Barium	<100-200	10-160
Cadmium	1-3	<1-4
Chromium	<10-10	<10
Cobalt	1-3	<1-<3
Copper	5-12	3-7
Iron	390-6800	5-27
Lead	2-45	1-5
Manganese	80-240	2-3
Mercury	0.1-0.2	<0.1-0.3
Nickel	2-8	1-7
Selenium	<1-1	<1
Silver	<1	<1
Zinc	20-90	7-39
BOTTOM SEDIMENT (ug/Kg)		
PCB	0	
SEDIMENT CONCENTRATIONS (mg/L)		
Maximum daily mean	13,500	
Minimum daily mean	8	
SEDIMENT LOADS (tons)		
Maximum daily	1,860,000	
Minimum daily	10	

Source: USGS Water Resources Data - Texas, Volume 2.
USGS Water-Data Report TX-82-2

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TABLE 8-4

Available Specific Chemical and Water Quality Data for the Brazos River at College Station, TX (Upstream) and Richmond, TX (Downstream)

Parameter	At College Station (Mile 271.9) 1981-1982	At College Station (Mile 271.9) 1983-1984	At Richmond (Mile 92.0) 1981-1982	At Richmond (Mile 92.0) 1983-1984	At Richmond (Mile 92.0) 1984-1985	At Richmond (Mile 92.0) 1985-1986
(Units in mg/l unless otherwise specified)						
Specific Conductance (umhos/cm)	251-1770	509-1500	204-1520	251-1410	172-1920	262-1770
Temperature (deg. C)	2-32	1-31.5	4-31	3-31	5-31	7-30
Hardness (as CaCO3)	220-310	160-260	160-300	93-270	87-310	180-260
Calcium, dissolved	65-93	50-92	51-90	28-70	38-82	34-78
Magnesium, dissolved	13-19	9.2-23	7.9-20	5.5-20	5.6-21	4.5-16
Sodium, dissolved	74-180	49-190	36-170	17-140	22-150	16-140
Potassium, dissolved	3.5-5.6	4.2-6.4	5.0-5.5	4.5-6.7	4.3-6.0	3.8-5.1
Alkalinity (as CaCO3)	94-210	130-230	92-160	82-160	87-144	91-165
Sulfate, dissolved	63-170	64-180	53-160	18-120	26-160	18-130
Chloride, dissolved	86-300	52-290	51-270	21-210	27-320	17-220
TDS	433-814	320-870	280-811	150-670	153-911	150-650
pH	NA	NA	7.6-8.5	7.8-8.1	7.5-8.3	7.8-8.5
Turbidity (FTU)	NA	NA	4.2-200	9-530	26-350	4.2-890
Dissolved Oxygen	NA	NA	7-11.5	7.2-10.5	7.2-9.6	7.0-11.2
Dissolved Oxygen, % sat	NA	NA	94-115	81-96	97-104	87-112
BOD	NA	NA	1.6-4.5	1.2-8.1	1.5-2.6	1.2-3.6
Coliform (cols/100 ml)	NA	NA	80-210	92-3400	88-650	20-410000
Streptococci (cols /100 ml)	NA	NA	220-3300	80-8600	32-500	20-9100
Sediment, suspended	NA	NA	19-4440	12-1430	20-4370	32-3140
ORGANICS (Total in bottom material, in mg/kg)						
PCBs			0.0	NA	NA	NA
DDD			0.0	NA	NA	NA
DDE			0.3	NA	NA	NA
DDT			0.0	NA	NA	NA
Lindane			0.0	NA	NA	NA

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TABLE 8-4 (cont.)

Available Specific Chemical and Water Quality Data for the Brazos River at College Station, TX (Upstream) and Richmond, TX (Downstream)

Parameter	At College Station (Mile 271.9) 1981-1982	At College Station (Mile 271.9) 1983-1984	At Richmond (Mile 92.0) 1981-1982	At Richmond (Mile 92.0) 1983-1984	At Richmond (Mile 92.0) 1984-1985	At Richmond (Mile 92.0) 1985-1986
(Units in ug/l unless otherwise specified)						
METALS						
Aluminum	NA	NA	NA	NA	NA	20-150
Arsenic, total	NA	NA	2-4	NA	NA	NA
dissolved	NA	NA	2-3	<1-7	1-5	2-3
Barium, total	NA	NA	<100-200	NA	NA	NA
dissolved	NA	NA	110-160	64-160	92-160	56-120
Beryllium, total	NA	NA	NA	NA	NA	NA
dissolved	NA	NA	NA	<0.5-<1.0	<0.5-2.0	<0.5
Cadmium, total	NA	NA	<1-3	NA	NA	NA
dissolved	NA	NA	<1-4	<1-1	<1-3	<1-4
Chromium, total	NA	NA	<10-10	NA	NA	NA
dissolved	NA	NA	<10	<1-1	<1-2	<1
Cobalt, total	NA	NA	<1-3	NA	NA	NA
dissolved	NA	NA	<1-<3	<3	<3	<3
Copper, total	NA	NA	5-14	NA	NA	NA
dissolved	NA	NA	3-7	2-4	2-7	1-5
Iron, total	NA	NA	390-6800	NA	NA	NA
dissolved	NA	NA	5-27	<3-66	3-83	7-160
Lead, total	NA	NA	2-45	NA	NA	NA
dissolved	NA	NA	1-5	<1-3	<1-7	<5-2
Manganese, total	NA	NA	80-240	NA	NA	NA
dissolved	NA	NA	2-3	<1-7	<1-18	2-4
Mercury, total	NA	NA	0.1-0.2	NA	NA	NA
dissolved	NA	NA	<0.1-0.3	<0.1	<0.1	<0.1-0.1
Nickel, total	NA	NA	2-8	NA	NA	NA
dissolved	NA	NA	1-7	<1-4	<1-3	1-2
Selenium, total	NA	NA	<1-1	NA	NA	NA
dissolved	NA	NA	<1	<1-1	<1	<1-1
Silver, total	NA	NA	<1	NA	NA	NA
dissolved	NA	NA	<1	<1	<1	<1-1
Vanadium, total	NA	NA	NA	NA	NA	NA
dissolved	NA	NA	NA	<6-7	<6	<6
Zinc, total	NA	NA	10-60	NA	NA	NA
dissolved	NA	NA	7-39	<3-10	9-19	10-23

011362

8.3 Site Hydrogeology

A schematic south-to-north cross-section through the Sheridan Disposal Services Site is presented in Figure 8-6. This schematic cross-section illustrates the spatial distribution of stratigraphic units beneath the site. The upper thirty feet at the site (Stratum A) consist of interbedded sands, silts and clays. Figure 8-6 indicates that the uppermost sandy and silty clay unit within Stratum A may not be continuous throughout the site. However, the surficial clay is as much as forty-five feet deep beneath the southern two-thirds of the evaporation system. This clay zone has an average lab permeability (three samples) of 6.37×10^{-9} cm/sec (July 1987 SCRI). This distribution may be the result of deposition associated with the meander system that formed Clark Lake (and the natural depression now occupied by the main pond) and results in partially confined conditions in the shallow ground water under the evaporation system.

The shallow unconfined aquifer (Stratum B) consists of fine to coarse sand and contains a basal gravel layer approximately two to as much as ten feet thick. This shallow unconfined aquifer is generally 25 to 30 feet thick and reaches a maximum thickness of about 55 feet near the river. Beneath the evaporation system, the shallow unconfined aquifer is approximately 20 feet thick.

Ground water elevations in the shallow unconfined alluvial aquifer are generally at or above the elevation of the Brazos River. Shallow ground water contours developed from data collected bimonthly since January 1987 generally show a split in ground water flow direction (Figure 8-7). The gradients and frequency of predominant gradients have been calculated and indicate that the shallow ground water discharges predominantly north to the Brazos River. This gradient has reversed three times during the period of record this year (1987) in response to high river stage, but the resulting steep southern gradient is not maintained for a long period of time, switching from south to west and back to north. A more detailed discussion of this process will be included in the Ground Water Migration Management RI.

The shallow unconfined aquifer (Stratum B) has a field permeability (hydraulic conductivity) ranging from 1.1×10^{-2} cm/sec to 4.2×10^{-3} cm/sec, with an average of about 7.9×10^{-3} cm/sec (Table 4-7, 1987 RI). This average is based on wells MW-21, 23, 24 and 25 located in the well nest on the southern portion of the site.

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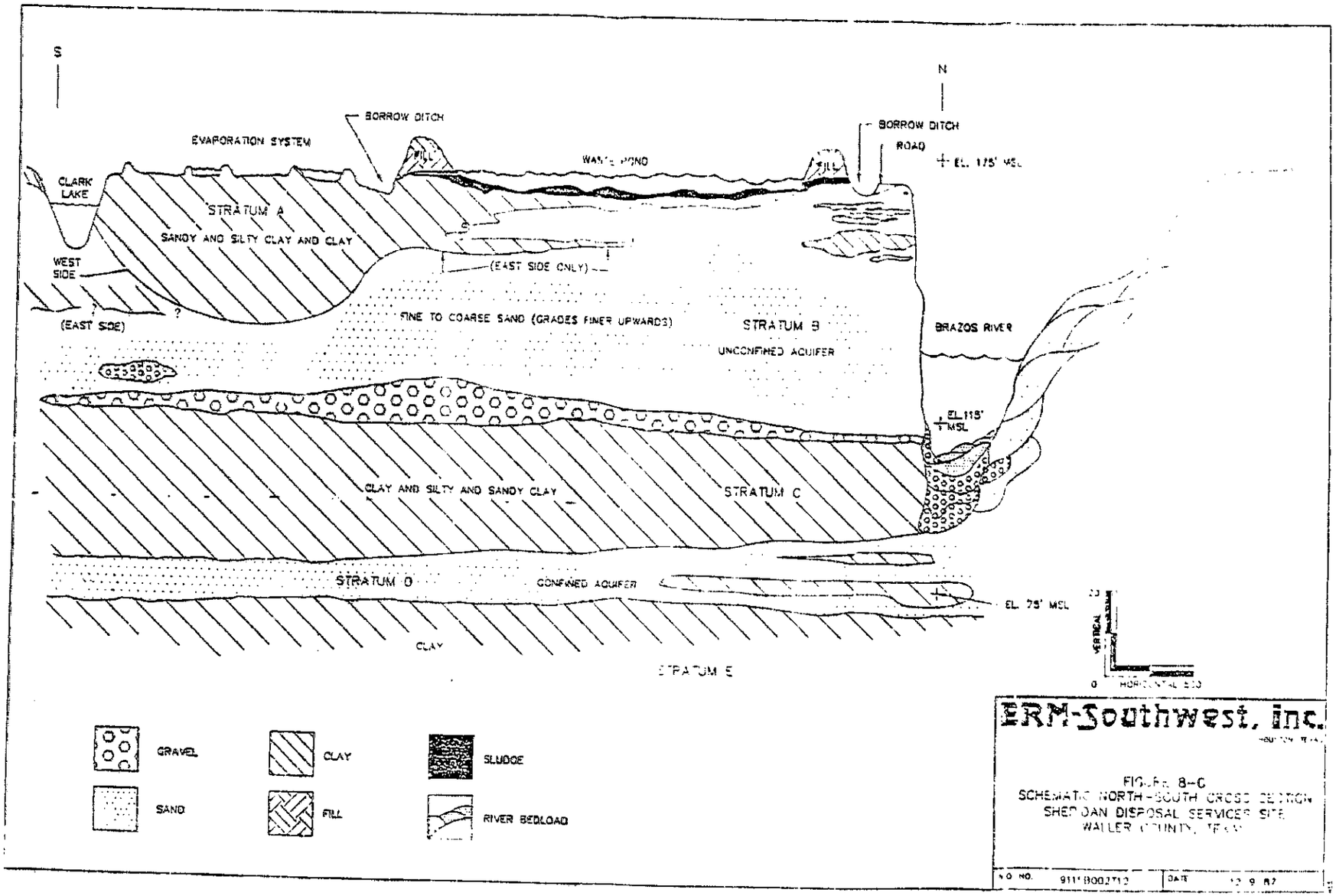

ERM-Southwest, inc.

FIGURE 8-C
SCHEMATIC NORTH-SOUTH CROSS SECTION
SHERIDAN DISPOSAL SERVICES SITE
WALLER COUNTY, TEXAS

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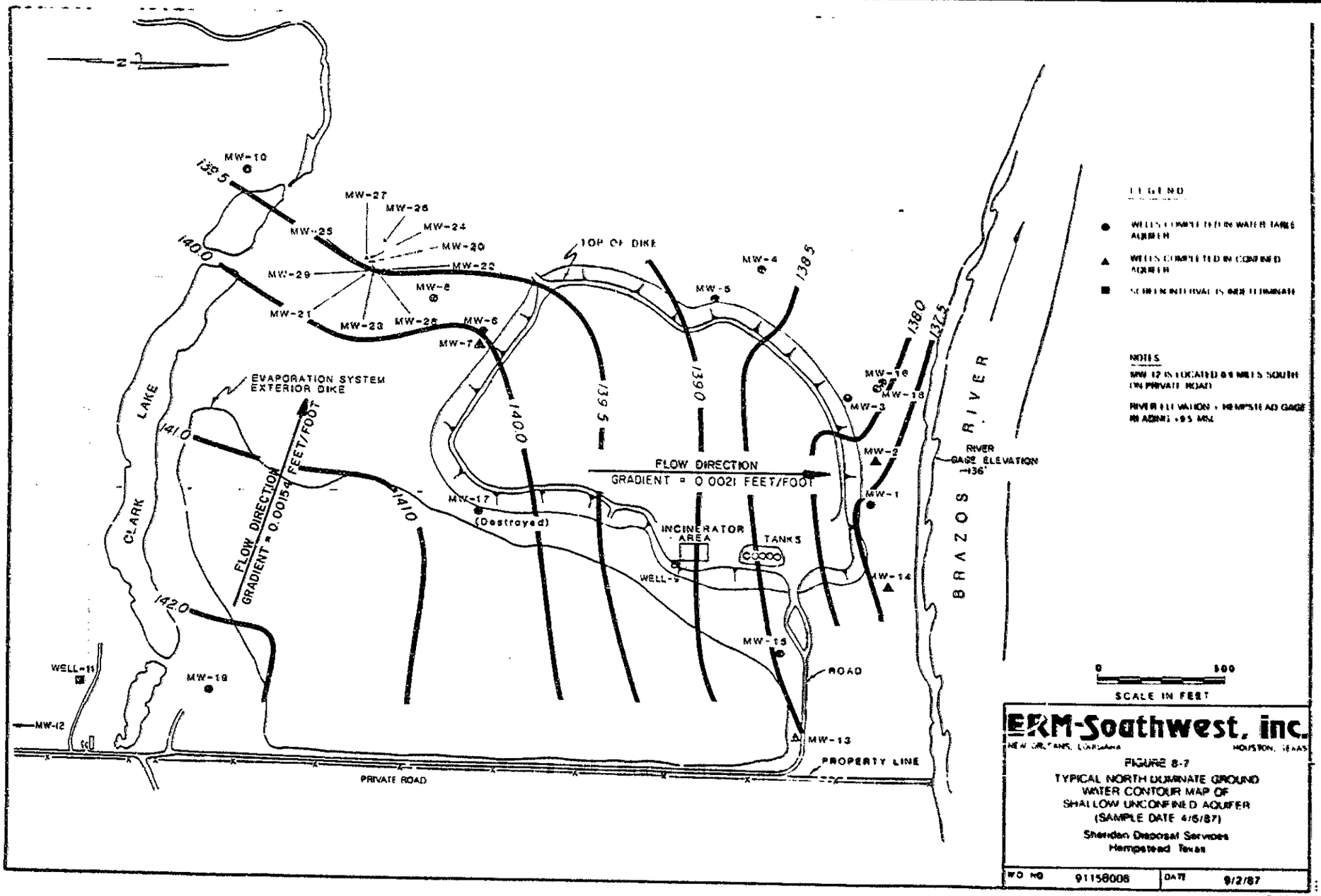
MW-10
MW-27
MW-26
MW-24
MW-25
MW-20
MW-22
MW-29
MW-8
MW-21
MW-23
MW-28
MW-6
MW-7
TOP OF DIKE
MW-4
MW-5
MW-16
MW-18
MW-3
MW-2
MW-1
MW-14
MW-15
MW-13
MW-17
(Destroyed)
MW-19
MW-12
WELL-11
WELL-9
INCINERATOR AREA
TANKS
ROAD
PROPERTY LINE
PRIVATE ROAD
EVAPORATION SYSTEM EXTERIOR DIKE
CLARK LAKE
BRAZOS RIVER
RIVER GAGE ELEVATION ~136'
FLOW DIRECTION
GRADIENT = 0.0021 FEET/FOOT
FLOW DIRECTION
GRADIENT = 0.0015 FEET/FOOT
1395
1400
1410
1420
1390
1385
1380
1375
LEGEND
WELLS COMPLETED IN WATER TABLE AQUIFER
WELLS COMPLETED IN CONFINED AQUIFER
SCREEN INTERVAL IS NOT ESTIMATED
NOTES
MW-12 IS LOCATED 0.5 MILES SOUTH ON PRIVATE ROAD
RIVER ELEVATION = HEMPSTEAD GAGE READING +0.5 MSL
0
500
SCALE IN FEET
ERM-Southwest, inc.
NEW ORLEANS, LOUISIANA
HOUSTON, TEXAS
FIGURE 8-7
TYPICAL NORTH DOMINATE GROUND WATER CONTOUR MAP OF SHALLOW UNCONFINED AQUIFER (SAMPLE DATE 4/6/87)
Sheridan Disposal Services
Hempstead Texas
WO NO 91158008
DATE 9/2/87

8-16

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The shallow unconfined aquifer is separated from a deeper confined aquifer (Stratum D) by a 25 to 35 foot thick clay aquitard (Stratum C). This confining clay unit under the shallow unconfined aquifer has laboratory permeabilities ranging from 7.6 x 10^{-7} cm/sec to 8.4 x 10^{-10} cm/sec with a median permeability of 4.4 x 10^{-8} (Table 4-19, 1987 SCRI). Pump test data in the confined aquifer indicated a "leakance" permeability of 2.3 x 10^{-3} to 1.4 x 10^{-5} cm/sec, depending on the model used for the calculation (Table 4-20, 1987 SCRI). A highly conservative travel time across the clay band was calculated to be 81 years. This clay layer represents a portion of the Fleming Formation, probably a clay unit of the Evangeline aquifer, and does not appear to be part of the overlying alluvium. The presence of a thick gravel unit at the base of Stratum B argues strongly for an unconformable contact between strata B and C.

Stratum D underlying the clay layer is a sand layer typically found at depths between 80 and 100 feet below grade. This aquifer averages 10-12 feet in thickness and consists of fine to medium grained sand. Occasionally, thin silt and clay seams are interbedded within the sand. The average permeability, transmissivity, and storage coefficient of the confined aquifer are 5.8 x 10^{-3} cm/sec, 1400 gpd/ft and 7.6 x 10^{-4} (unitless), respectively, (1987 SCRI, Table 4-11).

The confined aquifer at the site could sustain a single domestic water well but probably would not sustain a low producing irrigation or municipal production well. Available data indicate that ground water flow direction within the confined aquifer is generally toward the northwest. According to the 1987 RI (page 4-2), there is a potential for a hydraulic connection between the shallow unconfined and the deep confined aquifers at the SDS Site, but the realization of this connection is unlikely.

Stratum E is a clay aquitard that underlies the confined aquifer to an undetermined depth at the site. The laboratory permeability of Stratum E was determined from a single sample to be approximately 4.5 x 10^{-10} cm/sec.

8.4 Habitats and Species at the SDS Site

Since the site is located within a gently sloping (0.3%) meander scar area of the Brazos River flood plain, a variety of habitats are available on site and within the immediate area (Sheridan and the adjacent Styers property to the east). These include:

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- pastures and hayfields
- riverbank woodland
- wet thickets and woodlands
- floodplain woodlands
- disposal pond
- evaporation system
- Clark Lake
- Brazos River
- oxbow pond(s)
- cattle ponds

In the SCRI, a total of 125 terrestrial vascular plant species were identified within a two-square mile study area. Evidence of 12 mammalian species was obtained, 79 bird species (some in flocks of up to 1500 individuals) were documented, and two amphibious reptiles were identified in terrestrial and/or marshy habitats. A total of nine genera of aquatic species were identified in Clark Lake.

The primary site habitats and the biota associated with each area are summarized in Table 8-5. Any aquatic biota in ephemeral ditches, ponds and gullies are assumed to be represented in the Clark Lake population.

Three sediment samples of Clark Lake were obtained in December 1985 (See Table 8-6). The samples were taken from the lower (eastern) end and middle of Clark Lake. Priority pollutant organic analyses only detected methylene chloride and di-n-butyl phthalate in one sample at 0.0206 and 0.89 mg/kg, respectively. Both are likely field blank or laboratory contaminants. Samples taken from the upper (western) end - the portion that receives runoff directly from the main pond and dikes - was sampled August 27, 1987. Results of analysis of one composite water sample and one composite sediment sample are provided in Table 8-7.

011367

TABLE 8-5

Summary of Representative Species
for Habitats at the SDS Site

Habitat	Representative Potential Species	
1. Clark Lake	Killifish	Insect larvae
	Topminnow	Water beetles
	Gar	Algae
	Grass shrimp	Aquatic macrophytes
	Mussels	Water fowl
	Snails	Wildlife
	Worms	Domestic animals
	Humans	Crayfish
2. Brazos River	All of the above plus:	
	Game fish	
	Trash fish (shad, carp, threadfin, etc.)	
	Commercial fish	
	Alligator	
3. On-site habitats (Ephemeral ponds, gullies and low lying areas)	Terrestrial Habitats:	
	Pasture plants	Cattle
	"Oldfield" species (native tall grasses and weeds)	Wildlife
	Humans	Domestic animals
	Insects	Soil invertebrates
	Avifauna	Wild fruits
4. Evaporation system and stock ponds	Same as for Clark Lake, except Gar	

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Table 8-6

Priority Pollutant GC/MS Analysis of
Clark Lake Sediments, December 1985

Compounds Detected (mg/kg)	LI	L2	L3
Volatile Fraction:			
Methylene Chloride	0.0206*	ND	ND
Acid Fraction:			
Benzoic Acid	ND	ND	ND
Base/Neutral Fraction:			
Di-n-butyl phthalate	0.890*	ND	ND
Pesticide/PCB:	ND	ND	ND

ND - Not detected
* Possible lab contaminant.

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TABLE 8-7

Summary of Detected HSL Compounds in Samples Collected 08/27/87
From the West End of Clark Lake

Parameter	Lab.No. 64403-001 Composite Water Sample (mg/l)	Lab.No. 64403-002 Composite Sediment Sample (mg/l)
VOLATILE ORGANICS	<0.005-<0.025	<0.500-<2.500
SEMIVOLATILE ORGANICS	<0.010-<0.050	<0.330-<1.600
PESTICIDES		
'4,4'-DDD	<0.0002	0.016
PCBs	<0.001-<0.002	<0.080-<0.160
METALS		
Aluminum	15	14100
Arsenic	0.032	8.000
Barium	0.260	140
Beryllium	0.001	0.900
Calcium	63	24100
Chromium	0.010	20
Cobalt	<0.010	6
Copper	0.024	12
Iron	13	16500
Lead	0.012	17
Magnesium	11	8200
Manganese	0.460	300
Mercury	0.0009	<0.050
Nickel	<0.040	20
Potassium	17	3000
Sodium	24	200
Vanadium	0.040	18
Zinc	0.070	46
Total Cyanide	<0.010	<1.000

011370

9 - PATHWAY ANALYSIS AND EXPOSURE ASSESSMENT: SUMMARY OF APPROACH

The possibility for human exposure to constituents from source areas at a specific site is determined by site-specific physical conditions, most important of which are:

1. Climate
2. Topography
3. Disposal facilities
4. Access
5. Surrounding landuse
6. Hydrologic and geologic setting

The probability of exposure for a specific site is dependent upon accessibility and landuse. The route or pathway of exposure is dependent upon climate, topography and the location, condition and nature of the disposal facilities for the specific site. The level of exposure is dependent upon the source characteristics (concentration, distribution and topographic exposure of constituents of concern) and the position of the source(s) with respect to potential receptor areas. The exposure event depends upon a receptor species (e.g., man) being present in the receptor area to intercept a release from the source.

9.1 Summary of Actual and Assumed Site Conditions

A baseline risk assessment assumes no remedial action and is performed to evaluate the most probable, worst-case exposures that might occur at a site, given the conditions specific to that site. In the case of the Sheridan Site, the site-specific conditions are currently: 1) restricted access; 2) agricultural land use; 3) no residential development on or adjacent to the site; and 4) no wells in the shallow aquifer downgradient of the disposal facilities. However, at the specific request of EPA Region VI, two additional improbable site condition assumptions are evaluated in Appendix F. These assumptions are:

1. Residential development immediately adjacent to the disposal area; and

2. A water well in the shallow unconfined aquifer at the edge of the disposal area.

These additional assumptions are improbable because the landuse postulated is not likely at the site.

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For the standard baseline risk assessment, the following site conditions are considered:

1. Current Site Conditions - fenced, restricted site with no remediation and existing landuse and locations of human habitation. This is Site Condition 1 and is discussed in Section 10.

2. Future Site Conditions - assuming complete abandonment and no remediation of the site.

   Most probable future landuse is based on evaluation of site-specific landuse potential. This is Site Condition 2 and is discussed in Section 11. Site conditions would include:

   (1) No remedial action.

   (2) No access restriction.

   (3) Future residential construction outside the Brazos River flood plain.

   (4) Continued agricultural/sylvicultural use of the lands in the Brazos River flood plain.

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9.2 Summary of Pathway Analysis

The necessary elements for any human exposure to chemicals in the environment are:

1. A source;

2. A mechanism of chemical release from the source to the environment;

3. A pathway by which chemicals can get from the release point to a receptor area; and

4. A human receptor present in the receptor area at the time of chemical arrival.

For a pathway to be complete, all four elements of exposure must be present. For a direct contact exposure, the mechanism of chemical release and the pathway to the human receptor do not stand as separate and independent components, but are instead combined in the process of direct physical contact with sludge or affected soil.

The potential pathways of interest at the Sheridan Site operate through four environmental media: Air, Surface Water, Soil and Ground Water. These media each define one or more transport mechanisms by which chemicals might move from source to receptor

and are used in the following sections and subsections to categorize specific exposure pathways.

In this section, all the possible site-specific sources and pathways are first identified, then screened to determine if they are complete or incomplete (i.e., have a human receptor) under each of the three site conditions.

Once it is determined which pathways are complete and which are incomplete for each site condition, an exposure assessment is performed for the completed pathways. The exposure assessment involves: 1) a determination of calculated or actual measured exposure levels at identified receptor locations; and 2) a health-based assessment of any risks which might result from exposure to various source materials via the completed pathways.

The remainder of this section provides an overview of the pathways considered for each of the three site conditions - Current (actual) and two hypothetical abandoned conditions. Section 10 details the exposure analysis under current site conditions. Section 11 details the exposure analyses under assumed Site Condition 2. All evaluated exposure scenarios assume no remedial action.

011373

9.3 Sources at the SDS Site

A site map with locations of release sources is provided in Section 2, Figure 2-2. The primary source is the main pond. Secondary sources include the main pond dikes, the evaporation system sludges and soils. For purposes of this assessment, storage tanks located on the east side of the dike may constitute a small additional point source under assumed future site conditions. They are not considered separately since they contain the same materials as present in the pond, and would drain (if ruptured) to the pond. Material characteristics and constituents for the identified sources are provided in Section 3.

9.4 Pathway Identification and Screening

All potential pathways for the Sheridan Site are analyzed in Table 9-1 in terms of transport media, release sources and release mechanisms. These pathways have been assigned Roman numerals corresponding to the transport media (Air = I, Surface Water = II, Soil = III, and Ground Water = IV) and a letter indicating a discrete combination of release mechanism and human exposure route. These codes were included in the table to help cross-reference the discussions in the following sections and subsections.

TABLE 9.1

Summary Release Source Analysis for Current and Two Assumed Future Site Conditions

Transport Medium	Potential Release Source	Release Mechanism	Human Exposure Route	Nearest Receptor Area	Site Condition 1 (Section 10): Is Pathway Complete Under Current Site Conditions?	Why?	Site Condition 2 (Section 11): Is Pathway Complete Under Assumed Abandoned and Most Probable Future Landuse Site Conditions?	Why?	Site Condition 3 (Appendix F): Is Pathway Complete Under Assumed Abandoned and EPA Generic Future Landuse Site Conditions?	Why?
I Air										
IA	Main Pond (open)	Volatilization	Inhalation	Dike Trailer Owner's House	Yes	Human Receptors Present	Yes	Human Receptors Present	Yes	Human Receptors Present
IB	Tanks	Volatilization	Inhalation	As above	No	Tanks Intact and Maintained	Yes	Tanks not maintained rupture to main pond	Yes	Tanks not maintained rupture to main pond
IC	Dikes and Borrow Pits	Windblown Dust	Inhalation Skin Adsorption	Inside Fenced Facility Area	Occasionally	Infrequent Human Receptor Presence	Occasionally	Infrequent Human Receptor Presence (Ranchers/Hunters)	Yes	Assumed Residential Development Adjacent to Disposal Areas
II Surface Water										
IIA	Dikes Borrow Pits Around Main Pond	Elution and Runoff	Ingestion of Food-chain Organisms	Clark Lake	Yes	Presence of Cattle Possible Consumption by Humans	Yes	Infrequent Human Receptor Presence (Ranchers/Hunters)	Yes	Assumed Residential Development Adjacent to Disposal Areas Incidental/intentional Ingestion May Occur
IIB	Main Pond and Evaporation System	Dike Failure	As above	Clark Lake	No	Dikes Intact and Maintained	Possible with time	Presence of Cattle Possible Consumption by Humans	Yes	As above
IIC	Main Pond and Evaporation System	Direct Contact	Incidental Immersion or Ingestion	Main Pond Flooded Evap System	No	No Inadvertent Human Receptors - Restricted Area	Yes	Infrequent Human Receptor Presence (Ranchers/Hunters)	Yes	Assumed Residential Development Adjacent to Disposal Areas
IID	Dikes Pits Main Pond Evaporation System and Affected Soils	Brazos Bank Failure	Possible Consumption of Food-chain Organisms and/or Ingestion of Water	Brazos River	No	Possible Consumption of Aquatic Organisms (Bank failure has not occurred and is not imminent)	Potentially Complete	Possible Consumption of Aquatic Organisms Only (Bank failure might might occur with time)	Potentially Complete	Possible Consumption of Aquatic Organisms and Ingestion of Water (Bank failure might occur with time)
III Soil										
IIIA	Dikes Borrow Pits Main Pond and Evaporation System	Direct Contact	Skin Adsorption Incidental Ingestion	Inside Fenced Facility Area	No	No Inadvertent Human Receptors - Restricted Area	Yes	Inadvertent Intruders Ranchers/Hunters	Yes	Assumed Residential Development Adjacent to Disposal Areas
IIIB	Dikes Borrow Pits Main Pond and Evaporation System	Direct Contact	Intentional Ingestion (Pica Pica)	Inside Fenced Facility Area	No	No Inadvertent Child Receptors - Restricted Area	No	Inadvertent Intruders Ranchers/Hunters	Yes	Assumed Residential Development Adjacent to Disposal Areas
IIIC	Dikes Borrow Pits Main Pond and Evaporation System	Food-Chain Uptake	Ingestion of plants or animals growing on affected soils	Inside Fenced Facility Area	No	No Utilization by Humans or Livestock	Possible But Highly Unlikely	Consumption of Livestock or Wildlife	No	Assumption of Adjacent Residential Development Precludes Ranching/Farming
IV Ground Water										
IVA	Dikes Pits Main Pond Evaporation System and Affected Soil	Percolation and Seepage through Affected Sediments to the Unconfined Aquifer Deschasue	Ingestion or household use of ground water	Shallow Ground Water at or Downgradient of Site	No	No Human Receptors (no downgradient wells)	No	No Human Receptors (no downgradient wells)	Yes	Assumed household at edge of disposal area
IVB	As Above	to the Brazos As Above	Possible Consumption of Aquatic Organisms and/or Incidental Ingestion of Water	Brazos River	Yes	Possible Consumption of Aquatic Organisms only	Yes	Possible Consumption of Aquatic Organisms only	Yes	Possible Consumption of Aquatic Organisms and Ingestion of Water

Similarly, the three site conditions being evaluated are indicated in the right half of Table 9-1 as column headers. Each pathway has been designated as complete (yes) or incomplete (no) for each site condition for the reasons indicated in the columns titled "Why?".

9.5 Complete Pathways for Site Condition 1

As indicated in Table 9-1, there are four complete pathways for human exposure under current site conditions. These are:

1. Inhalation of volatilized constituents (Pathway IA);

2. Inhalation of constituents in windblown dust (Pathway IC);

3. Surface water runoff to Clark Lake (Pathway IIA); ingestion of water by cattle, with possible human consumption of cattle; and

4. Possible consumption of organisms from the Brazos River, which receives ground water from the site (Pathway IVB).

9.6 Completed Pathways for Site Condition 2

Site Condition 2 assumes no remediation and total abandonment in combination with most probable future landuse (agricultural) for the surrounding area. Agriculture should remain the prime landuse and the current number and location of dwellings within the Brazos Floodplain area (see Figures 8-5 and 9-1) should not change. However, because the site is assumed to be abandoned, hunting and fishing are assumed to occur on-site and in and around Clark Lake and livestock grazing is assumed to be unrestricted.

Completed pathways under Site Condition 2 include:

1. Inhalation of volatized constituents (Pathway IA).

2. Tank rupture into main pond and subsequent volatilization (Pathway IB).

3. Inhalation of constituents in windblown dust (Pathway IC).

4. Surface water runoff to Clark Lake and ingestion of water by cattle with possible human consumption of cattle (including Pond overtopping; Pathways IIA and IIB). Consumption of fish is not included because Clark Lake does not support edible species of fish.

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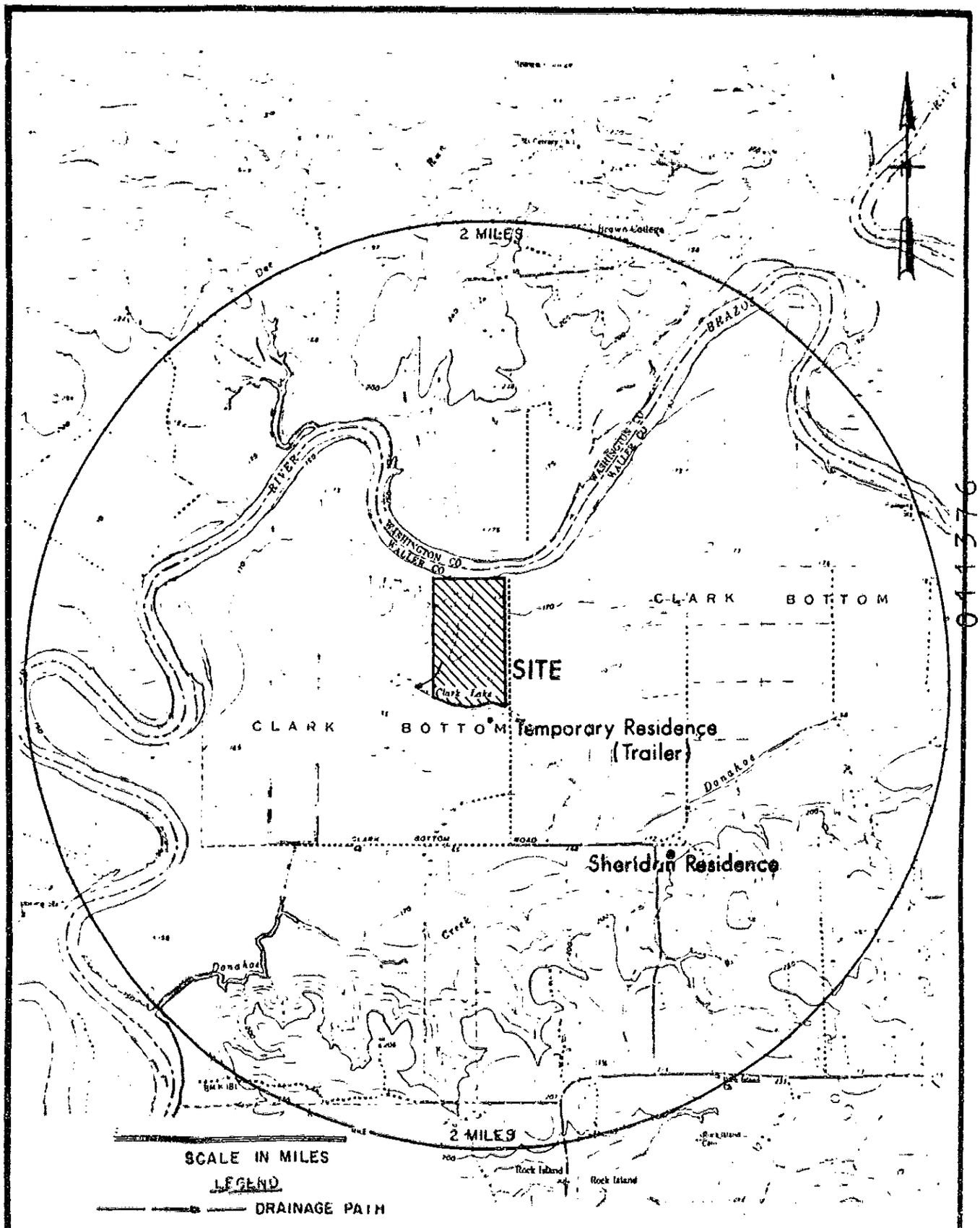

ERM-Southwest, inc.
NEW ORLEANS, LOUISIANA HOUSTON, TEXAS

DATE	9/2/87	W.O.NO.	9115A011

FIGURE 9-1

POTENTIAL HUMAN RECEPTOR LOCATIONS WITHIN A TWO MILE RADIUS

Sheridan Disposal Services
Hempstead, Texas

5. Direct contact with pond water and sludge (Pathways IIC and IIIA).

6. Possible consumption of organisms from the Brazos River subsequent to bank failure (Pathway IID).

7. Possible ingestion of plants or animals growing on affected soils (Pathway IIIC).

8. Possible consumption of organisms from the Brazos River, which receives ground water from the site (Pathway IVB).

For the purposes of direct exposure calculations, consumption and contact with main pond water was not considered in Site Condition 2. Risks associated with dermal and gastrointestinal absorption of compounds present in main pond water are recognized. However, the concentration of these constituents in main pond water, as compared to main pond sludges, are very small and would not impact the overall risk calculated due to exposure to sludge.

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9.7 Representative Constituent Concentrations

All of the quantities and concentrations used for prediction of exposure levels in the risk assessments for each site condition are summarized in Table 9-2. Quantities and concentrations are "compartmentalized" in order to supply compartment-specific loads to the models required to perform the pathway analyses and derive the exposure concentrations.

Please note that these values are all calculated directly from the numbers presented in Section 3, Tables 3-2, 3-3, 3-7, 3-8, 3-9, and 3-10 (1987 data gathered by ERM-Southwest) and numbers presented in the text and Appendices of the Source Control RI (July, 1987; data gathered by EPA, TWC and REI). The ranges of data for each compartment are summarized in Tables 4-1 and 4-2, Section 4.

Please note also that, except for pond water, the representative values summarized in Table 9-2 are NOT the same as those calculated for and presented in Section 7. The representative values, i.e., (min + max)/2, given in Tables 7-1 and 7-2 were developed for the purpose of completing the indicator selection process. This process did not require compartmentalization by source area because the indicator selection process takes into account only the worst-case compartments (see text discussion related to calculation of indicator chemical IS-Values, Tables 7-7, 7-8 and 7-9 in Sections 7.3.2 and 7.4 and Appendix E-1 calculation tables for detail).

TABLE 9-2

Summary of Representative Concentrations and Volumes for
Specific Waste Compartments and Receptors for the Sheridan Disposal Services Site

Parameter	Representative Water Concentrations (1): Main Pond Water (2) (Table 4-1&2)	Clark Lake Water (West end) (Table 8-7)	Brazos River Water Quality (Table 8-4)	Representative Concentrations for Soils/Sludges (1): Main Pond Sludges (2)	Dike Area: Averaged Soils (3)	Dike Area: Affected Soil	Evaporation Area: Soils	Evaporation Area: Sludges (2)	Background Soils (Tables 4-1&2)
Units	mg/l	mg/l	mg/l	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Area (acres)	19 (4)		Surficial	12	17	12	40.75	0.25	Surficial
Representative thickness (feet)	7.1 (5)		NA	1.5	11	5.5	0.5	0.5	NA
Approximate volume (cu.yds.)	217021		NA	30000	301693	114000	33000	200	NA
Density	1.0 g/cm3	1.0 g/cm3	1.0 g/cm3	1.1 g/cm3	1.6 g/cm3	1.3 g/cm3	1.6 g/cm3	1.3 g/cm3	1.6 g/cm3
Benzene	ND	ND	ND	1050	12	23	ND	47.95	ND
2,4-Dimethylphenol	ND	ND	ND	342	6	16	ND	24.7	ND
Ethylbenzene	ND	ND	ND	3267	6	11	ND	301	ND
Naphthalene	ND	ND	ND	257	8	13	ND	ND	0.115
Total PCBs (as Aroclor 1016)	ND	ND	ND	159	10	19	ND (6)	25	ND
Phenol	1.8	ND	ND	695	45	90	ND	757	ND
Tetrachloroethylene	0.26	ND	ND	121	ND	ND	ND	21.8	ND
Toluene	0.63	ND	ND	1225	10	19	ND	165.0	ND
Trichloroethylene	1.46	ND	ND	50	ND	ND	ND	ND	ND
Metals (as total constituent)									
Chromium	1.14	0.01	0.01	236	13	20	33.4	72.6	31.1
Lead	0.304	0.012	0.0235	404	149	290	45.7	164	11.6
Nickel	0.625	ND	0.005	67	12	14	17.6	31.5	17.2
Zinc	4.505	0.07	0.035	573	285	492	72.6	751	39.6

(1) Except for sludge samples, the representative concentration given is the average of [detected concentration(s) plus 1/2*(sample d.l.)] found for the waste compartment indicated

(2) Representative values for sludge samples are calculated as the average of all above-detection-limit concentrations or 1/2 of detected value if there is only one detection in the data base. See Appendix E-1 for documentation. These calculations provide worst-case levels for direct contact exposure and ground water models. Representative values for Toluene and Zinc to not include outlier values of 36,600 and 13,800 mg/kg, respectively, because concentrations of that magnitude were not confirmed in 1987 samples

(3) Average dike soil concentration is calculated as the mean of all visually affected and unaffected soils data from the dike boring samples collected July 6-10, 1987 (see Appendix E-1 for documentation). These calculations provide data for dust emissions and direct exposure models.

(4) Acreage given is based on the assumption that, if abandoned, the pond would fill to an elevation of 176.5 feet MSL and would decant over the lowest part of the dike at that elevation with each subsequent rainfall. The low point appears to be located on the north dike, west of the former tank battery and receiving pond (Figure 2-2)

(5) Depth given is based on the average depth (3.6 feet) from the water surface to the sludge surface (see Table 3-5) as recorded in the June 17-18, 1987 sampling of pond sludges, plus the difference between the water elevation recorded on that date (173' MSL) and 176.5' MSL (a difference of 3.5').

(6) PCBs (as Aroclor 1248) were detected from 0.5-1' depth in evaporation system cells 3 and 15 at concentrations of 1600 ug/kg and 110 ug/kg, respectively (samples from February 1988 and December 1987 sampling events)

10 - PATHWAY ANALYSIS AND EXPOSURE ASSESSMENT: CURRENT SITE CONDITIONS

In accordance with the rationale discussed in Section 9, this section presents a pathway analysis and exposure assessment for the SDS Site under current (as is) site conditions. These conditions are:

1) Restricted access - the only humans with access to the inside of the fenced perimeter of the waste disposal area are the site owner and authorized personnel.
2) Intact dikes and tanks (i.e., no overland flow from the main pond or emission sources other than the pond for volatiles).
3) Maintenance of facility (e.g., pumping of water from main pond to evaporation system on an as-needed basis; fence and dike repair).
4) No downgradient use of shallow ground water.
5) Nearest off-site human receptor is a single-family temporary residence (trailer) south of Clark Lake with a well completed upgradient of the disposal facilities at a depth of 135 feet (MW-11). The nearest permanent residence is that of the site owner, one mile southeast.

From Table 9-1, Section 9, Site Condition 1, it can be seen that the only completed pathways are:

1) Air - inhalation of dust and vapor on-site and at nearest residence.
2) Surface Water - runoff to Clark Lake
3) Ground Water - seepage of leachate from disposal area to ground water and subsequent transport to the Brazos River.

Each of the pathways is described and evaluated in the following sections.

10.1 Air Exposure Pathway

10.1.1 Potential Sources and Pathways

The air exposure pathway is potentially completed to a human receptor under existing site conditions only through two mechanisms: 1) volatilization of organic constituents and 2) wind-blown dust. Volatilization only needs to be evaluated for

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organic compounds since metals generally do not vaporize under ambient temperature and pressure conditions. Wind-blown dust needs to be evaluated only for metals and PCBs to avoid double accounting of highly volatile organics.

In its current condition, there are two potential sources for volatile organic emissions at the Sheridan Site: 1) the liquids, tars and sludges contained in the main pond; and 2) exposed areas of contaminated soils outside the main pond (dikes, exposed wastes, and two small areas in the first cell of the evaporation system.)

Volatilization of organics from the pond and soil surfaces is reduced by several factors, including the concentration and chemical nature of the volatiles at the physical interfaces (e.g., water-air interface, oil-water interface, soil-water interface, soil-air interface, etc.). Variation in climatic factors such as seasonal temperature, wind speed and direction, rainfall, humidity, surface cover, etc., also operate to limit or increase both volatilization and wind-blown dust.

Assuming that the ambient air is affected by volatilization and wind-blown dust, the primary considerations determining exposure are 1) receptor location with respect to prevailing winds, and 2) the level and duration of the exposure at the point of contact. These aspects are discussed in the following sections.

10.1.2 Potential Receptors

The site is very remote and is well removed from any major thoroughfares. Only one permanent residence is located within one mile of the site (Figure 9-1) - the home of the site owner, Mr. Duane Sheridan. A temporary trailer residence is also located within one mile of the site, just south of Clark Lake and west of the site access road, and is currently inhabited by one of Mr. Sheridan's sons.

Land use within a four-mile radius of the site is agricultural, primarily consisting of pasture, hayfields and rangeland. The small community of Brown College, Texas (Figure 2-1) is the most populated area within a four-mile radius and consists of approximately 20 houses scattered sparsely throughout the community area. No other communities or housing developments exist within a four-mile radius. The population for the four-mile radius is not known, but a total of 193 residences occur within this radius (SCRI, July 1987).

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The only other potential receptors in the area are numerous species of wildlife - particularly birds - that feed and/or nest on and near the site. Additionally, the site owner has animals including cattle, sheep, goats and pigs that are maintained outside the fenced area of the site.

10.1.3 Air Pathway Exposure Assessment

Based on the available demographic data summarized above, one of the completed exposure routes requiring evaluation for the air pathway is possible inhalation of chemicals resulting from chronic low-level volatilization of organics from the open water surface of the main pond. The other completed exposure route is inhalation of metals and PCBs in wind-blown dust from barren areas of the site (i.e., bare dikes and borrow pit areas).

To calculate the exposure from volatilization, a model was developed which assumes the maximum detected pond water concentrations (see Table 4-1) for each of the detected indicator organics as the worst-case source load under ambient conditions. Emission rates from the water using these concentrations were estimated by the method of Liss and Slater 1982 (see Appendix G-1).

The estimated exposure was evaluated at two potential receptor locations: a) the top of the pond dike system; and b) at the temporary trailer. Hourly data available from the Hobby Airport weather station in southeast Houston, Texas for wind speed and direction were used to model maximum 8-hour average exposures at the dike and the trailer for each of these scenarios. In addition, a maximum annualized average exposure was modeled using annual average meterological conditions for the site area. All air modeling for this scenario was performed by Pilko & Associates, Houston using the Texas Climatological Model, Version 8AB (for 8-hr and 30-min maximum average). (See Appendix G-1 for air modeling data and a complete description of the models used for calculation of emission and dispersion of volatiles from the pond.)

Metals were not considered in the vaporization models for the pond due to their very low vaporization constants. However, metals were evaluated for airborne dust derived from barren areas of the dikes and borrow areas around the main pond.

Organics other than PCBs were not considered in dusts due to relatively high vaporization rates and generally very low concentrations in site soils. Emission rates for dust were based on average constituent concentrations for all sampled dike soils

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(See Tables 3-8, 3-9, 9-2 and Appendix E-1) and using wind erosion rates for soil estimated using Cowherd's method (EPA 600/885/002, February 1985). Concentrations on- and off-site (at the trailer location) were estimated using two dispersion models [the Box Model (Schlesinger, et al 1987) and Turner's 1970 Gaussian model]. (See Appendix G-2 for a complete description of these methods).

10.1.4 Predicted Exposure Levels for Volatile Organics

The results of the modeling for volatile organics are presented in Tables 10-1 and 10-2. The modeled results indicate that no risk to human health or the environment currently exists from organic emissions from the pond surface at the site. Even conservatively assuming a receptor at the dike, none of the compounds come close to reaching Texas Air Control Board (TACB) recommended Effects Screening Levels for annual averages, assuming a wind speed of three m/sec. Air emissions concentrations modeled at the trailer (Table 10-2) average about 1/100th of the values at the dike. These modeled results are consistent with actual site air monitoring results (Section 4.3) collected for the SCRI and by EPA.

10.1.5 Predicted Exposure Levels for Metals in Wind-Blown Dust

The results of the modeling for exposure levels of indicator metals and PCBs in wind-blown dust are presented in Tables 10-3 (emissions rates) and 10-4 (resultant exposure levels). As with volatile emissions from the pond, the resultant concentrations both on-site and off-site - even at the edge of the disposal area and using the more conservative Gaussian dispersion model- indicate no health effects. All short-term concentrations are well below available IDLH and TLV values. All annual concentrations are well below TACB screening levels for concentrations at facility property line (TACB, 11/19/87).

10.2 Surface Water Exposure Pathway

Surface water pathways leading to Clark Lake are incomplete for chronic exposure due to the lack of edible species of aquatic organisms in the lake. However, livestock belonging to the Sheridan family do use the lake and consumption of these cattle by humans is possible. Details of the potential effect on livestock are more fully discussed in Section 11.4.3. Water quality and sediment analyses for the lake (see Table 8-7) do not show any concentrations in either sediment or water that are inconsistent with normal agricultural usage of similar ponds. For

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TABLE 10-1

Summary of Modeled Air Exposure Concentrations

of Indicator Organics Under Ambient Conditions - Top of Dike

Indicator Chemical	Theoretical Exposure Concentrations (ug/m3) Windspeed 1 m/sec Maximum 6-Hour Average	Windspeed 1 m/sec Maximum Annualized Average	Windspeed 3 m/sec Maximum 6-Hour Average	Windspeed 3 m/sec Maximum Annualized Average	TLV-TWA Maximum 8-Hour Average in ppm	TLV-TWA Maximum 8-Hour Average in ug/m3	TACB Guidelines Annual (ug/m3)
Benzene	0.22090	0.02919	0.39263	0.05207	10	31,940	3
Ethylbenzene	0.19005	0.02511	0.33833	0.04474	100	433,980	433
Tetrachloroethylene	0.1550	0.0204	0.2760	0.0365	50	338,999	335
Toluene	0.64859	0.086029	1.115696	0.015345	100	376,700	375
Trichloroethylene	0.992	0.131	1.77	0.234	50	268,542	135
Naphthalene	0.01698	0.002257	0.03044	0.00404	10	52,390	*
Phenol	0.22173	0.029419	0.59751	0.07925	5	19,240	*

Source Pilko & Associates, August 18, 1987

NOTE Exposures are based on emissions rates calculated from the maximum observed concentration found in the pond water, assuming an ambient air temperature of 25 degrees Centigrade. See Table 7-1 for assumed water concentrations.

TACB = Texas Air Control Board, current screening levels for maximum annual average concentrations dated 11/19/87

* Short-term limit more restrictive - annual limit does not apply.
TACB 30-minute limits are 440 ug/m3 for Naphthalene and 150 ug/m3 for Phenol

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TABLE 10-2

Summary of Modeled Air Exposure Concentrations

of Indicator Organics Under Ambient Conditions - Trailer South of Clark Lake

Indicator Chemical	Theoretical Exposure Concentrations (ug/m3) Windspeed 1 m/sec Maximum 8-Hour Average	Windspeed 1 m/sec Maximum Annualized Average	Windspeed 3 m/sec Maximum 8-Hour Average	Windspeed 3 m/sec Maximum Annualized Average	TLV-TWA Maximum 8-Hour Average in ppm	TLV-TWA Maximum 8-Hour Average in ug/m3	TACB Guidelines Annual (ug/m3)
Benzene	0.0291	0.00148	0.05190	0.00264	10	31,940	1
Ethylbenzene	0.0257	0.00127	0.04567	0.00227	100	433,960	435
Tetrachloroethylene	0.0204	0.00104	0.0363	0.00185	50	338,999	335
Toluene	0.08573	0.00436	0.15292	0.00778	100	376,700	375
Trichloroethylene	0.1310	0.00664	0.233	0.0119	50	268,542	115
Naphthalene	0.00224	0.00011	0.00402	0.00020	10	52,390	*
Phenol	0.02931	0.00149	0.07898	0.00402	5	19,240	*

Source Pilko & Associates, August 18, 1987

NOTE Exposures are based on emissions rates calculated from the maximum observed concentration found in the pond water, assuming an ambient air temperature of 25 degrees Centigrade. See Table 7-1 for assumed water concentrations.

TACB = Texas Air Control Board, current screening levels for maximum annual average concentrations dated 11/19/87.

* Short-term limit more restrictive - annual limit does not apply.
TACB 30-minute limits are 440 ug/m3 for Naphthalene and 150 ug/m3 for Phenol.

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TABLE 10-3

Wind Erosion Emission Rates for Indicator Metals and PCBs in Average Dike Soils

Indicator Compound	Average Concentration for Dike Soils (mg/kg)	Emission Rate*	
		Short-Term (g/sec)	Annual (ug/sec)
Chromium	13	0.032	1.6
Lead	149	0.364	17.9
Nickel	12	0.029	1.4
Zinc	285	0.695	34.2
PCBs	10	0.024	1.2

* Assumes a total respirable particulate emissions rate for the exposed soil (10 acres) of 2,440 g/s for short-term (worst-case) and 0.12 g/s for annual (see Appendix G-2). For this analysis, the receptor is conservatively assumed to be downwind at all times - that is, no correction is made for prevalent wind direction.

See Table 9-2 and Appendix E for derivation of representative concentrations for average dike soils.

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TABLE 10-4

Resultant Exposure Concentrations Modeled
for Indicator Metals and PCBs in Windblown Dust

Indicator Metal	(1) On-Site Concentrations: Short-Term (ug/m3) (3)	(1) On-Site Concentrations: Annual (ug/m3)	(2) Off-Site Concentrations (ug/m3): 1-Hour Edge	1-Hour Trailer	24-Hour Edge	24-Hour Trailer	Annual Edge	Annual Trailer	Applicable or Relevant Available Criteria (in ug/m3): Short Term STEL (ACGIH)	Short Term IDLH (NIOSH/OSHA)	8-Hour TLV/TWA (ACGIH)	Annual TACB Guidelines 11/19/87
Chromium	9.30E-01	3.20E-05	1.12E+01	5.80E+00	2.20E+00	9.00E-01	3.57E-05	1.12E-05	NA	5.00E+03	5.00E+01	1.00E-01 * 2.50E-02 **
Lead	1.06E+01	3.70E-04	1.25E+02	6.65E+01	2.52E+01	1.03E+01	4.09E-04	1.29E-04	NA	Variable	1.50E+02	Must meet NAAQS (5)
Nickel	8.50E-01	3.00E-05	1.03E+01	5.40E+00	2.00E+00	8.00E-01	3.30E-05	1.04E-05	NA	NA	1.00E+03	1.50E-02
Zinc	2.02E+01	7.05E-04	2.46E+02	1.27E+02	4.82E+01	1.96E+01	7.83E-04	2.46E-04	1.00E+04 * 2.00E+03 **	2.00E+06 **	5.00E+03 * 1.00E+03 ** 1.00E+04 ***	5.00E+00 * 1.00E+00 ** 1.00E+01 ***
PCBs (4)	7.10E-01	2.50E-05	8.60E+00	4.50E+00	1.70E+00	7.00E-01	2.75E-05	8.64E-06	1.00E+03	5.00E+03	5.00E+02	NA

(1) On-site concentrations modeled using the Box model, Schlesinger, et al 1987. (See Appendix E-2)
(2) Off-site concentrations modeled using the Gaussian Dispersion method Turner, 1970 (See Appendix E-2)
(3) Values good from 1 to 24 hours
(4) Criteria stated are for PCBs as 54% Chlorine Limits for 47% are 2X higher
(5) NAAQS for lead is a quarterly standard of 1.5 ug/m3

* as Chromium +3
** as Chromium +6

* as Zinc oxide fume
** as Zinc chloride fume
*** as Zinc oxide dust

References for Criterion: ACGIH = American Conference of Governmental and Industrial Hygienists, Threshold Limit Values and Biological Exposure Indices for 1987-1988
NIOSH/OSHA, September, 1985 Pocket Guide to Chemical Hazards, USDHH/CDC/NIOSH Washington, D.C.
STEL = Short Term Exposure Level (15-hour TLV = Threshold Limit Value/Time Weighted Average (8-hour/day, 40-hour/week)
IDLH = Immediately Dangerous to Life or Health.
TACB = List of Effects Screening Levels for Various Chemicals Interoffice Memo
Texas Air Control Board November 19 1987 Criterion are for facility boundary locations

instance, 4,4-DDD is a well known aerobic breakdown product of DDT, which was a very common agricultural chemical used in the South. Similarly, the high values for aluminum and other metals in the sediment of Clark Lake may be due to the use of alum, a flocculating agent used in stock ponds to clear the water.

Based on actual measurements, the concentration of indicator chemicals in Clark Lake are all below detection levels except for chromium (0.010 mg/l), lead (0.012 mg/l) and zinc (0.070 mg/l). These three metals are all below available drinking water standards (see Table 6-1) indicating that existing water concentrations do not represent a health threat to the existing stock watering usage. The surface water flow from the main pond area to Clark Lake is unlikely to contain appreciable amounts of indicator chemicals given the measured concentration of constituents in the exposed soils of the borrow ditches (Table 10-5). The borrow ditch areas receive and retain runoff from the dike areas and are the only site source potentially impacting runoff under existing conditions.

The only stormwater potentially contaminated to a significant degree is that falling in the main pond. This potentially contaminated stormwater will be contained within the diked main pond area. Consequently, this pathway does not represent any significant health threat.

10.3 Ground Water Exposure Pathway

10.3.1 Potential Sources and Pathways

There are two potential sources for shallow ground water contamination at the Sheridan Disposal Services Site: 1) the liquids, tars and sludges contained in the main pond; and 2) affected soils outside the main pond (dikes, exposed wastes, and two small sludge deposits in the first evaporation system cell which received outfall from the main pond).

The primary pathway for potential ground water exposure is the possible seepage of constituents from a source area to the shallow unconfined aquifer and subsequent discharge into the Brazos River. There are no ground water users downgradient of the disposal facilities. Therefore, the worst-case potential for human or environmental exposure beyond the site boundaries is limited to mixing of shallow ground water with the nearby surface waters of the river, uptake by aquatic species and subsequent human consumption.

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TABLE 10-5

Summary of Indicator Compounds Detected in Surficial Soils
Collected from the Borrow Ditch Area 08/06-07/87

Parameter	Boring S-8 0-1' 64258-001	Boring S-8 3-4' 64258-002	Boring S-9 0-1' 64258-003	Boring S-9 4-5' 64258-003	Average Background Soils
Organics (mg/Kg)					
Benzene	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND
2,4-Dimethylphenol	ND (<0.66)	ND (<0.33)	ND (<0.33)	ND (<0.33)	ND
Ethylbenzene	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)	0.135
Napthalene	ND (<0.66)	ND (<0.33)	ND (<0.33)	<0.33)	ND
Total PCBs	ND (<4.0-<8.0)	ND (<0.08-<0.16)	ND (<4.0-<8.0)	ND (<0.08-<0.16)	ND
Phenol	ND (<0.66)	ND (<0.33)	ND (<0.33)	ND (<0.33)	ND
Tetrachlorethylene	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND
Toluene	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND
Trichlorethylene	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND
Metals (mg/Kg)					
Chromium	9	3	6	7	31.1
Lead	17	7	14	11	11.6
Nickel	22	6	16	17	17.2
Zinc	60	12	52	32	39.6

All data for borings are from RMAL report dated September 10, 1987. Copy is provided in Appendix E-2

See Table 9-2 for background soils data

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The primary factors affecting exposure include the receptor location with respect to the source areas, the chemical nature of specific constituents, soil permeability and thickness, amount of rainfall, duration and frequency of high river stage, and dilution by the river. Although a northwestern component does exist in the shallow ground water flow pattern, for this section of the risk assessment all flow is conservatively assumed to be due north in order to calculate worst-case ground water discharge to the Brazos River.

10.3.2 Potential Receptors

As discussed above, the only potential receptors are the aquatic flora and fauna in the Brazos River, should constituents reach the river via ground water discharge. Exposure to fish and waterfowl could occur through the mixing of potentially affected ground water with the surface waters of the Brazos River. Subsequent exposure to human populations due to ingesting food-chain organisms is projected to be extremely small based on known recreational use of water in the area. Nevertheless, because of the potential risk to, say, local fishermen, this pathway was assumed to be complete and was evaluated as a potential episodic exposure. Because the river does not serve as a public water supply source near the site under current site conditions, any direct ingestion of river water would be inadvertent (probably as a result of recreational activities) and episodic.

10.3.3 Exposure Assessment

The prediction of surface water exposure concentrations of site-specific constituents requires computation of the mass flow rates of these constituents to the river via ground water seepage. Potential exposures can then be evaluated by calculating resultant surface water concentrations and comparing them to appropriate criteria.

While existing ground water data could serve as the relevant input parameter, the models utilized in the assessment start with the existing source concentrations and derive predicted unconfined aquifer concentrations. Three different modeling analyses were performed (increasing in sophistication and accuracy) to predict resultant constituent concentrations in the unconfined aquifer at the point of interface with the river. Each modeling effort involved a series of steps to proceed from existing waste concentration to aquifer concentration.

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10.3.3.1 Model 1

In the first modeling effort, EPA's organic leachate model (OLM) was used to predict leachate concentrations at the bottom of the visibly affected soils in the dikes and under sludges in the main pond and evaporation system. This model is very conservative in that no allowances for retardation or degradation are made. Moreover, the model does not provide a rate function (i.e., mass leached/time of active leaching).

The OLM model consists of the following equation:

$$C_1 = 0.00211 * C_o^{0.678} * S^{0.373}$$

where

C_1 = predicted constituent leachate concentration (mg/l)
C_o = initial concentration of the constituent in the source (mg/kg)
S = solubility for constituent (mg/l)

The results of the application of this OLM model (Appendix H-1) to the available sludge and soil concentrations are tabulated by source compartment in Table 10-6. Initial concentrations used are the compartment-specific representative concentrations shown in Table 9-2. Values from Table 9-2 for both soil and sludge compartments are used for evaporation system soils. Only the affected dike soil rather than average dike soil values are used for the dike area. This represents worst-case source material within the dike, since any water infiltrating through these materials would tend to leach a higher concentration of constituents from the most affected material. The solubility assumed for all four indicator metals was that for the chloride form, which was the most mobile form for most of the metals. It should be noted that the OLM was not really designed to predict metals concentrations and that the resulting leachate concentrations are probably much too conservative (see Section 10.3.3.4).

In order to evaluate the effect of leachate concentrations on ground water quality at a particular location, an aquifer dilution factor must be calculated to predict the concentration at the receptor location. One of the simplest, and most conservative, models available to calculate aquifer dilution is an alternative boundary analysis presented by Domenico and Palciauska (1982). This model, which is the basis for the VHS model, predicts the ground water concentration based on geometrical spreading of the constituent stream in the aquifer with continuous recharge.

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TABLE 10-6

Results of EPA's Organic Leachate Model (OLM) Using Representative Concentrations (1) for Specific Waste Compartments and Receptors for the Sheridan Disposal Services Site

PARAMETER	Main Pond Sludges		Visibly Affected Dike Area Soils		Evaporation Area: Soils		Evaporation Area: Sludges		Background Soils		Brazos River Water Quality (Table 8-4)
	[initial]	[leachate]	[initial]	[leachate]	[initial]	[leachate]	[initial]	[leachate]	[initial]	[leachate]	
Units	mg/kg	mg/l	mg/kg	mg/l	mg/kg	mg/l	mg/kg	mg/l	mg/kg	mg/l	mg/l
Area (acres)	15		17		40.75		0.25		Surficial		Surficial
Approximate volume (cu yds.)	30000		114000		33000		200		NA		NA
Density	1.1 g/cm3		1.6 g/cm3		1.6 g/cm3		1.3 g/cm3		1.6 g/cm3		1.0 g/cm3
Benzene	1050	3.85	23	0.29	ND	ND	42.95	0.44	ND	ND	ND
2,4-dimethylphenol	342	4.17	16	0.52	ND	ND	24.7	0.70	ND	ND	ND
Ethylbenzene	3267	3.32	11	0.07	ND	ND	301	0.66	ND	ND	ND
Naphthalene	257	0.34	12	0.04	ND	ND	ND	ND	0.135	0.002	ND
Total PCBs (as Aroclor 1016)	159	0.05	19	0.01	ND	ND	25	0.01	ND	ND	ND
Phenol	695	12.72	90	3.18	ND	ND	757	13.45	ND	ND	ND
Tetrachloroethylene	121	0.35	ND	ND	ND	ND	21.8	0.11	ND	ND	ND
Toluene	1225	2.69	19	0.16	ND	ND	165.0	0.69	ND	ND	ND
Trichloroethylene	50	0.41	ND	ND	ND	ND	ND	ND	ND	ND	ND
											(Total)
Chromium	236	12.14 (2)	13	1.70	33.4	3.23	72.6	5.46	31.1	3.07	0.01
Lead	404	24.92 (3)	149	12.67	45.7	5.69	164	13.50	11.6	3.24	0.0235
Nickel	67	5.35 (4)	12	1.67	17.6	2.16	31.5	3.21	17.2	2.13	0.005
Zinc	573	46.62 (5)	285	29.04	72.6	11.49	751	56.01	39.6	7.61	0.035

(1) See Table 9-2, and Appendix E-1 for derivation of representative concentrations

METALS SOLUBILITY DATA

(2) Solubility = 56.5g/100cc as $CrCl_2 \cdot 7H_2O$ = 12.35g/100cc as $CrSO_4 \cdot 7H_2O$ (Data not available for $CrCO_3$)

(3) Solubility = 151.3g/100cc as $Pb(ClO_3)_2$ = 0.00425g/100cc as $PbSO_4$ = 0.00011g/100cc as $PbCO_3$

(4) Solubility = 64.2g/100cc as $NiCl_2$ = 29.3g/100cc as $NiSO_4$ = 0.0093/100cc as $NiCO_3$

(5) Solubility = 4.3 kg/l as $ZnCl_2$ = 96.5g/100cc as $ZnSO_4 \cdot 7H_2O$ = 0.001/100cc as $ZnCO_3$

Solubility as chloride was use to calculate Cl because this salt is the most soluble form for the majority of the indicator metals

OLM MODEL PARAMETERS AND FORMULA

[initial] = initial concentration of each constituent in the soil in mg/kg = Co

[leachate] = leachate concentration predicted by OLM

[leachate] = 0.00211*(Co^0.678)*(S^0.373) where

S = solubility in mg/l for each constituent

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The VHS model is formulated as a boundary-value problem that approximates the spreading of a contaminant plume in the horizontal and vertical directions perpendicular to the prevailing ground water flow path and results in an equilibrium dilution for the receptor distance specified. The model is conservative in that no allowance for degradation is made and accounts only for transverse (not longitudinal) dispersion. Details of the model are presented in Appendix H-2.

For the main pond, the VHS model resulted in a dilution factor of 0.17 at the edge of the disposal area and 0.12 for the edge of the Brazos River. For the dike area, the dilution factors at the edge of the disposal area and at the river were 0.40 and 0.19, respectively; for the evaporation system, the factors were 0.16 and 0.02, respectively (See Appendix H-2).

Applying the VHS model to the leachate concentrations predicted by OLM results in the edge of river concentrations indicated in Table 10-7. Once the concentration of the interface is calculated it is possible to compute mass loading rates.

Mass loading rates (in g/day) from the aquifer to the river were calculated from the volumetric flow rate of the unconfined aquifer (m^3/day) times the concentration predicted at the edge of river. Volumetric aquifer flow rate (Fa) is calculated as follows:

$$Fa = ka * ia * Aa = m/day * 0.0031 * m^2 = m^3/day$$

where

ka = permeability of the aquifer = 7.9E-03 cm/sec
= 6.83 m/day

ia = gradient in the direction of flow = 0.0031 m/m

Aa = cross-sectional area of the aquifer perpendicular to the direction of flow = (aquifer thickness) times (facility width) where facility width is measured perpendicular to the direction of flow.

The number used for facility width is the same number as the "X" value entered in Appendix H-2, Table H2-1 for the VHS model. The resultant mass loading (Lr) to the river on a daily basis (g/day) is then calculated as:

$$Lr = Cr * Fa = mg/l * m^3/day * 1000\ l/m^3$$
$$= mg/l * 1000\ l/day = g/l * l/day$$
$$= g/day$$

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TABLE 10-7

Resultant Concentrations at Brazos Interface
from Combination of OLM and VHS

Parameter (mg/l)	Resultant Concentration at Brazos River: MAIN POND (Y = 140 m) Cl	Cy/Cl	Cy	DIKE AREA (Y = 100 m) Cl	Cy/Cl	Cy	EVAPORATION AREA (Y = 215 m) Cl	Cy/Cl	Cy
	(OLM)			(OLM)			(OLM)		
Benzene	3.85	0.12	0.46	0.29	0.19	0.06	0.44	0.02	0.009
2,4-Dimethylphenol	4.17		0.50	0.52		0.10	0.70		0.014
Ethylbenzene	3.32		0.40	0.07		0.01	0.66		0.013
Naphthalene	0.34		0.04	0.04		0.01	ND		ND
PCBs	0.05		0.0060	0.01		0.0019	0.01		0.0002
Phenol	12.72		1.53	3.18		0.60	13.46		0.270
Tetrachloroethylene	0.35		0.04	ND		ND	0.11		0.002
Toluene	2.69		0.32	0.16		0.03	0.69		0.014
Trichloroethylene	0.41		0.05	ND		ND	ND		ND
Chromium	12.14		1.46	1.70		0.32	5.46		0.109
Lead	24.92		2.99	12.67		2.41	13.5		0.270
Nickel	5.35		0.64	1.67		0.32	3.21		0.064
Zinc	46.62		5.59	29.04		5.52	56.01		1.120

Cy/Cl = dilution factor calculated in Appendix H-2 from the VHS model
Cl = leachate concentrate predicted from the OLM model (Table 10-6)
Cy = Cl * Cy/Cl = aquifer concentration

where

Cr = the concentration at the river bank predicted by the VHS model (mg/l)

Fa = aquifer flow rate (m^3/day)

To calculate resultant river concentrations, the total mass load (in g/day) was then divided by the volumetric flow of the river (in m^3/day) at low flow to obtain the worst-case river concentration. These predicted concentrations are shown in Table 10-8 which also contains four different water quality criteria (WQC). As can be seen in Table 10-8, even using these very conservative models, none of the available and possibly applicable or relevant criteria are exceeded except for PCBs. The upper bound PCB cancer risk is approximately 1.5×10^{-5}, based on Table 10-8. As will be shown in the following sections with the WMPLUME model, it is highly unlikely that PCBs would ever reach the river due to their high retardation coefficient, especially if biodegradation is also taken into account.

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10.3.3.2 Model 2

A primary problem with the assumptions in Model 1 is that the model does not take into account the effect of the clay and sand layers that lie between the generated leachate and the saturated zone (i.e., the leachate concentration is directly input to the aquifer). Based on available stratigraphic and hydrogeologic data for the site (see Section 8.3), there are, on the average, about 20 feet of unsaturated sediments between the surface and the average ground water elevation. The upper portion of this 20 feet is clay (Stratum A), which has a coefficient of permeability conservatively chosen to be 7.4×10^{-6} cm/sec (this value is derived from field and lab data for Stratum C clays). This value was chosen because the appropriate field data are not available for Stratum A clays. (See Section 8.3 and the SCRI (1987) for specific comparison of Strata A and C clay data.) The rest of the unsaturated zone is sand (Stratum B) forming the unconfined aquifer, which has an estimated average coefficient of permeability of 7.9×10^{-3} cm/sec.

In order to predict flow through the unsaturated zone, the average thickness as well as the permeability characteristics of these two strata must be taken into account. Stratum A surficial clays underlying the disposal facilities vary from over 35 feet of continuous clay under the evaporation system to apparently discontinuous, multiple clay stringers of 1-5 feet on

TABLE 10-8

Predicted Concentrations of Indicator Chemicals in the Brazos River at Low Flow

Based on Mass Loading Rates Predicted from OLM/VHS Models

Parameter (mg/l)	Aquifer Concentrations and Mass Loads (1) at Edge of Brazos: Sludges in Main Pond Cy (mg/l)	Sludges in Main Pond Mass Load (g/day)	Affected Soils in Dike Cy (mg/l)	Affected Soils in Dike Mass Load (g/day)	Sludges in Evap'tion Area Cy (mg/l)	Sludges in Evap'tion Area Mass Load (g/day)	Total Mass Loading From Aquifer to River (2) (g/day)	Worst-Case Resultant Concentration Cr in River at Low Flow (3) (mg/l)	Available Water Quality Criteria for Consumption of Organisms Only (mg/l)	Available Water Quality Criteria for Consumption of Water and Organisms (mg/l)	Available Water Quality GMCs for Protection of Freshwater Life (mg/l)	Final MCS (mg/l)	Total Constituent Existing River Load (mg/l)
Aquifer Flow = K*i*A (m3/day)	43 13		69 05		13 81								
Low Flow River Velocity (m3/day)								335 181					
PREDICTED FROM OLM/VHS													
Benzene	0 46	19 93	0 46	4 14	0 009	0 12	24 19	0 00072117	0 04 *	0 00066 *	5 3	0 005	0
2,4-Dimethylphenol	0 50	21 57	0 10	8 91	0 014	0 19	28 86	0 00086552	NA	NA	2 12	NA	0
Ethylbenzene	0 40	17 16	0 01	0 69	0 011	0 18	18 05	0 00005388	1 2	1 4	32	NA	0
Napthalene	0 04	1 76	0 01	0 92	Source ND	Source ND	2 68	0 00000799	NA	NA	2 3	NA	0
PCBs	0.0060	0 26	0 0019	0 13	0 0002	0 0028	0 39	0 00000117	0 000000079 *	0 000000079 *	0 002	NA	0
Phenol	1 53	65 99	0 60	41 43	0 270	3 73	111 15	0 00033161	NA	3 5	10 2	NA	0
Tetrachloroethylene	0 04	1 81	Source ND	Source ND	0 002	0 03	1 84	0 00000549	0 00653 *	0 0008 *	5 20	NA	0
Toluene	0.32	13 80	0 03	2 07	0 014	0 19	16 07	0 00004793	424	14 3	17 5	NA	0
Trichloroethylene	0 05	2 12	Source ND	Source ND	Source ND	Source ND	2 12	0 00000633	0 0067 *	0 0027 *	45	0 005	0
Chromium (III)	1 46	62 97	0 32	22 10	0 109	1 51	86 57	0 00025824	3433	170	1 7	0 05	0 01
Lead	2 99	128 96	2 41	166 42	0 270	3 73	299 11	0 00089238	N/A	0 05	0 003	0 05	0 0135
Nickel	0.64	27.60	0 32	22 10	0 064	0 89	50 59	0 00015092	0 10	0 0134	1 4	NA	0 005
Zinc	5.59	241 10	5 52	381 18	1 120	15 47	637 74	0 00190264	7 5 **	5 **	0 12	NA	0 035

(1) Mass Load = Cy * Aquifer Flow

(2) Total mass load = sum of mass loads from the three compartments at SDS

(3) Resultant Concentration = Mass Load/Low-Flow River Velocity

* UCR - based acceptable concentration for a 10E-06 cancer risk

** Organoleptic criteria

the west and north sides of the main pond. Therefore, for the purposes of this assessment, a continuous surficial clay layer five feet thick has been assumed to underlie the entire disposal area. The sand portion of the unsaturated zone is thus assumed to be 15 feet thick.

The assumption of no intervening material in Model 1 is unrealistic. Therefore, Model 2 utilizes a time dependent unsaturated zone model (UZM) developed by EPA investigators Enfield, Carsel, Cohen, Phan and Walters (Enfield et al., 1982) to predict the impact of the unsaturated zone on projected leachate concentrations.

Method 1 from Enfield's 1982 paper was selected because it provides a unified, "two-pass" approach to estimate organic transport through soils. The model assumes no dispersion and transport is a function of the following parameters:

1) Bulk density of the soil = P = 1.6 g/cm^3;
2) Interstitial porewater velocity = Vd/ne where Vd is the average recharge rate (Darcy velocity in cm/hour) and ne is effective porosity = 0.3;
3) Water content of the soil
4) Sorption coefficients (R_p values for each constituent);
5) Degradation rates;
6) C_o, the initial concentration in mg/l (OLM leachate concentration is assumed); and
7) Solubility of the constituent (needed only if Koc is not known and has to be estimated from solubility).

Details of the UZM model are presented in Appendix H-1, along with calculation tables and examples of data presentation. It is assumed that the flow system is saturated since the detailed soil moisture data are not available.

The primary output of this step in the modeling effort is predicted "breakthrough" concentrations at the interface of the saturated zone or aquifer. These concentrations are presented in Table 10-9, along with assumed half-life values used to simulate degradation in the subsurface. Degradation half-life values were assumed to be 1/10th of the rates listed in Table 7-9 for surface water. Where no surface water data were available, the rate for the most similar compound was used (e.g., 60 days for benzene and phenolic groups, such as toluene, ethylbenzene, etc.).

While the degradation rates for ground water are estimated, these values are necessary in order to carry out the UZM calculation. If the degradation rates are zero, the "breakthrough"

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TABLE 10-9

Summary of "Break-Through" Concentrations Predicted at the Top of the Saturated Zone Using Enfield's Unsaturated Zone Model for each Disposal Compartment at the SDS Site

Parameter (p)	Tp Total Time Tp=Tpc+Tpa to xT=20'	Assumed Half-Life	Concentration Ci Remaining in Pulse at Tp + Time to Break-Through (xTp + 20')		
			Main Pond Sludges	Affected Dike Soils	Evap Sludges
	(days)	(days)	(mg/l)	(mg/l)	(mg/l)
Benzene	397	60	4.64E-02	3.50E-03	5.31E-03
2,4-Dimethylphenol	834	60	5.03E-02	6.27E-03	8.45E-03
Ethylbenzene	3415	60	4.00E-02	8.45E-04	7.60E-03
Naphthalene	2481	60	4.13E-03	4.83E-04	Source=ND
PCBs (Total as Aroclor 1016)	57870	129	5.13E-03	1.28E-03	1.28E-03
Phenol	141	60	2.38E-01	3.84E-02	1.63E-01
Tetrachloroethylene	1900	300	1.53E-01	Source=ND	4.55E-02
Toluene	1252	60	3.25E-02	1.93E-03	8.33E-03
Trichloroethylene	541	900	3.04E-01	Source=ND	Source=ND
Chromium	3872	1.00E+13	1.21E+01	1.70E+00	5.46E+00
Lead	3872	1.00E+13	2.49E+01	1.27E+01	1.35E+01
Nickel	3872	1.00E+13	5.35E+00	1.67E+00	3.21E+00
Zinc	3872	1.00E+13	4.66E+01	2.90E+01	5.60E+01

See Appendix H1, Tables H1-1, H1-2 and H1-3 for details.

Source = ND = Not Detected in any samples in the source compartment.

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concentration at the interface of the aquifer will be the same as the input concentration from OLM, and this scenario (OLM/UZM/VHS) would result in the same concentrations as calculated for OLM/VHS. Furthermore, it is reasonable to expect some degradation of constituents as they pass through the unsaturated zone.

Note that the metals emerge from the model at exactly the same concentration as predicted by OLM to occur at the bottom of the sludge. This happens because no degradation occurs, such that the model only retards the metals (because of R_p). The model does not have a function for exchange of metals into geologic materials, which is unrealistic because, with 20 feet of sediments, at least some of the metals leached from the sludge should be tied up in soils.

These predicted concentrations serve as an input into the aquifer dilution or VHS model in a similar manner to Model 1. Predicted concentrations for the OLM/UZM/VHS model series at the edge of the river are detailed in Table 10-10.

As with Model 1, these values were then used to develop total site mass loadings and a resultant Brazos River concentration. The results of those calculations are displayed in Table 10-11.

As with the overly conservative Model 1, Model 2 results indicate that predicted Brazos River concentrations do not exceed any of the available and possibly applicable or relevant water quality criteria, except that the 10^{-6} risk value for PCBs is exceeded. However, all predicted concentrations are protective of aquatic life and the PCB value predicted (0.00000013 mg/l) is less than the 10^{-5} risk value for PCBs and does not represent a significant increase in lifetime cancer risk.

10.3.3.3 Model 3

Because of some of the simplifying, and potentially inaccurate assumptions contained in the OLM and VHS models, Model 3 was developed in an effort to more accurately predict resultant concentrations. As such, it serves as a cross-check on the results obtained in Models 1 and 2.

In Model 3, the input leachate concentrations predicted by OLM were used in the Wilson and Miller two-dimensional transport model using WMPLUME software. (See Appendix H-3 for details of the model.) Since the concentrations predicted by OLM are worst-case for the main pond sludge compartment, data for this compartment were used in Model 3.

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TABLE 10-10

Resultant Concentration at Brazos River Interface
From a Combination of OLM-UZM-VHS

Parameter (mg/l)	Resultant Concentration at Brazos River: MAIN POND (Y = 140 m) Ci	Cy/Ci	Cy	DIKE AREA (Y = 100 m) Ci	Cy/Ci	Cy	EVAPORATION AREA (y = 215 m) Ci	Cy/Ci	Cy
	(UZM)	(VHS)		(UZM)	(VHS)		(UZM)	(VHS)	
Benzene	0.046	0.12	0.0056	0.0035	0.19	0.0007	0.0053	0.02	0.0001
2,4-Dimethylphenol	0.050		0.0060	0.0063		0.0012	0.0085		0.0002
Ethylbenzene	0.040		0.0048	0.000845		0.0002	0.0076		0.0002
Napthalene	0.004		0.0005	0.0005		0.0001	ND		ND
PCBs	0.005		0.0006	0.0013		0.0002	0.0013		0.000026
Phenol	0.238		0.0286	0.0384		0.0073	0.1630		0.0033
Tetrachloroethylene	0.153		0.0184	ND		ND	0.0455		0.0009
Toluene	0.033		0.0039	0.0019		0.0004	0.0083		0.0002
Trichloroethylene	0.304		0.0365	ND		ND	ND		ND
Chromium	1.21		0.15	1.70		0.32	5.46		0.109
Lead	24.90		2.99	12.70		2.41	13.5		0.270
Nickel	5.35		0.64	1.67		0.32	3.21		0.064
Zinc	46.60		5.59	29.04		5.52	56.01		1.120

ND = compound not detected in source.
Ci = initial concentration predicted by UZM at the top of the aquifer.
Cy/Ci = aquifer dilution feet or calculated by VHS.
Cy = Ci * Cy/Ci = aquifer concentration.

TABLE 10-11

Predicted Concentrations of Indicator Chemicals in the Brazos River at Low Flow

Based on Mass Loading Rate: Predicted from OLM/UZM/VHS Models

Parameter (mg/l)	Aquifer Concentrations and Mass Loads (1) at Edge of Brazos: Sludges in Main Pond Cy (mg/l)	Sludges in Main Pond Mass Load (g/day)	Affected Soils in Dike Cy (mg/l)	Affected Soils in Dike Mass Load (g/day)	Sludges in Evap'tion Area Cy (mg/l)	Sludges in Evap'tion Area Mass Load (g/day)	Total Mass Loading From Aquifer To River (2) (g/day)	Worst-Case Resultant Concentration Cr in River at Low Flow (3) (mg/l)	Available Water Quality Criteria for Consumption of Organisms Only (mg/l)	Available Water Quality Criteria for Consumption of Water and Organisms (mg/l)	Available Water Quality Criteria for Protection of Freshwater Life (mg/l)	Final MCL (mg/l)	Total Constituent Existing River Load (mg/l)
Aquifer Flow = k*i*A (m3/day)	43.13		69.05		13.61								
Low Flow River Velocity (m/day)								335.61					
PREDICTED FROM UZM/VHS													
Benzene	0.0056	0.24	0.0007	0.05	0.0001	0.0015	0.29	0.00000067	0.04 *	0.00066 *	5.3	0.005	0
2,4-Dimethylphenol	0.0060	0.26	0.0012	0.08	0.0002	0.0028	0.34	0.00000103	NA	NA	2.12	NA	0
Ethylbenzene	0.0048	0.21	0.0002	0.01	0.0002	0.0028	0.22	0.00000067	3.2	1.4	32	NA	0
Napthalene	0.0005	0.02	0.0001	0.01	Source ND	Source ND	0.03	0.00000008	NA	NA	2.3	NA	0
PCBs	0.0006	0.03	0.0002	0.02	0.000026	0.0004	0.04	0.00000013	0.000000079 *	0.000000079 *	0.002	NA	0
Phenol	0.0236	1.02	0.0073	0.50	0.0033	0.0456	1.57	0.00000468	NA	3.5	10.2	NA	0
Tetrachloroethylene	0.0184	0.79	Source ND	Source ND	0.0009	0.0126	0.81	0.00000241	0.00885 *	0.0008 *	5.28	NA	0
Toluene	0.0039	0.17	0.0019	0.13	0.0001	0.0014	0.30	0.00000090	424	14.3	17.5	NA	0
Trichloroethylene	0.0365	1.57	Source ND	Source ND	Source ND	Source ND	1.57	0.00000469	0.0807 *	0.0027 *	45	0.005	0
Chromium (III)	0.15	6.47	0.32	22.10	0.109	1.5054	30.07	0.00008972	3433	170	1.7	0.05	0.01
Lead	2.99	128.96	2.41	166.42	0.270	3.7269	299.11	0.00089238	NA	0.05	0.082	0.05	0.0235
Nickel	0.64	27.60	0.32	22.10	0.064	0.8866	50.59	0.00015092	0.10	0.0138	1.4	NA	0.025
Zinc	5.59	241.10	5.52	381.18	1.120	15.4708	537.74	0.00190269	7.5 **	5 **	0.12	NA	0.015

UZM/VHS = Concentration predicted from sequential use of Enfield's UZM and Dominaco's VHS models (Table 10-11)

(1) Mass loads to the river from each source are calculated as Cy*Fa where Fa = flow rate of the aquifer in m3/day

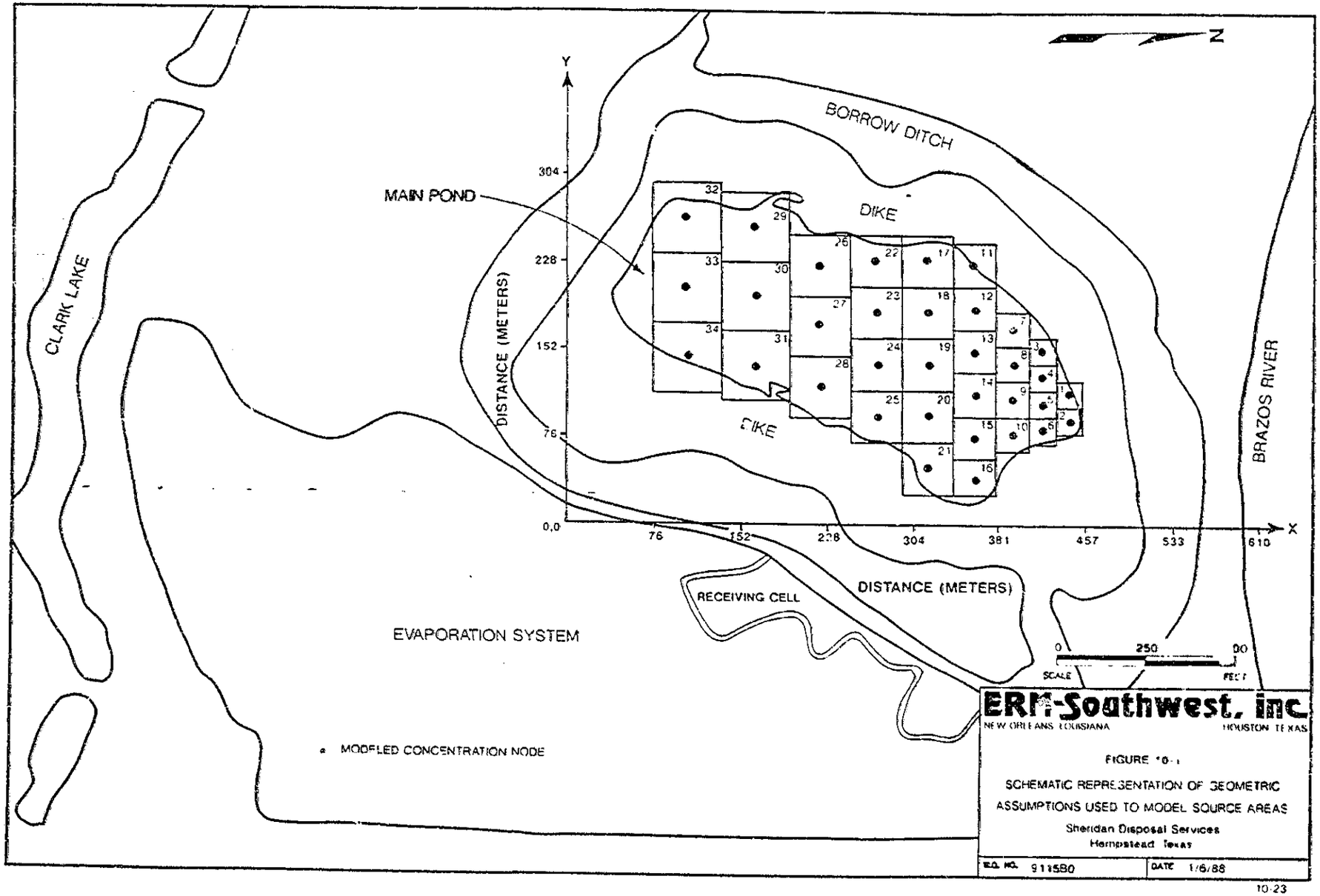
(2) Total mass loading to the river is the sum of the mass loads from each disposal compartment

(3) Resultant concentration Cr in the river is calculated as total mass loading divided by minimum river flow =

$$Cr = \frac{g/day}{m3/day} = g/m3 = g/1000\ l = 1000\ mg/1000\ l = mg/l$$

* LCR-based acceptable concentration for a 10E-06 cancer risk.

** Organoleptic criteria.


N
BORROW DITCH
DIKE
DIKE
MAIN POND
CLARK LAKE
BRAZOS RIVER
EVAPORATION SYSTEM
RECEIVING CELL
DISTANCE (METERS)
DISTANCE (METERS)
Y
X
0,0
76
152
228
304
381
457
533
610
MODELED CONCENTRATION NODE
SCALE
FEET
ERM-Southwest, inc
NEW ORLEANS LOUISIANA
HOUSTON TEXAS
FIGURE 10-1
SCHEMATIC REPRESENTATION OF GEOMETRIC
ASSUMPTIONS USED TO MODEL SOURCE AREAS
Sheridan Disposal Services
Hempstead Texas
DATE 1/6/88

10-23

In order to meet the spatial assumptions of WMPLUME concerning the relationship of source cell size and distance to receptor, the main pond was divided into 34 source cells as illustrated in Figure 10-1. Thus, the main pond is modeled as a multiple point source. (See Appendix H-3 for a complete discussion of WMPLUME and its assumptions.)

The inputs used for this modeling effort are summarized in Tables 10-12 and 10-13. The concentration (Co) predicted by OLM was used for the initial concentration. The seepage velocity was calculated based on the permeability of the clay underlying the disposal areas. The conservative average saturated thickness of the unconfined aquifer at the site (10 m) was assumed. Degradation was assumed to be zero.

The seepage rates are dependent upon constituent retardation coefficients (Rd). Since some constituents have very small Rd values (e.g., phenol), the source is depleted of some constituents more quickly than for others. Therefore, a mass balance was performed to determine how long the model could assume continuous seepage for each constituent, based on the current estimates of total site load for each constituent in each compartment (Table 10-14). The results of this comparison are shown in Table 10-15.

WMPLUME results are represented in terms of constituent concentrations at the receptor, i.e., the Brazos River. The worst-case concentrations for ground water predicted by WMPLUME from OLM-predicted leachate concentrations are summarized in Table 10-16. As for the concentrations predicted by the two VHS model series, these concentrations have been multiplied by the flow of the aquifer to predict daily loading to the river. Resultant concentrations in the river are then calculated at low flow and compared to the available and potentially applicable or relevant water quality criteria for protection of human and non-human life using the river.

With respect to concentrations of indicator chemicals in the river: (1) Final Maximum Concentration Limits (MCLS) are considered relevant and appropriate where MCLS are available; and (2) State and Federal water quality criteria for the protection of human health are relevant and appropriate where MCLS are not available.

As can be seen in Table 10-16, no relevant and appropriate criteria are exceeded for any indicator chemicals (including PCBs, which never reach the river) for the worst-case concentrations

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TABLE 10-12

SUMMARY OF WMPLUME MODEL INPUT LOADING RATES

Sheridan Disposal Services Site

			Input Parameters for Individual Model Cells					
			Areas 1-6	Areas 7-10	Areas 11-16	Areas 17-25	Areas 26-28	Areas 29-34
		Area (sq m)	523	929	1452	2090	2845	3716
		Qo (cu.m/day)	3.34	5.93	9.28	13.4	18.2	23.7
Indicator Parameters	Rp	Co (mg/l)	LOADING RATES (kg/d) Per Cell					
Benzene	5.53	3.85	0.0129	0.0229	0.0357	0.0514	0.0699	0.0914
2,4-Dimethylphenol	11.63	4.80	0.016	0.028	0.045	0.064	0.087	0.114
Ethylbenzene	48.46	3.32	0.011	0.0197	0.031	0.0443	0.0604	0.0788
Naphthalene	34.60	0.34	0.0011	0.0020	0.0032	0.0045	0.0062	0.0081
PCBs (Total as Arochlor 1016)	807.00	0.04	0.00013	0.00024	0.00037	0.00053	0.00073	0.00095
Phenol	1.97	19.75	0.066	0.117	0.183	0.264	0.359	0.469
Tetrachloroethylene	26.49	0.35	0.0012	0.0021	0.0032	0.0047	0.0064	0.0083
Toluene	17.46	3.75	0.013	0.022	0.035	0.050	0.068	0.089
Trichloroethylene	7.55	0.41	0.0014	0.0024	0.0038	0.0055	0.0075	0.0097
Chromium	54.00	9.33	0.0312	0.0554	0.0866	0.125	0.170	0.222
Lead	54.00	18.76	0.0634	0.112	0.176	0.253	0.345	0.450
Nickel	54.00	5.51	0.0184	0.0327	0.0511	0.074	0.100	0.1308
Zinc	54.00	126.58	0.423	0.7514	1.174	1.69	2.30	3.006

NOTES:

1) Co is the initial concentration of leachate at the bottom of the waste (top of unsaturated zone) predicted by OLM
2) Loading Rate (f) = Co * Qo; in kg/d.
3) Qo = k * i * A; (in cu m/day) where
   k = k(clay) = 7.4 x 10E-06 cm/sec, i = 1, and
   A = area of each source cell as defined above.
4) Rp = Retardation coefficient for pollutant p (see Table 7-9).

TABLE 10-13

SUMMARY OF WMPLUME MODEL INPUT PARAMETERS
Sheridan Disposal Services Site

Input Parameter	Case 1	Case 2	Case
C_O (mg/l)		SEE TABLE 10-12	
Q_O (m^3/day)		SEE TABLE 10-12	
ax (meters)	50	50	50
ay (meters)	5	5	5
V_a (meter/day)	2.12×10^{-2}	2.12×10^{-2}	2.12×10^{-2}
K_a (cm/sec)	7.9×10^{-3}	7.9×10^{-3}	7.9×10^{-3}
i_a (m/m)	.0031	.0031	.0031
n_e (unitless)	.3	.3	.3
m_a (meters)	10	10	10
λ $(days)^{-1}$	0	0	0
R_p (unitless)		SEE TABLE 10-12	
t_{source} (days)	365	3650	36500
$t_{dispersion}$ (days)	365	3650	36500

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NOTES

1) To calculate source loading rate, multiply $C_O \times Q_O$ for each constituent.

2) $Q_O = k_c i_c A$, where $k_c = k_{clay} = 7.4 \times 10^{-6}$ cm/sec, $i_c = 1$, and A = area of each source cell as outlined in Table 10-12.

3) $V_a = k_a i_a$, where k and i are values for the aquifers as outlined above.

λ = decay rate. Assumed to be zero for all compounds.

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TABLE 10-14

Summary of Calculated Loads Based on Representative Concentrations [illegible]
Specific Waste Compartments and Receptors for the Sheridan Disposal [illegible]

Representative Loads (1)

Parameter	Sludge Pond Water	Clark Lake Water (West end)	Brazos River Water Quality	Sludges in the Main Pond		Averaged Soils in Main Pond Dikes (2)		Soils (3)		Sludges		Background Soils		Load from Disposal Areas (kg)	Total Site
ASSUMED STARTING CONDITIONS													(assumed)		
Area (acres)	19 (4)	1.79	Surficial	12	12	17	17	40.75	40.75	1.25	1.25	NA	100		
Approximate Volume (cu yds)	217031	14468 (full)	NA	30000	30000	214000	214000	33000	33000	200	200	NA	122667		
(cu m)	165914	11062 (full)	NA	22938	22938	163624	163624	25232	25232	153	153	NA	246711		
Density	1.0 g/cm3	1.0 g/cm3	1.0 g/cm3	1.1 g/cm3	1.1 g/cm3	1.6 g/cm3	1.6 g/cm3	1.6 g/cm3	1.6 g/cm3	1.3 g/cm3	1.3 g/cm3	1.6 g/cm3	1.6 g/cm3		
Average flow (cfs)	0	0	6477												
(lps)			1.83E+05												
RESULTANT LOADS	(Total kg)	(Total kg)	(kg/day)	(kg/m3)	(Total kg)	(kg/m3)	(Total kg)	(kg/m3)	(Total kg)	(kg/m3)	(Total kg)	(kg/m3)	(Total kg)		
Benzene	ND	ND	ND	1.16E+00	2.65E+04	0.0192	3.14E+03	ND	ND	0.055825	8.54E+00	ND	ND	7.96E+04	
2,4-dimethylphenol	ND	ND	ND	3.76E-01	8.63E+03	0.0128	2.09E+03	ND	ND	0.032110	4.91E+00	ND	ND	1.07E+04	
Ethylbenzene	ND	ND	ND	3.59E+00	8.24E+04	0.0096	1.57E+03	ND	ND	0.191100	5.98E+01	ND	ND	8.41E+04	
Naphthalene	ND	ND	ND	2.83E-01	6.48E+03	0.0096	1.57E+03	ND	ND	ND	ND	0.000116	1.33E+01	8.06E+03	
Total PCBs (as Aroclor 1016)	ND	ND	ND	1.75E-01	4.01E+03	0.016	2.62E+03	ND	ND	0.012500	4.97E+00	ND	ND	6.63E+03	
Phenol	2.61E-02	ND	ND	2.65E-01	1.75E+04	0.032	1.18E+04	ND	ND	0.044101	1.50E+02	ND	ND	2.95E+04	
Tetrachloroethylene	4.31E+01	ND	ND	1.33E-01	3.05E+03	ND	ND	ND	ND	0.028343	4.33E+00	ND	ND	3.30E+03	
Toluene	1.05E+02	ND	ND	1.35E+00	3.09E+04	0.0150	2.62E+03	ND	ND	0.214500	3.28E+01	ND	ND	3.37E+04	
Trichloroethylene	2.42E+02	ND	ND	5.50E-02	1.26E+03	ND	ND	ND	ND	ND	ND	ND	ND	1.50E+03	
Chromium	1.59E+02	1.11E-04	1.58E+02	2.60E-01	5.95E+03	0.010500	3.40E+03	0.055440	3.35E+03	0.094380	1.44E+03	0.049760	1.23E+04	1.07E+04	
Lead	5.04E+01	1.33E-04	3.73E+02	4.44E-01	1.02E+04	0.318400	5.90E+04	0.073120	1.84E+03	0.211200	3.26E+01	0.018560	1.58E+03	5.11E+04	
Nickel	1.04E+02	ND	7.92E+01	7.37E-02	1.69E+03	0.019200	3.14E+03	0.028160	7.11E+02	1.040950	6.26E+00	0.027520	8.79E+03	5.65E+03	
Zinc	7.48E+02	7.74E-04	5.55E+02	6.30E-01	1.45E+04	0.456000	7.46E+04	0.116160	2.93E+03	0.976300	1.49E+02	0.063360	1.56E+04	9.29E+04	

(1) All loads are calculated from the representative concentrations provided in Table 9.2
(2) Assumed concentration is the average calculated for all dike soils (see Table 9.1 and Appendix [illegible]). Volume is as estimated in the [illegible]
(3) Soils sampled within the evaporation system where there were no visible sludges
(4) Acreage given is based on the assumption that if abandoned the pond would fill to an elevation of 126.5 feet MSL and would decant over the lowest part of the dike at that elevation with each subsequent rainfall. The low point appears to be located on the north dike west of the former tank battery and receiving pond (Figure 2.2)

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TABLE 10-15

Total Estimated Site Loads for Each Constituent and Calculation of Time to Depletion of the Source Load Based on WMPLUME Modeled Rates of Leakance to the Aquifer

Parameter	Main Pond Only: Main Pond Total Loading Rate (Kg/day)	Main Pond Only: Main Pond Total Load (Kg)	Main Pond Load Only: No. of Days To Deplete Source Load	Main Pond Load Only: No. of Years To Deplete Source Load	Total Load From All Disposal Compartments	Total Site Load: No. of Days To Deplete Source Load	Total Site Load: No. of Years To Deplete Source Load
Benzene	1.6039	2.05E+04	16522	45.3	2.96E+04	18455	50.6
2,4-Dimethylphenol	1.791	8.63E+03	4819	13.2	1.07E+04	5974	16.4
Ethylbenzene	1.3835	8.24E+04	59559	163.2	8.41E+04	60788	166.5
Naphthalene	0.1415	6.48E+03	45795	125.5	8.06E+03	56961	156.1
PCBs (Total as Aroclor 1016)	0.01662	4.01E+03	241276	661.0	6.63E+03	398917	1092.9
Phenol	8.229	1.75E+04	2127	5.8	2.95E+04	3585	9.8
Tetrachloroethylene	0.0918	3.05E+03	33224	91.0	3.10E+03	33769	92.5
Toluene	1.564	3.09E+04	19757	54.1	3.37E+04	21547	59.0
Trichloroethylene	0.171	1.26E+03	7368	20.2	1.50E+03	8772	24.0
Chromium	3.8954	5.95E+03	1527	4.2	1.09E+04	2798	7.7
Lead	7.8964	1.02E+04	1292	3.5	5.11E+04	6471	17.7
Nickel	2.2986	1.69E+03	735	2.0	5.65E+03	2458	6.7
Zinc	52.7336	1.45E+04	275	0.8	9.29E+04	1762	4.8

See Table 10-14 for calculation of total site loads and individual disposal compartment loads and Table 10-12 for seepage rates (Kg/day) to the aquifer calculated by WMPLUME for each model cell

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TABLE 10-16

Hypothetical Concentrations of Indicator Chemicals in the Brazos River at Low Flow
Based on Mass Loading Rates Predicted from the OLM/WAPLUME Model Series

Parameter (mg/l)	Worst-Case Aquifer Concentrations and Mass Loads (1) at Edge of Bra: Sludges in Main Pond: Cy (mg/l)	Mass Load (g/day)	Load Time (years)	Total Site Load to River: Cy (mg/l)	Mass Load (g/day)	Load Time (years)	POND LOAD Worst-Case Resultant Concentration (Cr) in River at Low Flow (3) (mg/l)	TOTAL SITE LOAD Worst-Case Resultant Concentration (Cr) in River at Low Flow (4) (mg/l)	Available Water Quality Criteria for Consumption of Organisms Only (mg/l)	Available Water Quality Criteria For Consumption o water and Organisms (mg/l)	Available Water Quality CMCs for Protection of Freshwater Life (mg/l)	Final MCL (mg/l)	Total Constituent Existing River Load (mg/l)
Aquifer Flow = K*I*A (m3/day)	43 13												
Low Flow River Velocity (m3/day)							335181	335181					
PREDICTED FROM OLM/VHS													
Benzene	0 0062	4 5804	10	8 072	348 15	50 00	0 00001367	0 00103868	0 049 *	0 00060 *	5 3	0 005	0
2 4-Dimethylphenol	0 0031	0 1337	10	0 108	4 65	20 00	0 00000040	0 00001388	NA	NA	2 12	NA	0
Ethylbenzene	0 1494	6 4436	100	0 149	6 44	100	0 00001922	0 00001922	3 2	1 4	32	NA	0
Naphthalene	0 0000	0 0000	10	0 05	1 99	100	0 00000000	0 00000594	NA	NA	2 3	NA	0
PCBs	0 0000	0 0000	100	0 0000	0 00	100	0 00000000	0 00000000	0 000000079 *	0 000000079 *	0 002	NA	0
Phenol	0.0002	0 0086	1	12 970 (3)	559 40	10	0 00000003	0 00166895	NA	3 5	10 2	NA	0
Tetrachloroethylene	0 0000	0 0000	10	0 108	4 65	100	0 00000000	0 00001388	0 00885 *	0 0008 *	5 28	NA	0
Toluene	0.0001	0 0043	10	3 304	142 51	100	0 00000001	0 00425116	424	14 3	17 5	NA	0
Trichloroethylene	0 0030	0 0030	.0	0 003	0 13	10	0 00000001	0 00000039	0 0807 *	0 0027 *	45	0 005	0
Chromium	0 0000	0 0000	1	0 000	0 00	10	0 00000000	0 00000000	3433	170	1 7	0 05	0 01
Lead	0 0000	0 0000	1	0 0004	0 02	30	0 00000000	0 00000005	NA	0 05	0 082	0 05	0 0215
Nickel	0 0000	0 0000	1	0 000	0 00	10	0 00000000	0 00000000	0 10	0 0134	1 4	NA	0 005
Zinc	0 0000	0 0000	1	0 000	0 00	10	0 00000000	0 00000000	7 5 **	5 **	0 12	NA	0 015

(1) Mass loads to the river are calculated as Cy*Fa where Fa = flow rate of the aquifer in m3/day and Cy = the worst-case concentration in ground water predicted at the edge of the river by WAPLUME (Appendix H-3) assuming OLM-predicted leachate concentrations for the period of time until the source load is depleted

(2) Resultant concentration Cr in the river is calculated as total mass loading divided by minimum river flow =

$$Cr = \frac{g/day}{m3/day} * m3/1000\ l = mg/l$$

(3) When degradation is used in WAPLUME the resultant concentration predicted for phenol is 0 00000 even at 100 years

(4) Total site load to the river is modeled by allowing WAPLUME to run until all the indicator chemical source load for all three sources is exhausted (up to a maximum of 100 years which is the probable time span for the catastrophic bank failure to occur) by assuming that the entire source load is located in the sludge pond and will leach at the rates predicted by OLM for pond sludge concentration These assumptions have the effect of "forcing" worst-case maximum concentration into the predicted plume (because the source is not spread out) and worst-case time-dependent concentration because the actual individual source loads would not be continuous long enough to produce the predicted concentration

* UCR-based acceptable concentration for a 10E-06 cancer risk

** Organoleptic criteria

and loads predicted to occur from the main pond alone or when the model is run long enough to deplete the entire site load and the entire load is assumed to be located in the main pond. This is the case even under the extremely conservative simplifying assumptions used to calculate loading to the river:

1. Only the worst-case concentration predicted by WMPLUME for each chemical was used to calculate total load to the river, even though the plume spread pictured in Appendix H-3, Figures H3-1 through H3-14 could be used to calculate a much lower average loading rate.

2. To assess the worst-case mass loading to the river for the entire site, it was assumed that all source locations are in the main pond and that the leachate concentrations predicted by OLM for the pond is applicable to the entire source load.

3. The average concentrations used for organics are heavily weighted by 1984 samples (Appendix E-1). The highest organic concentration found is samples in 1987 were much lower for most organics, possibly representing degradation in the interim.

The net effect of these simplifying assumptions is to over-estimate both the duration of the source and the worst-case concentration predicted by the model for each indicator chemical because the load is more centralized, allowing less lateral spread (i.e., dilution) of the plume.

10.3.3.4 Discussion of Modeling Accuracy

Based on an extensive evaluation of available ground water models, the WMPLUME model was chosen because it best simulated constituent transport under site specific conditions. Further, neither OLM or UZM were developed for metals and the aquifer concentrations predicted under Model 1 and Model 2 are much higher than is realistic. In addition, neither OLM or VHS allows degradation of organics and none of the three (OLM, UZM or VHS) allows calculation of a mass loading rate to the aquifer that can be used for true transport to the receptor locations.

The overly conservative nature of Models 1 and 2 is demonstrated by Model 3, particularly for metals. There are two primary reasons for the over-estimation of concentrations at the river by VHS:

1. VHS assumes that the receptor is located exactly downgradient of the source and provides an "instantaneous dilution" equivalent to the available aquifer flow between the edge-of-waste and the receptor location.

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2. VHS does not include longitudinal dispersion, only transverse dispersion, of constituents in the aquifer. Therefore, even with the use of UZM to "counteract" some of the conservativeness of VHS for organic concentrations, the model overestimates highly mobile compounds such as phenol and trichloroethylene.

As can be seen by comparison of the results for the main pond sludges summarized in Table 10-8 for the OLM/ VHS model with the highest concentrations listed in Table 10-16 for the WMPLUME model, VHS provides concentrations which are four times higher than those predicted by WMPLUME (see ethylbenzene). VHS predicts phenol concentrations that are almost 10,000 higher than WMPLUME.

The combined use of OLM/UZM/VHS does not "overpredict" organic concentrations directly downgradient of the source for some of the organics for the simple reason that the UZM portion of the combination has both a degradation and a retardation function which in combination allows the organics time to degrade. Since metals do not degrade, UZM does not counteract the overestimation for the metals.

The conservative nature of the models can perhaps be best demonstrated by examining the time it would take to deplete the source of each indicator chemical when OLM-generated leach rates are assumed. In the WMPLUME model, the leachate mass loading rate is generating by running the OLM leachate through a boundary clay at the flow rate allowed by the clay. The model then transports the constituent to the receptor location and provides concentrations at that location. The load to the river is then the aquifer flow rate times the transported concentration. The use of WMPLUME also allows one to calculate the time to depletion of each constituent from the source, as summarized in Table 10-15. Based on the leachate concentrations predicted by OLM for the metals, the total source load (pond plus dikes plus evaporation system) would be depleted in less than 20 years (as little as five years for zinc).

The source represented by only the metals in sludges in the main pond would be totally depleted in less than three years if OLM leachate concentrations are assumed (see Table 10-15). If this were truly the leaching rate of the pond, there would be no metals in the sludge samples collected and analyzed in 1987, because all disposal ceased in 1983 - a four-year span during which all the metals would have been removed if the OLM results are realistic. This is not the case. Therefore, it is clear that OLM must seriously overestimate the leachability of metals.

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10.4 Summary

The current site use pathway analysis and exposure assessment evaluates the risk based on present site conditions. These conditions include: 1) restricted site access, 2) dikes and tanks that are intact, 3) general facility maintenance including fencing, dike repair and pumping of water from the pond where necessary to prevent overtopping, 4) no use of ground water downgradient of the pond between the pond and the river and 5) the nearest permanent off-site human receptor is at Mr. Sheridan's home located approximately one mile southeast of the site and the nearest temporary residence is at a trailer south of Clark Lake where Mr. Sheridan's son lives.

The only completed pathways under the current use scenario are: 1) inhalation of dust and vapor on-site and at the nearest residence, 2) surface water runoff to Clark Lake and 3) ground water seepage to the Brazos River.

The air exposure pathway can be completed due to volatilization of organics and wind-blown dust. The volatilization may occur from the pond liquids and sludges or from affected soils. Wind blown dust may originate among the dikes or evaporation area. Based on concentrations of volatiles in the pond, sludge and soils, and climatological data, the site was modeled using the Texas Climatological Model, version 8AB.

Results of the modeling for volatile organics presented in Tables 10-1 and 10-2 indicate that no significant risk exists to human health or the environment even when conservatively assuming a receptor at the dike. The dust modeling considered metals but did not include organics except PCBs because of relatively high volatilization rates and generally low soil concentrations of organics. The modeling results, as shown in Tables 10-3 and 10-4, showed no significant risk even at the edge of the disposal area. All constituent concentrations were well below TACB screening levels.

The surface water exposure pathway includes runoff of storm water to Clark Lake. Since no edible aquatic species are found in the lake there is no completed chronic pathway. Livestock, however, do use the lake. These livestock may eventually be consumed. Analysis of water and lake sediment indicate this pathway does not pose a health or environmental threat.

The ground water exposure pathway considers potential impact from site ground water that eventually reaches the Brazos River. There are no ground water users between the site and the Brazos

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River. Ground water modeling utilized three combinations of four different models. Model 1 used EPA's organic leachate model (OLM) and the aquifer dilution model (VHS). Model 2 used the OLM, the unsaturated zone model (UZM) and VHS. Model 3 used the OLM and the Wilson and Miller WMPLUME model. Using these first two extremely conservative models, no constituents exceeded the human cancer related risk of 10^{-5}. PCBs did exceed the human cancer risk at 10^{-6}.

WMPLUME, the more realistic ground water model, showed that no relevant and appropriate criteria for any indicator chemicals, including PCBs, were exceeded.

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11 - PATHWAY ANALYSIS AND EXPOSURE ASSESSMENT: SITE CONDITION 2 - UNRESTRICTED SITE AND MOST PROBABLE FUTURE LANDUSE

In accordance with the rationale discussed in Section 9, this section presents a pathway analysis and exposure assessment for the SDS Site under assumed future Site Condition 2. The general assumptions necessary for the evaluation of assumed Site Condition 2 are as follows:

1) Unrestricted site access - the disposal site abandoned by the current site owner.

2) Future landuse for the area is assumed agricultural, specifically ranching and cropping for hay. Secondary potential use is hunting.

3) The nearest probable location for residential development in the future would be lands outside of the flood plain. Because of the location of the site in the flood plain of the Brazos River and the inability to get financing and insurance for such a location, it is not likely that the site would ever be developed for residential or resort purposes.

4) It is assumed that all current locations for single-family homes and trailers within the flood plain will remain inhabited in the future. Therefore, the nearest human receptors would be located at the same trailer evaluated under Site Condition 1 in Section 10.

5) The only pathway to humans from the shallow ground water remains the Brazos River, as evaluated under current site conditions in Section 10.

6) Assuming that the main pond is not maintained in any way, the pond could fill to the minimum elevation provided by the lowest point of the dike. To provide worst-case chronic surface water pathway exposure probabilities, it is assumed that the dike is overtopped with each rainfall, producing a volume of potentially contaminated runoff equivalent to the total inches of rainfall in the rainfall event times the area of the pond at the minimum elevation (19 acres). The only pathway to humans would be possible ingestion of cattle that had been drinking from Clark Lake. The lake supports no edible fish species.

7) It is assumed that erosion impacts the barren areas of the dikes or borrow areas around the main pond.

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These general assumptions set the stage for development of specific exposure scenarios for each pathway under assumed Site Condition 2. Where necessary to the discussion, assumptions have been made regarding such factors as visitation frequency in the former disposal areas for the rancher/hunter, percent time spent grazing in contaminated areas, etc.

A summary of pathways is provided for Site Condition 2 in Table 9-1. Each of the completed pathways designated in Table 9-1 is addressed and evaluated, as necessary in the following sections.

11.1 Air Exposure Pathway

11.1.1 Potential Sources and Pathways

The air exposure pathway is potentially complete to humans under Site Condition 2 through two possible mechanisms from three possible sources. The mechanisms (volatilization and windblown dust) are the same as those for Site Condition 1 but with one possible additional source - ruptured tanks.

Because ruptured tanks represent a much smaller volatilization source than the main pond and would drain to the main pond and contain the same materials as the main pond, rupture of tanks is not considered as a separate exposure for volatilization. Direct contact with tank materials in a partially ruptured tank would be equivalent to direct contact with pond sludges; therefore, this exposure will not be separately addressed.

The main conditions affecting the rates of emission of volatilized organics and metals in wind-blown dust (e.g., climate and vegetation cover) are the same as for the air exposures detailed in Section 10.1. The locations of the nearest receptors are also the same, including occasional humans within the disposal areas. Except for the loss of restrictions on the disposal areas, the land use is also the same.

11.1.2 Potential Receptors

The site will remain remote and is assumed to retain the same residences as the current site conditions - namely, the trailer south of Clark Lake and the current site of the Sheridan home about one mile to the southeast. Humans in the vicinity of the assumed abandoned disposal areas would likely be limited to the site owner and an occasional hunter.

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11.1.3 Air Pathway Exposure Assessment

As for Site Condition 1, the three exposure locations assumed are the edge of waste (top of the dike for volatilized organics), the edge of a barren area, (for dusts) and the nearest resident (the trailer south of Clark Lake). All exposures are the same as those given in Section 10. See Appendices G-1 and G-2 for details of the emissions and dispersion models used.

11.2 Surface Water Exposure Pathway

11.2.1 Potential Sources and Pathways

As shown in Table 9-1, Surface Water Pathways IIA through IID are potentially complete for Site Condition 2. These pathways are:

IIA. Runoff could potentially elute constituents and/or carry eroded soils to Clark Lake where constituents might become available for uptake by organisms living in or drinking from the lake.

IIB. Without maintenance, the dikes around the main pond might eventually fail, emptying liquid contents to the Clark Lake drainageway. A potential for immediate acute exposures, as well as subsequent chronic exposures from any contaminated sediments that make it as far as the lake, are possible.

IIC. Direct contact with sludges in the main pond due to the lack of site restrictions might occur. Such contact would be limited to incidental ingestion of soil from hands while working in the disposal area; all direct exposure pathways are discussed in Section 11.3.

IID. Without maintenance, the banks of the Brazos River might eventually fail, emptying site constituents into the river.

The potential sources for Pathway IIA are the dikes and borrow pit areas around the main pond. This pathway has the same characteristics for all three site conditions. The exposure levels that might result from the pathways listed are discussed in the following subsections.

11.2.2 Potential Receptors

The primary potential receptor for surface water exposures under Site Condition 2 for Pathways IIA and IIB is cattle and possible

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human consumption of wildlife. Cattle are assumed to be "resident" within the property boundaries. Potential receptors for surface water exposure under Site Condition 2 for Pathway IID are the aquatic life in the Brazos River and possible human consumption thereof.

11.2.3 Surface Water Pathway Exposure Assessment

11.2.3.1 Pathway IIA: Erosion and Overtopping of Main Pond Dikes During Storms

Erosion of Dike Soils

In order to evaluate the possible fate and effects of potential constituents of concern in sediments eroded from the dikes with time, it is necessary to first predict the fate of the sediments themselves. The following points are relevant to this discussion:

1. In order for constituents in dike soils to affect concentrations in Clark Lake, it is necessary first to transport constituents overland and/or along drainageways to Clark Lake.
2. The volatile and semi-volatile organics will tend to vaporize and/or degrade en route.
3. The PCBs and metals would tend to travel predominantly in association with particles of sediment. Soluble fractions would exchange with and/or sorb to soils en route, except during extreme flood conditions when some fraction of the soils eroded during the storm might make it all the way to Clark Lake in a single "pass".
4. The magnitude of sediment transport is a function of the velocity of runoff flow in the drainageways between the disposal facilities and Clark Lake. The runoff velocity is a function of the following factors:
   a. Slope (0.003 ft/ft = 0.3%);
   b. Rainfall intensity (1 year 30-min storm = 1.5 inches);
   c. Distance of transport (1800 feet);
   d. Tortuosity of the drainage path (Figure 11-1); and
   e. Intervening topography, particularly swales and hollows which would decrease runoff velocity (see Figure 8-4, Section 8.2).

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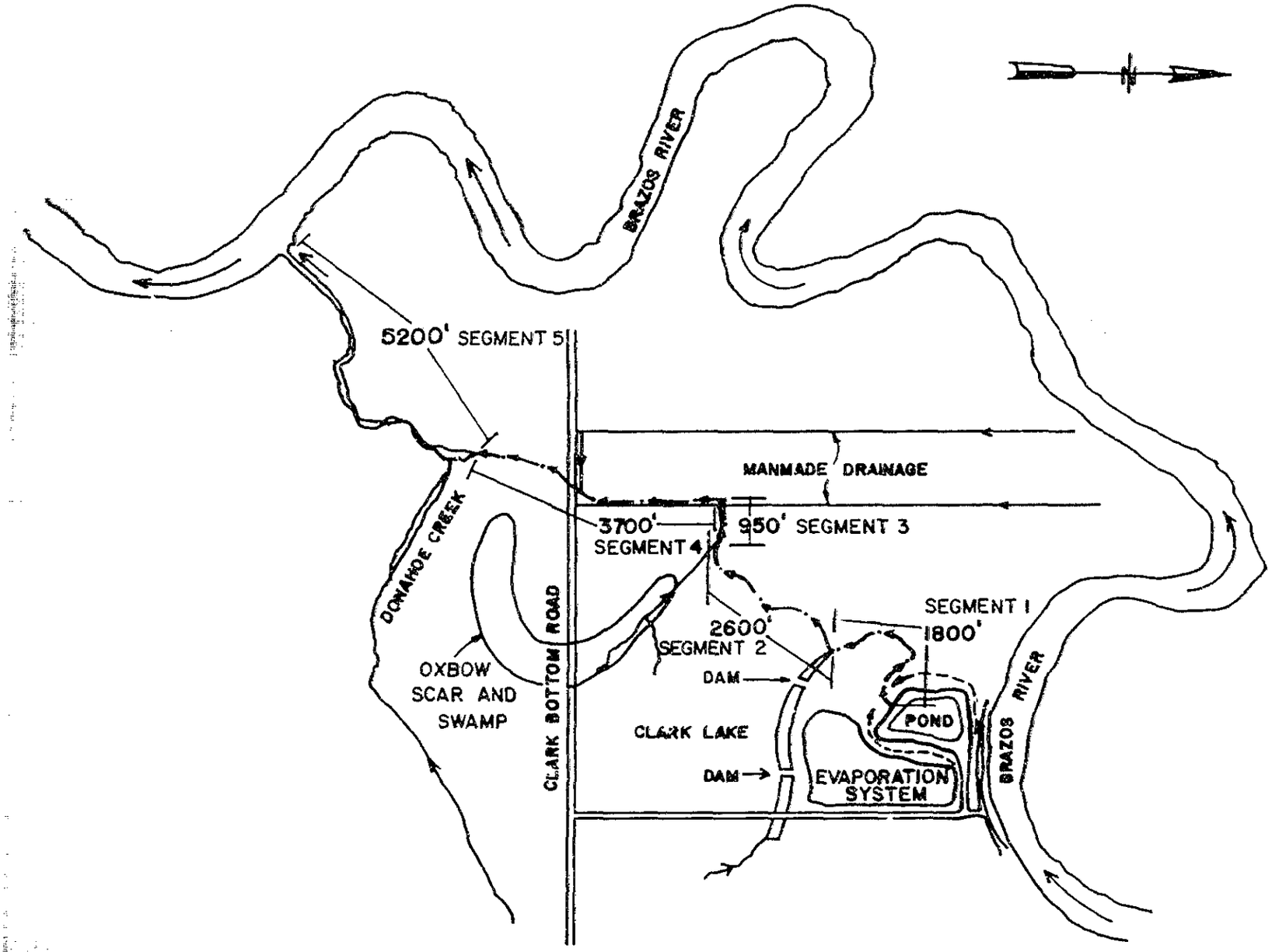

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FIGURE 11-1

DETAIL OF SURFACE WATER FEATURES AND PATHWAY DISTANCES
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Hempstead, Texas

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Eroded soils would first fill the borrow pit areas surrounding the dikes. The volume of the main portion of the borrow pits (the area between the 170 feet MSL contour lines, Figure 8-4) is roughly equivalent to that of the dikes. The sub-watershed defined by the borrow pits (areas I and II on Figure 8-4) is even larger - a total area of 38 acres, including the erosion face of the dikes.

There will be negligible transport of sediments from the borrow set ditch to Clark Lake because the slope of the borrow ditch around the dike is negligible.

The discharge rate from the borrow pit area during a 100-year, 24-hour storm would be 50 ft^3/sec. (see Section 5 of the July 1987 SCRI); the geometry of the borrow ditch gives an R value of 1.14; the roughness coefficient for straight and uniform earth channels is 0.02 (King & Breta, 1963). The minimum flow velocity that will carry sediment is 0.6 ft/sec, although 1.0 ft/sec is arguable given data scatter (Blatt, Middleton & Murray, 1980). The Manning equation shows that a drop of 0.1 ft is needed along the 2000 ft length of the borrow ditch to arrive at a velocity of 0.6 ft/sec but since the borrow ditch is essentially level on the east and north sides of the pond and the west side is essentially level over the southern 1500 feet, no sediment flow would be anticipated due to lack of gradient.

Overtopping of the Main Pond

As stated in the preamble to this section, if the site were to be abandoned, the main pond on-site would gradually fill to the lowest elevation on the dike (176.5 feet MSL, on the northern portion of the dike), expanding the water area of the pond to 19 acres. Thereafter, a volume of water equal to 19 acres times the rainfall (in inches) for each rain event would decant to the borrow pit areas.

The representative concentrations of indicator chemicals reported in Table 9-2 for waters in the main pond are based on water volumes corresponding to elevations at least three feet below 176.5 MSL and current data (1984-1987). In all cases for the indicator chemicals, the 1984 data are much higher than those collected in 1987, even immediately after pumping most of the standing water out of the pond. As the pond fills and time allows degradation to occur, the concentration of organic constituents found in the pond water will decrease even more.

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Once the pond is filled, the concentrations likely in any water overtopping the dikes would be further diluted by at least a factor of two (assuming that the displaced water is half rain and half standing pond water). Floating oil/emulsion layers on the pond surface would tend to either raft up on higher portions of the dike or be carried over the low point and sorb to the dike slopes and edges of the borrow pits, to be covered by or eroded with dike soils during succeeding rains.

The "dilution volumes" generated by a 100-year 24-hour storm (about 12 inches of rain) for the Clark Lake watershed have been calculated (Table 11-1). The total infall volume to the main pond for the same storm would be 19 acre-feet of water (about 2.34×10^7 liters). The diluent capacity of the watershed draining the site area for the storm would be 1.32×10^8 liters from runoff and infall, plus an additional standing volume in Clark Lake of 8.97×10^7 liters. Assuming that the infall to the pond displaces an equal amount of standing pond water after mixing (1:1), the total dilution available would be $(2.34 \times 10^7/2)/(2.22 \times 10^8) = 0.11$ times the initial concentration in the main pond. While these volumes do not account for any water loss due to infiltration, the resultant dilution capacity would not change significantly because the infiltration capacity of these soils is low. According to Musgrave and Holton (1964), clayey and loamy soils (which the Brazoria-Norwood Association at the site is classified as) have an infiltration capacity of 0.05 to 0.15 inches per hour. Assuming that most (>95%) of the 12 inches of rain occur in the first 12 hours of the 24-hour storm event (as is evidenced by the precipitation record of Nov. 1, 1943) and using an infiltration capacity of 0.075 inches per hour, the amount of infiltration during a major storm would be:

$$0.075 \text{ inches/hr} \times 12 \text{ hours} = 0.9 \text{ inches.}$$

This is the amount of rainfall which infiltrates into the soil. The percent of run-off from the storm is then:

$$\text{Runoff} = \frac{12 \text{ inches} - 0.9 \text{ inches}}{12 \text{ inches}} = .925 \text{ or } 92.5\%$$

Hence, most of the water will not infiltrate the soil, but will be available to run-off. Also, note that this dilution factor does not include water running to the Clark Lake system from any source other than main pond and borrow pit area. Total watershed dilution capacity is considerably higher.

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TABLE 11-1

Estimated Runoff Volumes for a 100-Year, 24-Hour Storm in the Clark Lake Watershed

Runoff Compartment	Aerial Acreage	Assumed Average Depth: Standing	Assumed Average Depth: Capacity	Standing Volume (liters)	Capacity Volume (liters)	For 100-Year, 24-Hour Storm (12" Rain): Estimated Runoff Volume (liters)	Direct Infall Volume (liters)	Resultant Total Rainfall "Effluent" (liters)
Borrow Ditch area	38	NA	NA	0	NA	4.69E+07	NA	4.69E+07
Area IIIB	18	NA	NA	0	NA	2.22E+07	NA	2.22E+07
West End, Clark Lake	3.3 *	3 '	6 '	9.77E+06	3.91E+07 **	NA	8.14E+06	4.07E+06
Area IIIa + IV	20.9	NA	NA	0	NA	2.58E+07	NA	2.58E+07
Main Pond, Clark Lake	8.1 *	10 '	14 '	7.99E+07	1.68E+08 **	NA	1.50E+07	9.99E+06
SUBTOTAL	88.3			8.97E+07	2.07E+08	9.49E+07	2.31E+07	1.09E+08
Main Pond, Disposal Area	19	NA	7.5 '	NA	1.41E+08	NA	2.34E+07	2.34E+07
GRAND TOTALS	195.6			8.97E+07	3.48E+08	9.49E+07	4.66E+07	1.32E+08

NOTES: Volumes for the main pond and Clark Lake were calculated assuming a rectangular cross-section, corrected for bank slopes by multiplying by 0.8 to reduce the resultant volume by 20 percent

Volumes of runoff for non-basin areas were calculated by multiplying total rainfall (12 inches) times total acreas and converting to metric units (liters). Volumes for infall are calculated by multiplying 12 inches times the capacity acreages for the lake and main pond (19 acres).

* Acreage measured at water level of 161 MSL = standing volume acreage

** Acreage measured at water level of 165' MSL = capacity volume

For the west end of Clark Lake, capacity acreage = 2 times standing acreage.

For the main pond of Clark Lake, capacity acreage = 1.5 times standing acreage.

11.2.3.2 Pathway IIB: Failure of Main Pond Dikes

If the main pond dike fails, the volume of liquids discharged to the Clark Lake watershed from the site would be approximately 1.41×10^8 liters. Assuming failure occurs catastrophically but not in association with a storm event, the borrow pit area (38 acres times an average depth of three feet) could contain the entire contents of the pond with essentially no drainage to Clark Lake.

If failure occurs during the 100-year, 24-hour storm, the dilution factor would be $(1.41 \times 10^8)/(1.41 \times 10^8 + 1.32 \times 10^8) = 0.52$.

11.2.3.3 Pathway IID: Potentially Complete Surface Water Pathway (Worst Case): Bank Failure of the Brazos River

Risks associated with this pathway are difficult to quantify due to the number of assumptions that have to be made to predict resultant loads to the river. For instance, assumptions would have to include either an average erosion rate or a number of events needed to erode the entire disposal area into the Brazos River. Therefore, this pathway has not been evaluated quantitatively.

The bank failure pathway would always be an acute (i.e., episodic) type of exposure. It is very unlikely that this exposure would be significant due to the available assimilative capacity of the river. Moreover, such an acute exposure would be very unlikely to result in any residual chronic effects either to aquatic life or to humans (e.g., via food-chain uptake) because the dynamics of the event are such that any organisms in the "event plume" (and able to remain in place) would not experience the plume concentrations for a long enough period of time to assimilate any constituents of concern. In summary, this pathway would probably result in some increased risk to aquatic species but because of the acute nature of the exposure, is unlikely to result in significant risks to humans.

11.3 Direct Exposure to Waste Compartments

Direct exposure to the wastes at the site might occur under the abandoned conditions assumed for Site Condition 2. The potential direct exposures include:

1) dermal contact with soils, sludges or water in all waste compartments.

2) incidental ingestion of soils and sludges from all waste compartments on the hands.

At the Sheridan Site there are three areas that contain wastes: the main pond sludges, the evaporation system sludges and the main pond dike affected soils. The sludges in the main pond and evaporation system present the greatest potential risk because the accessibility presents a greater likelihood of direct contact by humans or wildlife. Unlike the main pond and evaporation system sludges, the affected soils in the dike are covered with unaffected soil and vegetative cover. Dike borings indicated that affected soils are covered by an overburden of three or more feet of vegetated, secure soils. Thus, the dikes present a much less significant risk than the other two compartments. Of course, to the extent that there are exposed sludges or affected soils on the dikes, the potential risk would be greater, probably presenting risks comparable to evaporation system sludges.

Therefore, for Site Condition 2, a total lifetime body load is calculated for the remaining compartments, i.e., pond sludge and evaporative system sludge, using all indicator chemicals present in that compartment.

The hazard index and/or cancer risk for each indicator chemical was calculated and arranged for each compartment. This arrangement allowed the determination of a Total Hazard Index and Total Cancer Risk for each compartment based on the risk presented by each indicator chemical in that compartment. These exposures are compared to EPA-recommended Critical Toxicity Values (Superfund Public Health Evaluation Manual, EPA/540/1-86/060).

11.3.1 Exposure Assumptions

In order to evaluate the risks to humans posed by potential direct contact with waste at the site, it is necessary to assume typical human body size and weight. Typical values as reported by Hawley (1985) are summarized in Table 11-2. These values are relevant to Site Condition 2 exposure and would apply to the sportspersons visiting the site during the hunting season, or to the site owner, that is, to a rancher/hunter for assumed ages 12 to 70 years. While the average surface area of the hands and arms of the adult is given as 0.34 m^2 (Table 11-2), this amount of surface area does not necessarily represent the most likely extent of adherence by soil to skin.

A visitor to the site will be wearing a short sleeve shirt or a long sleeve shirt with the sleeves rolled up in warm weather. During the three to five months of cold weather in fall and winter, the visiting individual most probably will be wearing long sleeves, and on occasion, gloves. However, to allow for a conservative scenario, it will be assumed that the visitor to the

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TABLE 11-2

Summary of Human Body Metrics

Age Group	Average Weight (Kg)	Average Skin Surface Areas (m2) for Extremities: Arms+Hands	Forearms+Hands	Hands	Legs+Feet	Feet	SUBTOTAL	TOTAL Body Surface (m2)	Estimated Torsal Surface (m2)
Adult [1]	70 [1]	0.34 [1]	0.17 [1]	0.091 [1]	0.54 [4]	0.13 [3]	0.89 [3]	1.81 [1]	0.92 [5]
	% of TOTAL [2]	19%	9.5%	5%	30% [4]	7% [3]	49% [3]		

[1] Source: Hawley, John K., 1985. Assessment of Health Risk from Exposure to Contaminated Soil. Risk Analysis 5(4): 289-302
All data presented with this footnote are as published in Table 1 of Hawley's paper, or elsewhere in that document.
All other data are calculated from data in Table 1 of Hawley's paper, as noted below

[2] Percentages are calculated as (surface area of body part(s))/(total body surface area)*100

[3] Percentage is assumed to be the same as calculated values for 2-1/2 year-olds and 6-year-olds in Hawley 1985.

[4] Percentage is calculated as SUBTOTAL % (49%) - ARMS & Hands % (19%) = 30%. Surface area for Legs & Feet is then calculated as 0.30*1.81 = 0.56 m2 (percent times total body area)

[5] Torsal surface estimated by subtracting subtotal for extremities from total body surface

site will be wearing either short sleeves or rolled-up sleeves throughout the year. This clothing will protect the upper arms of the site visitor from exposure to soil. Furthermore, a visitor at the site will be performing only incidental tasks that will bring him into contact with soil.

For these two reasons -- the presence of clothing and the incidental, occasional nature of contact with soil by an adult -- it is assumed that the surface area of skin that will be exposed on an incidental basis will be on the hands and forearms. This area represents approximately one-half of the total surface area of the hands and arms, or 0.17 m^2 (Hawley, 1985).

From this surface area, a unit soil exposure (in mg soil/day) can be calculated using the factor for soil adherence to skin, which is given as 11.0 mg soil per 21.5 cm^2 skin surface area per day (Hawley, 1985). Thus, unit soil exposure for hands and forearms is 870 mg/day (1,700 cm^2 x [11.0 mg soil/21.5 cm^2] x 1/day) (Table 11-3).

Once the age and size of the human receptor is postulated, the next step is to set up the worst-case (acute) exposure conditions under which the human might contact contaminated soil in the abandoned disposal area. For the purposes of this analysis for Site Condition 2, it is assumed that a rancher/hunter has occasion to work or hunt in the disposal area 52 days per year (one day per week).

In order to conservatively assess the risk from exposure to affected soils and sludges associated with visitation to a multi-compartmental site such as the Sheridan Site, the risk for 52 visits per year was assessed separately for the main pond sludge and the evaporative sludge. This approach serves two purposes: 1) it provides the most conservative estimate of risk for these two compartments by allowing one visit per week to each, regardless of its relative acreage, and 2) it allows for direct comparison of the overall relative risk presented by each compartment.

11.3.2 Direct Exposure Criteria Comparisons

All direct contact exposures are evaluated for Site Condition 2 by calculating a yearly "dose" from each waste compartment and summing all the dose values. An average total Chronic Daily Intake (CDI) per year is then calculated by dividing the total yearly exposure by 365 days and 70 kg. The subchronic Daily Intake (SDI) is calculated by summing the worst possible total exposure that might occur in a single day and dividing by 70 kg of body weight (Table 11-3).

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Table [illegible]

Summary of Direct Exposure Assumptions - Rancher/Hunter - Disposal Area [illegible] days/year
Ingestion Rate [illegible] Absorption Factors [illegible]

Type of Exposure	Adult Body Surface Area Exposed (%2)	Resultant Dose (mg/d)	Frequency and Duration of Exposure by Disposal Compartment: Warm Pond Sludges Frequency (days/yr)	Warm Pond Sludges Duration (hrs)	Evaporation Sludges Frequency (days/yr)	Evaporation Sludges Duration (hrs)
Number of days/year in disposal area = 52						
Body weight = 70 kg						
DERMAL EXPOSURE (2)						
Hands and Arms	0.17 (3)	870	52	12	52	12
INGEST ON EXPOSURE (2)						
Incidental from hands	NA	50 (4)	52	NA	52	NA

DERMAL EXPOSURE = waste compartment concentration * unit soil exposure * conversion factor * frequency * hours * dermal absorption factor * soil absorption

INGEST ON EXPOSURE = waste compartment concentration * unit soil exposure * conversion factor * frequency * ingestion absorption factor * soil absorption factor

Concentration in Waste Compartment

INDICATOR CHEMICAL (from Table 9-2)	Warm Pond Sludges (mg/kg)	Evaporation Sludges (mg/kg)
Benzene	1050	42.95
2,4-Dimethylphenol	142	24.7
Ethylbenzene	3267	301
Naphthalene	257	ND
PCBs (Total)	159	25
Phenol	695	757
Tetrachloroethylene	121	21.8
Toluene	1225	165
1,1,1-Trichloroethane	50	ND
Chromium	236	72.6
Lead	404	164.0
Nickel	67	31.5
Zinc	573	751.0

ABSORPTION FACTORS		
Dermal Absorption as pure compound:		
Ingestion Absorption Factors (5)		
PAHs (nuclear aromatic hydrocarbons)		50%
Chlorinated organics		100%
Inorganics	Range = (1.0-50%)	25%
Absorption Factors (percent of pure compound as dermal or ingestion exposure) (6)		
PAHs (Alkyls)	(Range=10-25%)	25%
Chlorinated organics	Range=(1-10%)	10%
Inorganics	Range=(0.1-2%)	1%
Soil/Sludge Absorption Factors (7)		
Dermal		5%
Ingestion/Inhalation		30%

RESULTANT RISK FACTORS					
SDI: Maximum Subchronic Daily Exposure (mg/kg-day)	EPA Published RfD (mg/kg-day)	ADI: Daily Chronic Exposure (mg/kg-day)	EPA Published RfD (mg/kg-day)	Carcinogenicity: CDI (mg/kg-day)	Upper Bound Cancer Risk
(8)	Appendix C	(9)	Appendix C	Appendix C	(10)

Ingestion frequency by Rancher/Hunter to disposal area = 52 days/year. Duration of each dermal exposure is a probable maximum time until the individual can remove soil/sludge from exposed skin.

(2) Soil/sludge dermal exposures assume 11 mg as soil/sludge per 21.5 cm2 of exposed skin surface (Hawley, 1985)

(3) See Table 11-2

(4) Hawley, 1985

(5) Wilson, Hawley, Wagee & Santos, 1987, Proceedings of the 8th National Superfund Conference, 166-168

(6) Health Effects Assessment Documents, EPA/540/1-86/(Multiple Listings)

(7) PCB values from OHEA Document EPA/600/6-86/002, Development of Advisory Levels for Polychlorinated Biphenyls (PCBs) Cleanup, May 1986

(8) Calculated as the worst-case exposure for a single day

(9) Calculated as the total yearly exposure (mg/kg-year)/365

(10) Calculated as (CDI *CPF)*58/70 = upper bound cancer risk (assumes 58 years of exposure at the calculated CDI dose)

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The Total Yearly Exposure (TYE) for each compartment is calculated as follows:

FOR DERMAL EXPOSURE TO SOIL:

TYE = Conc. of contaminant (kg/10^6 mg soil) X body area exposed (cm^2)

x 11 mg soil/21.5 cm^2 skin surface

x frequency of exposure (days/year)

x duration of exposure (hours)

x absorption factor (%/time in hours)

= total yearly dermal exposure in mg contaminant/year

FOR GASTROINTESTINAL EXPOSURE TO SOIL:

TYE = Conc. of contaminant (kg/10^6 mg soil)

x unit of ingested soil [(mg soil)/day]

x frequency of exposure (days/year)

x absorption factor (%)

= total yearly gastrointestinal exposure in mg contaminant/year

Data on dermal and gastrointestinal absorption rates and soil matrix effects for each indicator chemical are given in Table 11-4.

All areas, factors, frequencies and durations of exposure are detailed in Table 11-5A through 11-5M for each indicator chemical.

In accordance with EPA guidance, total SDI values are compared to available Acceptable Intake Subchronic (AIS) values for each indicator chemical. Calculated total CDI values (mg/kg-year/365) are compared to available published AIC (Acceptable Intake Chronic) values. For carcinogens, available Cancer Potency Factor (CPF) values were tabulated and the resultant upper bound cancer risk for each indicator chemical (assuming 58 years of exposure) was determined. (See Tables 11-5A through 11-5M).

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TABLE 11-4

Summary of Absorption Factors for Individual
Indicator Chemicals as Used in Calculations
of Total Yearly Exposure

Absorption Factors for Non-PCBs

Dermal Absorption (as pure compound) [1]		12% per twelve hours
Ingestion Absorption Factors [2]		
Polynuclear Aromatic Hydrocarbons		50%
All other organics		100%
Inorganics	(Range = 1-50%)	25%
Soil Absorption Factors: percent of pure compound as dermal or ingestion exposure [3]		
Volatiles	(Range = 10-25%)	25%
Semivolatiles	(Range = 1-10%)	10%
Inorganics	(Range = 0.1-1%)	1%

Absorption Factors for PCBs [4]

Dermal	5%
Gastrointestinal	30%

Indicator Parameter	Absorption Factor (%)	
	Dermal	Gastrointestinal
Benzene	3	25
2,4-Dimethylphenol	1.2	10
Ethlybenzene	3	25
Naphthalene	1.2	5
PCBs (Total)	5	30
Phenol	1.2	10
Tetrachloroethylene	3	25
Toluene	3	25
Trichloroethylene	3	25
Chromium	0.12	0.25
Lead	0.12	0.25
Nickel	0.12	0.25
Zinc	0.12	0.25

[1] Hawley 1985

[2] Ryan, Hawkins, Magee and Santos. 1987. Proceedings of the Eighth National Superfund Conference.

[3] Health Effects Assessment Documents. EPA/540/1-86 (Multiple Listings)

[4] Development of Advisory Levels for Polychlorinated Biphenyls (PCBs) Cleanup. OHEA Document EPA/600/6-86/002, May 1986.

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TABLE 11-5A

Direct Exposure Calculation for Rancher/Hunter for 52 Days/Year DENZINE
Unrestricted Site - Most Probable Future Landuse

Type of Exposure	Adult Body Surface Area Exposed (m2)	Resultant Unit Soil Exposure (mg/day)	Main Pond Sludges Frequency (days/yr)	Main Pond Sludges Duration (hrs)	Evaporation Sludges Frequency (days/yr)	Evaporation Sludges Duration (hrs)
DERMAL EXPOSURE						
Hands and arms	0 17	870	52	12	52	12
INGESTION EXPOSURE						
Incidental from hands	NA	50	52	NA	52	NA
Concentration			(mg/kg) 1050			(mg/kg) 42 95
RESULTANT YEARLY EXPOSURE						
Resultant Exposure (mg/yr)- Incidental dermal			1 425			0 058
Resultant Exposure (mg/yr)- Incidental ingestion			0 683			0 028
		Average Daily *	0 043		Average Daily *	0 002
		TYE * (mg/yr)	2 108		TYE * (mg/yr)	0 086

RESULTANT RISK FACTORS -EXPOSURE TO MAIN POND SLUDGE

SDI:Maximum Subchronic Daily Exposure (mg/kg-day)	5 79E-04
EPA Published AIS (mg/kg-day)	NA
CDI Daily Chronic Exposure (mg/kg-day)	8 25E-05
EPA Published AIC (mg/kg-day)	NA
CPF (mg/kg-day)^-1	0 052
UPPER BOUND CANCER RISK	3 55E-06

RESULTANT RISK FACTORS -EXPOSURE TO EVAPORATION SYSTEM SLURRY

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	2 37E-05
EPA Published AIS (mg/kg-day)	NA
CDI Daily Chronic Exposure (mg/kg-day)	3 37E-06
EPA Published AIC (mg/kg-day)	NA
CPF (mg/kg-day)^-1	0 052
UPPER BOUND CANCER RISK	1 45E-07

NOTE: Upper Bound Cancer Risk calculated
as CDI * CPF * 58 yrs/70 yrs

TABLE 11-5B

Direct Exposure Calculation for Rancher/Hunter for 52 Days/Year 2,4-DIMETHYLPHENOL
Unrestricted Site - Most Probable Future Landuse

Type of Exposure	Adult Body Surface Area Exposed (m2)	Resultant Unit Soil Exposure (mg/day)	Main Pond Sludges Frequency (days/yr)	Main Pond Sludges Duration (hrs)	Evaporation Sludges Frequency (days/yr)	Evaporation Sludges Duration (hrs)
DERMAL EXPOSURE						
Hands and arms	0.17	870	52	12	52	12
INGESTION EXPOSURE						
Incidental from hands	NA	50	52	NA	52	NA
Concentration			(mg/kg) 342			(mg/kg) 24.7
RESULTANT YEARLY EXPOSURE						
Resultant Exposure (mg/yr)- incidental dermal			0.186			0.013
Resultant Exposure (mg/yr)- incidental ingestion			0.089			0.006
		Average Daily =	0.005		Average Daily =	0.0004
		TYE = (mg/yr)	0.275		TYE = (mg/yr)	0.020

RESULTANT RISK FACTORS -EXPOSURE TO MAIN POND SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	7.54E-05
EPA Published AIS (mg/kg-day)	0.014
CDI Daily Chronic Exposure (mg/kg-day)	1.07E-05
EPA Published AIC (mg/kg-day)	0.0014
CPF (mg/kg-day)^-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

RESULTANT RISK FACTORS -EXPOSURE TO EVAPORATION SYSTEM SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	5.45E-06
EPA Published AIS (mg/kg-day)	0.014
CDI Daily Chronic Exposure (mg/kg-day)	7.76E-07
EPA Published AIC (mg/kg-day)	0.0014
CPF (mg/kg-day)^-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

Note AIS and AIC values are draft for 3,4-Dimethylphenol No draft values for 2,4-DMP

NOTE Upper Bound Cancer Risk calculated
as CDI * CPF * 58 yrs/70 yrs

TABLE 11-5C

Direct Exposure Calculation for Rancher/Hunter for 52 Days/Year ETHYLBENZENE
Unrestricted Site - Most Probable Future Landuse

Type of Exposure	Adult Body Surface Area Exposed (m2)	Resultant Unit Soil Exposure (mg/day)	Main Pond Sludges Frequency (days/yr)	Main Pond Sludges Duration (hrs)	Evaporation Sludges Frequency (days/yr)	Evaporation Sludges Duration (hrs)
DERMAL EXPOSURE						
Hands and arms	0.17	870	52	12	52	12
INGESTION EXPOSURE						
Incidental from hands	NA	50	52	NA	52	NA
Concentration			(mg/kg) 3267			(mg/kg) 301
RESULTANT YEARLY EXPOSURE						
Resultant Exposure (mg/yr)- incidental dermal			4.434			0.409
Resultant Exposure (mg/yr)- incidental ingestion			2.124			0.196
		Average Daily *	0.126		Average Daily *	0.012
		TYE * (mg/yr)	6.558		TYE * (mg/yr)	0.604

RESULTANT RISK FACTORS -EXPOSURE TO MAIN POND SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	1.80E-03
EPA Published AfS (mg/kg-day)	0.97
CDI Daily Chronic Exposure (mg/kg-day)	2.57E-04
EPA Published AfC (mg/kg-day)	0.1
CPF (mg/kg-day)^-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

RESULTANT RISK FACTORS -EXPOSURE TO EVAPORATION SYSTEM SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	1.66E-04
EPA Published AfS (mg/kg-day)	0.97
CDI Daily Chronic Exposure (mg/kg-day)	2.36E-05
EPA Published AfC (mg/kg-day)	0.1
CPF (mg/kg-day)^-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

NOTE Upper Bound Cancer Risk calculated
as CDI * CPF * 58 yrs/70 yrs

TABLE 11-5D

Direct Exposure Calculation for Rancher/Hunter for 52 Days/Year NAPHTHALENE
Unrestricted Site - Most Probable Future Landuse

Type of Exposure	Adult Body Surface Area Exposed (m2)	Resultant Unit Soil Exposure (mg/day)	Main Pond Sludges Frequency (days/yr)	Main Pond Sludges Duration (hrs)	Evaporation Sludges Frequency (days/yr)	Evaporation Sludges Duration (hrs)
DERMAL EXPOSURE						
Hands and arms	0.17	870	52	12	52	12
INGESTION EXPOSURE						
Incidental from hands	NA	50	52	NA	52	NA

Concentration	(mg/kg) 257		(mg/kg) ND
RESULTANT YEARLY EXPOSURE			
Resultant Exposure (mg/yr)- incidental dermal	0.140		0.000
Resultant Exposure (mg/yr)- incidental ingestion	0.033		0.000
Average Daily =	0.003	Average Daily =	0.0000
TYE = (mg/yr)	0.173	TYE = (mg/yr)	0.000

RESULTANT RISK FACTORS -EXPOSURE TO MAIN POND SLUDGE

SDI :Maximum Subchronic Daily Exposure (mg/kg-day)	4.75E-05
EPA Published AIS (mg/kg-day)	0.41
CDI Daily Chronic Exposure (mg/kg-day)	6.77E-06
EPA Published AIC (mg/kg-day)	0.41
CPF (mg/kg-day)^-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

RESULTANT RISK FACTORS -EXPOSURE TO EVAPORATION SYSTEM SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	0.00E+00
EPA Published AIS (mg/kg-day)	0.41
CDI Daily Chronic Exposure (mg/kg-day)	0.00E+00
EPA Published AIC (mg/kg-day)	0.41
CPF (mg/kg-day)^-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

NOTE Upper Bound Cancer Risk calculated
as CDI * CPR * 58 yrs/70 yrs

TABLE 11-5E

Direct Exposure Calculation for Rancher/Hunter for 52 Days/Year PCBs (Total)
Unrestricted Site - Most Probable Future Landuse

Type of Exposure	Adult Body Surface Area Exposed (m2)	Resultant Unit Soil Exposure (mg/day)	Main Pond Sludges Frequency (days/yr)	Main Pond Sludges Duration (hrs)	Evaporation Sludges Frequency (days/yr)	Evaporation Sludges Duration (hrs)
DERMAL EXPOSURE						
Hands and arms	0.17	870	52	12	52	12
INGESTION EXPOSURE						
Incidental from hands	NA	50	52	NA	52	NA
Concentration			(mg/kg) 159			(mg/kg) 25
RESULTANT YEARLY EXPOSURE						
Resultant Exposure (mg/yr)- incidental dermal			0.360			0.057
Resultant Exposure (mg/yr)- incidental ingestion			0.124			0.020
		Average Daily *	0.009		Average Daily *	0.0015
		TYE * (mg/yr)	0.484		TYE * (mg/yr)	0.076

RESULTANT RISK FACTORS -EXPOSURE TO MAIN POND SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	1.33E-04
EPA Published AIS (mg/kg-day)	NA
CDI Daily Chronic Exposure (mg/kg-day)	1.89E-05
EPA Published AIC (mg/kg-day)	NA
CPF (mg/kg-day)^-1	4.34
UPPER BOUND CANCER RISK	6.81E-05

RESULTANT RISK FACTORS -EXPOSURE TO EVAPORATION SYSTEM SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	2.09E-05
EPA Published AIS (mg/kg-day)	NA
CDI Daily Chronic Exposure (mg/kg-day)	2.98E-06
EPA Published AIC (mg/kg-day)	NA
CPF (mg/kg-day)^-1	4.14
UPPER BOUND CANCER RISK	1.07E-05

NOTE Upper Bound Cancer Risk calculated
as CDI * CPF * 58 yrs/70 yrs

D814

TABLE 11-SF

Direct Exposure Calculation for Rancher/Hunter for 52 Days/Year PHENOL
Unrestricted Site - Most Probable Future Landuse

Type of Exposure	Adult Body Surface Area Exposed (m2)	Resultant Unit Soil Exposure (mg/day)	Main Pond Sludges Frequency (days/yr)	Main Pond Sludges Duration (hrs)	Evaporation Sludges Frequency (days/yr)	Evaporation Sludges Duration (hrs)
DERMAL EXPOSURE						
Hands and arms	0.17	870	52	12	52	12
INGESTION EXPOSURE						
Incidental from hands	NA	50	52	NA	52	NA
Concentration			(mg/kg) 695			(mg/kg) 757
RESULTANT YEARLY EXPOSURE						
Resultant Exposure (mg/yr)- Incidental dermal			0.377			0.411
Resultant Exposure (mg/yr)- Incidental ingestion			0.181			0.197
		Average Daily =	0.011		Average Daily =	0.012
		TYE = (mg/yr)	0.558		TYE = (mg/yr)	0.608

RESULTANT RISK FACTORS -EXPOSURE TO MAIN POND SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	1.53E-04
EPA Published AIS (mg/kg-day)	0.04
CDI Daily Chronic Exposure (mg/kg-day)	2.18E-05
EPA Published AIC (mg/kg-day)	0.04
CPF (mg/kg-day)^-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

RESULTANT RISK FACTORS -EXPOSURE TO EVAPORATION SYSTEM SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	1.67E-04
EPA Published AIS (mg/kg-day)	0.04
CDI Daily Chronic Exposure (mg/kg-day)	2.38E-05
EPA Published AIC (mg/kg-day)	0.04
CPF (mg/kg-day)^-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

NOTE. Upper Bound Cancer Risk calculated
as CDI * CPF * 58 yrs/70 yrs

0808

TABLE 11-5G

Direct Exposure Calculation for Rancher/Hunter for 52 Days/Year TETRACHLOROETHYLENE
Unrestricted Site - Most Probable Future Landuse

Type of Exposure	Adult Body Surface Area Exposed (m2)	Resultant Unit Soil Exposure (mg/day)	Main Pond Sludges Frequency (days/yr)	Main Pond Sludges Duration (hrs)	Evaporation Sludges Frequency (days/yr)	Evaporation Sludges Duration (hrs)
DERMAL EXPOSURE						
Hands and arms	0 17	870	52	12	52	12
INGESTION EXPOSURE						
Incidental from hands	NA	50	52	NA	52	NA
Concentration			(mg/kg) 121			(mg/kg) 21 8
RESULTANT YEARLY EXPOSURE						
Resultant Exposure (mg/yr)- Incidental dermal			0 164			0 030
Resultant Exposure (mg/yr)- Incidental Ingestion			0 079			0 014
		Average Daily =	0 005		Average Daily =	0 001
		TYE = (mg/yr)	0 243		TYE = (mg/yr)	0 044

RESULTANT RISK FACTORS -EXPOSURE TO MAIN POND SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	6 67E-05
EPA Published ATS (mg/kg-day)	NA
CDI Daily Chronic Exposure (mg/kg-day)	9 51E-06
EPA Published AIC (mg/kg-day)	0 02
CPF (mg/kg-day)^-1	0 051
UPPER BOUND CANCER RISK	4 02E-07

RESULTANT RISK FACTORS -EXPOSURE TO EVAPORATION SYSTEM SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	1 20E-05
EPA Published ATS (mg/kg-day)	NA
CDI Daily Chronic Exposure (mg/kg-day)	1 71E-06
EPA Published AIC (mg/kg-day)	0 02
CPF (mg/kg-day)^-1	0 051
UPPER BOUND CANCER RISK	7 24E-08

NOTE Upper Bound Cancer Risk calculated
as CDI * CPF * 58 yrs/70 yrs

D812

TABLE 11-5H

Direct Exposure Calculation for Rancher/Hunter for 52 Days/Year TOLUENE
Unrestricted Site - Most Probable Future Landuse

Type of Exposure	Adult Body Surface Area Exposed (m2)	Resultant Unit Soil Exposure (mg/day)	Main Pond Sludges Frequency (days/yr)	Main Pond Sludges Duration (hrs)	Evaporation Sludges Frequency (days/yr)	Evaporation Sludges Duration (hrs)
DERMAL EXPOSURE						
Hands and arms	0.17	870	52	12	52	12
INGESTION EXPOSURE						
Incidental from hands	NA	50	52	NA	52	NA
Concentration			(mg/kg) 1225			(mg/kg) 165
RESULTANT YEARLY EXPOSURE						
Resultant Exposure (mg/yr)- incidental dermal			1.663			0.224
Resultant Exposure (mg/yr)- incidental ingestion			0.796			0.107
		Average Daily =	0.047		Average Daily =	0.006
		TYE = (mg/yr)	2.459		TYE = (mg/yr)	0.331

RESULTANT RISK FACTORS -EXPOSURE TO MAIN POND SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	6.76E-04
EPA Published AIS (mg/kg-day)	0.43
CDI Daily Chronic Exposure (mg/kg-day)	9.62E-05
EPA Published AIC (mg/kg-day)	0.3
CPF (mg/kg-day)^-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

RESULTANT RISK FACTORS -EXPOSURE TO EVAPORATION SYSTEM SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	9.10E-05
EPA Published AIS (mg/kg-day)	0.43
CDI Daily Chronic Exposure (mg/kg-day)	1.30E-05
EPA Published AIC (mg/kg-day)	0.3
CPF (mg/kg-day)^-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

NOTE Upper Bound Cancer Risk calculated
as CDI * CPF * 58 yrs/70 yrs

TABLE 11-51

Direct Exposure Calculation for Rancher/Hunter for 52 Days/Year TRICHLOROETHYLENE
Unrestricted Site - Most Probable Future Landuse

Type of Exposure	Adult Body Surface Area Exposed (m2)	Resultant Unit Soil Exposure (mg/day)	Main Pond Sludges Frequency (days/yr)	Main Pond Sludges Duration (hrs)	Evaporation Sludge* Frequency (days/yr)	Evaporation Sludge* Duration (hrs)
DERMAL EXPOSURE						
Hands and arms	0.17	870	52	12	52	12
INGESTION EXPOSURE						
Incidental from hands	NA	50	52	NA	52	NA
Concentration			(mg/kg) 50			(mg/kg) ND
RESULTANT YEARLY EXPOSURE						
Resultant Exposure (mg/yr)- Incidental dermal			0.068			0.000
Resultant Exposure (mg/yr)- Incidental ingestion			0.033			0.000
		Average Daily =	0.002		Average Daily =	0.000
		TYE = (mg/yr)	0.100		TYE = (mg/yr)	0.000

RESULTANT RISK FACTORS -EXPOSURE TO MAIN POND SLUDGE

SDI:Maximum Subchronic Daily Exposure (mg/kg-day)	2.76E-05
EPA Published AIS (mg/kg-day)	NA
CDI Daily Chronic Exposure (mg/kg-day)	3.93E-06
EPA Published AIC (mg/kg-day)	NA
CPF (mg/kg-day)^-1	0.011
UPPER BOUND CANCER RISK	3.58E-08

RESULTANT RISK FACTORS -EXPOSURE TO EVAPORATION SYSTEM SLUDGE

SDI:Maximum Subchronic Daily Exposure (mg/kg-day)	0.00E+00
EPA Published AIS (mg/kg-day)	NA
CDI Daily Chronic Exposure (mg/kg-day)	0.00E+00
EPA Published AIC (mg/kg-day)	NA
CPF (mg/kg-day)^-1	0.011
UPPER BOUND CANCER RISK	0.00E+00

NOTE Upper Bound Cancer Risk calculated
as CDI * CPF * 58 yrs/70 yrs

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TABLE 11-51

Direct Exposure Calculation for Rancher/Hunter for 52 Days/Year CHROMIUM
Unrestricted Site - Most Probable Future Landuse

Type of Exposure	Adult Body Surface Area Exposed (m2)	Resultant Unit Soil Exposure (mg/day)	Main Pond Studies Frequency (days/yr)	Main Pond Studies Duration (hrs)	Evaporation Studies Frequency (days/yr)	Evaporation Studies Duration (hrs)
DERMAL EXPOSURE						
Hands and arms	0.17	870	52	12	52	12
INGESTION EXPOSURE						
Incidental from hands	NA	50	52	NA	52	NA
Concentration			(mg/kg) 236			(mg/kg) 72.6
RESULTANT YEARLY EXPOSURE						
Resultant Exposure (mg/yr)- incidental dermal			0.013			0.004
Resultant Exposure (mg/yr)- incidental ingestion			0.002			0.0005
		Average Daily *	0.0003		Average Daily *	0.0001
		TYE * (mg/yr)	0.014		TYE * (mg/yr)	0.004

RESULTANT RISK FACTORS -EXPOSURE TO MAIN POND SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	3.94E-06
EPA Published AIS (mg/kg-day)	1.4 *, 0.025**
CDI Daily Chronic Exposure (mg/kg-day)	5.61E-07
EPA Published AIC (mg/kg-day)	1.0 *, 0.005**
CPF (mg/kg-day)^-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

RESULTANT RISK FACTORS -EXPOSURE TO EVAPORATION SYSTEM SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	1.21E-06
EPA Published AIS (mg/kg-day)	1.4 *, 0.025**
CDI Daily Chronic Exposure (mg/kg-day)	1.73E-07
EPA Published AIC (mg/kg-day)	1.0 *, 0.005**
CPF (mg/kg-day)^-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

* as Chromium III ** as Chromium VI

NOTE: Upper Bound Cancer Risk calculated
as CDI * CPF * 58 yrs/70 yrs

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TABLE 11-5K

Direct Exposure Calculation for Rancher/Hunter for 52 Days/Year LEAD
Unrestricted Site - Most Probable Future Landuse

Type of Exposure	Adult Body Surface Area Exposed (m2)	Resultant Unit Soil Exposure (mg/day)	Main Pond Sludges Frequency (days/yr)	Main Pond Sludges Duration (hrs)	Evaporation Sludges Frequency (days/yr)	Evaporation Sludges Duration (hrs)
DERMAL EXPOSURE						
Hands and arms	0.17	870	52	12	52	12
INGESTION EXPOSURE						
Incidental from hands	NA	50	52	NA	52	NA
Concentration			(mg/kg) 404			(mg/kg) 164
RESULTANT YEARLY EXPOSURE						
Resultant Exposure (mg/yr)- incidental dermal			0.022			0.009
Resultant Exposure (mg/yr)- incidental ingestion			0.003			0.0011
		Average Daily =	0.0005		Average Daily =	0.0002
		TYE = (mg/yr)	0.025		TYE = (mg/yr)	0.010

RESULTANT RISK FACTORS -EXPOSURE TO MAIN POND SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	6.75E-06
EPA Published AIS (mg/kg-day)	NA
CDI Daily Chronic Exposure (mg/kg-day)	9.61E-07
EPA Published AIC (mg/kg-day)	0.0014
CPF (mg/kg-day)^-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

RESULTANT RISK FACTORS -EXPOSURE TO EVAPORATION SYSTEM SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	2.74E-06
EPA Published AIS (mg/kg-day)	NA
CDI Daily Chronic Exposure (mg/kg-day)	3.90E-07
EPA Published AIC (mg/kg-day)	0.0014
CPF (mg/kg-day)^-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

NOTE Upper Bound Cancer Risk calculated
as CDI * CPF * 58 yrs/70 yrs

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TABLE 11-5L

Direct Exposure Calculation for Rancher/Hunter for 52 Days/Year NICKEL
Unrestricted Site - Most Probable Future Landuse

Type of Exposure	Adult Body Surface Area Exposed (m2)	Resultant Unit Soil Exposure (mg/day)	Main Pond Sludges Frequency (days/yr)	Main Pond Sludges Duration (hrs)	Evaporation Sludges Frequency (days/yr)	Evaporation Sludges Duration (hrs)
DERMAL EXPOSURE						
Hands and arms	0 17	870	52	12	52	12
INGESTION EXPOSURE						
Incidental from hands	NA	50	52	NA	52	NA
Concentration			(mg/kg) 67			(mg/kg) 31 5
RESULTANT YEARLY EXPOSURE						
Resultant Exposure (mg/yr)- Incidental dermal			0 004			0 002
Resultant Exposure (mg/yr)- Incidental ingestion			0.0004			0.0002
		Average Daily =	0.0001		Average Daily =	0 00004
		TYE = (mg/yr)	0 004		TYE = (mg/yr)	0 002

RESULTANT RISK FACTORS -EXPOSURE TO MAIN POND SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	1 12E-06
EPA Published AIS (mg/kg-day)	0 014
CDI Daily Chronic Exposure (mg/kg-day)	1 59E-07
EPA Published AIC (mg/kg-day)	0 01
CPF (mg/kg-day)^-1	non-carcinogen*
UPPER BOUND CANCER RISK	0 00E+00

* Non-carcinogen for oral exposures

RESULTANT RISK FACTORS -EXPOSURE TO EVAPORATION SYSTEM SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	5 26E-07
EPA Published AIS (mg/kg-day)	0 014
CDI Daily Chronic Exposure (mg/kg-day)	7 49E-08
EPA Published AIC (mg/kg-day)	0 01
CPF (mg/kg-day)^-1	non-carcinogen*
UPPER BOUND CANCER RISK	0 00E+00

NOTE Upper Bound Cancer Risk calculated
as CDI * CPF * 58 yrs/70 yrs

D820

TABLE 11-5M

Direct Exposure Calculation for Rancher/Hunter for 52 Days/Year ZINC
Unrestricted Site - Most Probable Future Landuse

Type of Exposure	Adult Body Surface Area Exposed (m2)	Resultant Unit Soil Exposure (mg/day)	Main Pond Sludges Frequency (days/yr)	Main Pond Sludges Duration (hrs)	Evaporation Sludges Frequency (days/yr)	Evaporation Sludges Duration (hrs)
DERMAL EXPOSURE						
Hands and arms	0.17	870	52	12	52	12
INGESTION EXPOSURE						
Incidental from hands	NA	50	52	NA	52	NA
Concentration			(mg/kg) 573			(mg/kg) 751
RESULTANT YEARLY EXPOSURE						
Resultant Exposure (mg/yr)- incidental dermal			0.031			0.041
Resultant Exposure (mg/yr)- incidental ingestion			0.004			0.0049
		Average Daily *	0.0007		Average Daily *	0.0009
		TYE * (mg/yr)	0.035		TYE * (mg/yr)	0.046

RESULTANT RISK FACTORS -EXPOSURE TO MAIN POND SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	9.57E-06
EPA Published ATS (mg/kg-day)	0.21
CDI Daily Chronic Exposure (mg/kg-day)	1.36E-06
EPA Published ATC (mg/kg-day)	0.21
CPF (mg/kg-day)**-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

RESULTANT RISK FACTORS -EXPOSURE TO EVAPORATION SYSTEM SLUDGE

SDI Maximum Subchronic Daily Exposure (mg/kg-day)	1.25E-05
EPA Published ATS (mg/kg-day)	0.21
CDI Daily Chronic Exposure (mg/kg-day)	1.79E-06
EPA Published ATC (mg/kg-day)	0.21
CPF (mg/kg-day)**-1	non-carcinogen
UPPER BOUND CANCER RISK	0.00E+00

NOTE: Upper Bound Cancer Risk calculated
as CDI * CPF * 58 yrs/70 yrs

11.3.3 Calculation of Total Hazard Indices and Total Carcinogenic Risk

Individual carcinogenic and non-carcinogenic risks for each indicator chemical, and the total carcinogenic and non-carginogenic risks for the main pond and evaporation system, are summarized in Tables 11-6A and 11-6B. A Hazard Index (HI) was calculated for each non-carcinogenic compound as follows:

$$HI = CDI/AIC * 100 = \% \text{ of } AIC$$

The Total Hazard Index for each compartment was then calculated by summing the Hazard Index values for each indicator chemical.

Potential risks for carcinogens are estimated as probabilities of excess cancer risk as a result of exposure. Upper bound lifetime excess cancer risks are estimated by multiplying the cumulative dose received during the period of exposure (averaged over the lifetime of exposure) times the cancer potency factor (CPF), i.e., RISK = CDI x CPF.

The upper bound risks of all the carcinogenic indicator chemicals in an individual compartment were then summed to give the total carcinogenic risk for that compartment. The total carcinogenic risk for each compartment of main pond sludge and evaporative system sludge was computed according to the formula:

$$\text{Total Compartmental Carcinogenic Risk} = \sum_{i=1}^{n} (CDI_i)(CPF_i)(58/70)$$

where CDI_i = chronic daily intake of individual indicator chemical

CPF_i = cancer potency factor of individual indicator chemical

n = 13

As shown in Tables 11-6A and 11-6B, the total upper bound carcinogenic risk and the Total Hazard Index for each compartment under Site Condition 2 are as follows:

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TABLE 11-6A

Summary of Total Hazard Index and Total Carcinogenic Risk
Posed by Direct Contact with Main Pond Sludge, 52 Days/Year

INDICATOR CHEMICAL	Total CDI (mg/kg-day)	EPA AIC (mg/kg-day)	Hazard Index HI=CDI/AIC	EPA CPF (mg/kg-day)^-1	Upper Bound Cancer Risk 58yr/70yr * CDI*CPF
Benzene	8.25E-05	NA	NA	0.052	3.55E-06
2,4-Dimethylphenol	1.07E-05	0.0014 (1)	0.76%	NA	NA
Ethylbenzene	2.57E-04	0.1	0.26%	NA	NA
Naphthalene	6.77E-06	0.41 (2)	0.0017%	NA	NA
PCBs (Total) (3)	1.89E-05	NA	NA	4.34	6.80E-05
Phenol	2.18E-05	0.04	0.05%	NA	NA
Tetrachloroethylene	9.51E-06	0.02	0.05%	0.051	4.02E-07
Toluene	9.62E-05	0.3	0.03%	NA	NA
Trichloroethylene	3.93E-06	NA	NA	0.011	3.58E-08
Chromium	5.61E-07	1	0.0001%	NA	NA
Lead	9.61E-07	0.0014	0.07%	NA	NA
Nickel	1.59E-07	0.01	0.0016%	NA	NA
Zinc	1.36E-06	0.21	0.0006%	NA	NA
CUMULATIVE RISKS FOR ALL INDICATORS					
	Total Hazard Index		1.23%		
	Total Carcinogenic Risk				7.20E-05

CDI = Chronic Daily Intake as calculated from direct exposure for each indicator chemical (from Tables 11-5A through 11-5M).
AIC = Acceptable Chronic Intake (see Appendix C).
CPF = Cancer Potency Factor (see Appendix C).
(1) Number is draft value from EPA Region VI for 3,4-Dimethylphenol. No draft value for 2,4-DMP.
(2) Personal communication, hand-written notes from Fred Reitman, EPA Region VI, 2/22/88.
(3) PCB calculations using dermal and gastrointestinal absorption factors from OHEA Document EPA/600-6-86/002: Development of Advisory Levels for Polychlorinated Biphenyls (PCBs) Cleanup, May, 1986.

TABLE 11-6B

Summary of Total Hazard Index and Total Carcinogenic Risk
Posed by Direct Contact with Evaporative Sludge, 52 Days/Year

INDICATOR CHEMICAL	Total CDI (mg/kg-day)	EPA AIC (mg/kg-day)	Hazard Index HI=CDI/AIC	EPA CPF (mg/kg-day)^-1	Upper Bound Cancer Risk 58yr/70yr * CDI*CPF
Benzene	3.37E-06	NA	NA	0.052	1.45E-07
2,4-Dimethylphenol	7.76E-07	0.0014 (1)	0.06%	NA	NA
Ethylbenzene	2.36E-05	0.1	0.02%	NA	NA
Naphthalene	0.00E+00	0.41 (2)	0.00%	NA	NA
PCBs (Total) (3)	2.98E-06	NA	NA	4.34	1.07E-05
Phenol	2.38E-05	0.04	0.06%	NA	NA
Tetrachloroethylene	1.71E-06	0.02	0.01%	0.051	7.23E-08
Toluene	1.30E-05	0.3	0.0043%	NA	NA
Trichloroethylene	0.00E+00	NA	NA	0.011	0.00E+00
Chromium	1.73E-07	1	.0000%	NA	NA
Lead	3.90E-07	0.0014	0.03%	NA	NA
Nickel	7.49E-08	0.01	0.0007%	NA	NA
Zinc	1.79E-06	0.21	0.0009%	NA	NA
CUMULATIVE RISKS FOR ALL INDICATORS					
	Total Hazard Index		0.18%		
	Total Carcinogenic Risk				1.09E-05

CDI = Chronic Daily Intake as calculated from direct exposure for each indicator chemical (from Tables 11-5A through 11-5M).
AIC = Acceptable Chronic Intake (see Appendix C).
CPF = Cancer Potency Factor (see Appendix C).
(1) Number is draft value from EPA Region VI for 3,4-Dimethylphenol. No draft value for 2,4-DMP.
(2) Personal communication, hand-written notes from Fred Reitman, EPA Region VI, 2/22/88.
(3) PCB calculations using dermal and gastrointestinal absorption factors from OHEA Document EPA/600/6-86/002: Development of Advisory Levels for Polychlorinated Biphenyls (PCBs) Cleanup, May, 1986

Compartment	Total Hazard Index	Total Carcinogenic Risk
Main Pond Sludge	1.23%	7.20E-05
Evaporative Pond Sludge	0.18%	1.09E-05

EPA guidance indicates that the generally accepted range for total upper bound excess cancer risk is 1×10^{-4} to 1×10^{-7}. Typical factors that impact selection of the appropriate risk level from within this range for a given site include:

1) Site characteristics;
2) Current and anticipated future exposure; and
3) Current and anticipated future uses.

Based upon an evaluation of these factors, a risk level of 1.0×10^{-5} was selected as the benchmark for comparative risk level evaluations for the Sheridan Site. This level takes into account site features such as remote rural location, which leads to a very limited receptor population, in combination with the limited likelihood for additional future development.

The 1×10^{-5} risk level was also selected in recognition of several of the conservative assumptions that go into development of the estimated risks derived from the various exposure scenarios. For example, in modeling either direct contact or ground water exposures over an extended period of time, it is assumed that existing constituent concentrations do not diminish over time. However, over the 50 or more estimated years of exposure, existing site constituents would diminish in concentration either through release to the atmosphere or natural degradation processes. The result is particularly true for volatile compounds present near the surface. Adequate overall protection will be maintained if a 1×10^{-5} risk level is achieved.

The main pond sludge and evaporative pond sludge for each present a total carcinogenic risk in excess of 10^{-5}, and in each case the majority of this risk results from the presence of PCBs.

11.4 Soil Exposure Pathway

11.4.1 Potential Sources and Pathways

As summarized in Table 9-1, there are two soil-related pathways that might be completed under Site Condition 2 assumptions. These are:

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Pathway IIIA: Direct contact with sludges of the main pond or other site soils and incidental ingestions associated with such contact.

Pathway IIIC: Food-chain uptake of metals by plants growing on contaminated soil and potential consumption by humans.

Risk associated with direct contact and ingestion for Pathway IIIA have already been considered in Section 11.3 above. Risks for Pathway IIIC are discussed in the following subsection.

11.4.2 Potential Receptors

The potential receptor for direct contact with affected soils and sludges is the rancher/hunter working and/or hunting on the property. Specific exposure conditions and frequencies for these persons are discussed in Section 11.3.1.

The primary receptors for Pathway IIIC food-chain uptake are cattle and wildlife feeding in the area of the site. Assumed "indicator" wildlife include ducks, quail, deer and rabbits.

11.4.3 Pathway IIIC: Consumption of Organisms Growing On Or Feeding in Contaminated Areas

The main concern for this pathway is the proportion of total cattle forage which might be consumed from plants growing on site acreage with potentially contaminated soils. The total acreage of range land assumed to be available for Site Condition 2 is 600 acres. The disposal area, 92 acres, covers 19% of the total available range land. The total range available is then 600 acres minus 12 acres in Clark Lake minus ungrazable acreage within the former disposal area.

For Site Condition 2, the disposal area would consist of the following: 19 acres of water in the main pond; 13 acres of exposed dike; about 18 acres of borrow ditch; and 42 acres in the evaporation system, about half of which (20 acres) stays wet most of the year. Therefore, of the total acreage within the disposal area (92 acres), 39 acres (42%) are unavailable for grazing due to water or wetness, even during the dry spells. In rainy season, the remaining 22 acres of the evaporation system are unusable because of standing water.

Based on these numbers, it is calculated that an animal can spend a maximum of only 9% of total yearly grazing time in the disposal site area. This makes a total of 32 days (9% x 365 days) on forage on and adjacent to the waste site and 332 days (91% x 365 days) on "background" forage.

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Range Carrying Capacity and Probable Risk to Cattle

The range capacity of this area is 1 AU/3 acres (AU = animal unit = 1 cow and 1 calf) on improved pasture and 1 AU/7 acres on average condition unimproved pasture (Mike Shilvey, Texas Agricultural Extension Service, personal communication, January 1988). At these range capacities, 174 AU/year could be maintained on 600 acres of improved rangeland; 74 AU/year could be maintained if the acreage were unimproved.

According to Brown et al (1983), plants will generally uptake no more than one percent of the metal content in the soil, up to the point at which the soil concentration becomes phytotoxic. Table 11-7 shows the concentration of metals found in the soil, plant uptake and the upper level of chronic dietary exposure of metals which will not affect production for cattle (Brown et al, 1983). As can been seen from this table, predicted plant concentrations are well below acceptable forage concentrations.

Blood samples and fat tissue were analyzed in January 1986 from Mr. Sheridan's cattle for lead and PCBs respectively, for the Source Control RI (July 1987). These data show no detectable levels for either constituent (Table 11-8). Trace amounts of DDE were detected in the GC scans from four different fat tissue samples. DDE is a metabolite of DDT and its presence is believed to be due to the historical use of DDT at the site. Even so, the detected levels of DDE are well below the USDA Acceptable Levels for this compound in cattle (Table 11-9). These data indicate that there is minimal bioaccumulation of these compounds in cattle foraging at the site.

Hunting

The hunting seasons overlap for deer, quail and ducks. Duck season is a split season typically running from October 31 to November 8, and then from November 21 to January 17, a total of 67 days. Quail season is open from November 7 to February 28 (a total of 114 days) and deer season is from November 7 to January 3, a total of 50 days which are overlapped by the other two seasons. Thus, the area would be available for hunting for a maximum total of 114 days each year.

The average sportsperson living near the site (say, within a 50 mile radius) might spend as much as six days per year hunting on this property (two days each for duck, quail and deer). Assuming an especially competent hunter who always makes his quota each day, the hunter may obtain up to ten ducks (population permitting), 24 quail and two deer per season.

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TABLE 11-7

Summary of Predicted Plant Concentrations and
Comparison to Acceptable USDA Forage Concentrations

Metal	Surficial Soil Concentrations: Above Grade Dike Soils (mg/kg)	Surficial Soil Concentrations: Evaporation System Soils (mg/kg)	Predicted Plant Concentrations (1): Dike Soils (mg/kg) As Dry Wt	Predicted Plant Concentrations (1): Dike Soils (mg/kg) As Wet Wt	Predicted Plant Concentrations (1): Evap. Sys. Soils (mg/kg) As Dry Wt	Predicted Plant Concentrations (1): Evap. Sys. Soils (mg/kg) As Wet Wt	Acceptable Forage Concentration (2) (mg/kg) As Dry Wt	Acceptable Forage Concentration (2) (mg/kg) As Wet Wt
Chromium	7.5	25.8	.075	0.02	1.03	.258		
as CL							1000	250
as Oxide							3000	750
Lead	9	41.8	.09	0.02	1.67	.418	30	7.5
Nickel	10.5	17.7	.105	0.03	.708	.177	50	12.5
Zinc	38.5	73.5	.385	0.01	2.94	.735	500	125

NOTES:

(1) Brown, K.W., G.B. Evans and B.D. Fentrup, 1983. Hazardous Waste Land Treatment. Butterworth Publishers, Woburn, MA. 692 pp. Uptake = < 1% of soil concentration. Dry weight for forage is approximately 25% of wet weight, so effective wet weight concentrations are 25% of dry weight concentrations.

(2) Brown, et al, 1983.

TABLE 11-8

CATTLE BLOOD SAMPLING ANALYTICAL RESULTS
(RI Data, January 1986)

Sample Animal	Blood Lead (ppm	Fat PCBs (ppm)	DDE (ppm)
CA1	<0.2	--	--
*CA2	<0.2	ND,ND(<0.1)	0.27, 0.24
CA3	<0.2	ND(<0.1)	ND(<0.1)
CA4	<0.2	ND(<0.1)	ND(<0.1)
CA5	<0.2	ND(<0.1)	ND(<0.1)
CA6	<0.2	ND(<0.1)	0.28
CA7	<0.2	ND(<0.1)	ND(<0.1)
CA8	<0.2	ND(<0.1)	ND(<0.1)
CA9	<0.2	ND(<0.1)	ND(<0.1)
CA10	<0.2	ND(<0.1)	0.37
CA11	<0.2	ND(<0.1)	0.55
CA12	<0.2	--	--
CA13	<0.2	ND(<0.01)	ND(<0.1)
Blank Fat Tissue		ND(<0.1)	ND(<0.1)

* - Replicate fat tissue samples were analyzed for CA2.

ND - Not Detected

\- Not Analyzed

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TABLE 11-9

SUMMARY OF DDE RESIDUE LEVELS
IN CATTLE FAT TISSUE

(RI Data, January 1986)

Cattle	DDE (ppm)	USDA Acceptable DDE Levels (ppm)
Bull 2 yr.	.27	5
Duplicate	.24	
Calf 6 mo.	.28	5
Calf 6 mo.	.37	5
Cow 2 yr.	.55	5

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Deer and quail could conceivably live on the property, as long as the new owner keeps his cattle from overgrazing the range for the deer and fences them out of prime brush habitat for the quail. Most game ducks are migratory and generally would not be resident long enough to accumulate significant body loads. Feeding ranges for the deer would be much larger than the acreage assumed for the new owner; even if it were not, the soil levels and predicted forage concentrations would be protective of deer as well as cattle (see above). The number of quail and duck shot per season would be sufficient to provide one meal for the annual family reunion for the sportsperson(s) involved. Thus, it is highly unlikely that consumption of wildlife shot in the site area by a visiting sportsperson would have any health risk.

The only non-regulated game species living in habitats available on the site that has potential for more frequent hunting by a ranch owner is rabbit. Rabbits would live in this area provided that the brushy habitat they occupy is not destroyed from overgrazing by cattle. Assuming that rabbits are common on the property, it is conceivable that the ranch owner would hunt rabbits 52 times per year (1 day per week). If the ranch owner was 75% successful, he could catch and eat 39 rabbits/year. If these rabbits are evenly distributed over the entire area, only five (13%) would have been in contact with the waste disposal area. While the amount of intake and accumulation by the rabbit is unknown, it is unlikely that it would be significant over the rabbits' lifetime (3-5 years) because the rabbit would not spend all of its time in direct contact with any waste compartment. That is, the rabbit would spend much of its time in brushy areas away from exposure to waste.

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11.5 Ground Water Exposure Pathway

There is no existing consumption of shallow ground water at the site. Projecting most probable landuse, it is not at all likely that the rancher/hunter would install a drinking, irrigation or stock pond well downgradient of the disposal area in the shallow aquifer for the following reasons:

1) The available land area between the river and the disposal area is very restricted and not suitable for construction of a home, especially with the access road taking up most of the available area.

2) Given the range capacity of the ranch/hunter's land, all stock water would be adequately and most cheaply provided by Clark Lake.

3) The capacity of the shallow aquifer is not sufficient to support irrigation of row crops, even if row-cropping were advisable in the rangeland.

Therefore, the sources, pathways and receptors for Site Condition 2 ground water exposure are identical to those for Site Condition 1. Please see Section 10.3.

11.6 Summary of Risks in Site Condition 2

A summary of pathway analysis and exposure assessment was completed for Site Condition 2. Assumptions include:

1) unrestricted site access; site abandoned by current owner;

2) future landuse is primarily agricultural, with potential for hunting;

3) no residential development adjacent to the site, and current locations of single family dwellings remain the same for the future;

4) the main pond is allowed to fill with stormwater and is not maintained in any way. Rainfall will cause overtopping of main pond fluid. Erosion of dikes and borrow areas can occur;

5) no downgradient drinking water wells exist; the only ground water pathway to humans remains through the Brazos River, as evaluated in Site Condition 1.

Results of each pathway analysis are outlined below.

Air Pathways IA, IB and IC: Exposure levels for these pathways were identical to those for Site Condition 1. No significant increase in human health risk related to these pathways is predicted.

Surface Water Pathways IIA, IIB, IIC and IID: A pathway which might result in an increase in risk to human health is IID: failure of the Brazos River Bank and subsequent erosion of the entire disposal area into the Brazos River. Risks associated with this pathway are difficult to quantify because too many rate estimates would have to be assumed.

Soil Pathways IIIA and IIIC: Increased risks associated with potential food-chain uptake (Pathway IIIC) of constituents

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from plants growing on waste areas, or animal consumption of these plants appears to be negligible.

Direct contact exposures for carcinogenic compounds to a rancher/hunter were found as follows:

	Upper Bound Cancer Risk
Main Pond Sludge	7.20E-05
Evaporation System Sludge	1.09E-05

The Total Hazard Indices (for non-carcinogenic compounds) for each compartment were substantially lower than 100%; therefore, these two compartments at the Sheridan Site present a negligible non-carcinogenic risk.

Ground Water Pathway IVB: The risk associated with transport of constituents via shallow ground water to the Brazos was found to be negligible under worst-case leaching/seepage and no degradation in assumptions using WMPLUME. Even the more conservative model (VHS) did not indicate a significant increase in PCBs over WQC for human consumption (See Section 10.3).

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12 - SUMMARY

This baseline risk assessment covers the Sheridan Disposal Services Site located in Waller County, near Hempstead, Texas. The site occupies approximately 110 acres and includes a 42 acre irrigation/evaporation system, a 12 acre main pond and a 17 acre dike area around the main pond. The area of the main pond and dike are based on a water surface elevation in the main pond of 170.5 feet (mean sea level); these areas will vary with changes in the main pond water level. The remaining acreage consists of borrow ditches excavated for dike construction and other buffer zones inside the perimeter fence.

The site was initially used to dispose of wastes by open pit burning. Dikes composed of ash, dirt, sludges, waste and other solid materials were built around a natural depression forming the main pond. The pond was used to store oily wastes. Oils were initially steam treated at the site and reclaimed. An incineration system was later constructed for burning liquid wastes. Site disposal activity began in the late 1950's. In 1978 portions of the incineration system were closed due to a fire. Limited disposal activities continued until 1984.

Residuals from site activities include oils in the pond or stored in tanks on-site, oily sludge in the pond bottom, affected dike soils and sludges and some minor quantities of sludges in the evaporation system area. Specific compounds of concern in the residue include PCBs, organic solvents and trace metals. Indicator compounds chosen for the site are:

- Benzene
- 2,4-Dimethylphenol
- Ethylbenzene
- Naphthalene
- PCBs
- Phenol
- Tetrachloroethylene
- Toluene
- Trichlorethylene
- Chromium
- Lead
- Nickel
- Zinc

These compounds were chosen based on toxicity class, organic chemical class, prevalence at the site, mobility and persistence.

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The necessary elements for any human exposure to chemicals in the environment are:

1. A source;

2. A mechanism of chemical release from the source to the environment;

3. A pathway by which chemicals can get from the release point to a receptor area; and

4. A human receptor present in the receptor area at the time of chemical arrival.

For a pathway to be complete, all four elements of exposure must be present. For a direct contact exposure, the mechanism of chemical release and the pathway to the human receptor do not stand as separate and independent components, but are instead combined in the process of direct physical contact with sludge or affected soil.

The potential pathways of interest at the Sheridan Site operate through four environmental media: Air, Surface Water, Soil and Ground Water. These media each define one or more transport mechanisms by which chemicals might move from source to receptor.

Several exposure pathways were examined to determine the extent of risk that might be present at the Sheridan Disposal Site. These pathways include inhalation of dust and vapors, dermal contact or ingestion of the affected soils, sludges and water in the impoundments, or ingestion of organisms (fish, cattle) that might come in contact with affected media (water, soil) at the site.

The exposure pathways were then examined in terms of two site conditions to determine which pathways were complete. The site conditions are: 1) the current site conditions, which include a fenced, restricted site with no remediation and existing landuse (farming/ranching) and locations of human habitation; and 2) a future site condition, which assumes complete abandonment and no remediation of the site.

The only completed pathways under the current use scenario are: 1) inhalation of dust and vapor on-site and at the nearest residence, 2) surface water runoff to Clark Lake and 3) ground water seepage to the Brazos River.

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Results of the air modeling for volatile organics indicate that no significant risk exists to human health or the environment, even when assuming a receptor at the dike. The dust modeling showed no significant risk even at the edge of the disposal area. All constituent concentrations were well below TACB screening levels.

The surface water exposure pathway includes runoff of stormwater to Clark Lake. Since no edible aquatic species are found in the lake, there is no completed chronic pathway. Livestock, however do use the lake. These livestock may eventually be consumed. This pathway was not evaluated quantitatively; however, results of water and lake sediment analyses do not suggest that this pathway is likely to pose a significant health threat.

The ground water exposure pathway considers potential impact from site ground water that eventually reaches the Brazos River. There are no ground water users between the site and the Brazos River. Ground water modeling utilized three combinations of four different models. Model 1 used EPA's organic leachate model (OLM) and the aquifer dilution model (VHS). Model 2 used the OLM, the unsaturated zone model (UZM) and VHS. Model 3 used the OLM and the Wilson and Miller WMPLUME model. Using these first two extremely conservative models, no constituents exceed human cancer related risk at 10^{-5}. Only PCBs exceeded human cancer related risks at 10^{-6}.

WMPLUME, the more realistic ground water model, showed that no relevant and appropriate criteria are exceeded for any indicator chemicals, including PCBs.

Two near surface transmissive zones below the site have been extensively sampled. Only the most shallow transmissive zones shows any affected ground water to date and that zone exhibits low levels of predominately volatile organic compounds.

Potential future risks associated with unrestricted site access and most probable future landuse were also evaluated. Risk analyses assumed agricultural landuse with secondary hunting activity on the site. All pathways completed under Site Condition 1 are also completed under Site Condition 2. In addition, pathways associated with access to the main pond, dikes, borrow pit areas and the evaporation system are also considered. For future site conditions (Site Condition 2, most probable future landuse scenario), the following exposure assumptions were made:

1. One visit per week per compartment by an individual of 12 years of age or older.
2. For dermal exposure to main pond and evaporative system sludge, skin exposure restricted to hands and forearms ($0.17m^2$).

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3. For PCBs, a dermal absorption factor of 5% per 12 hours and a gastrointestinal absorption factor of 30%.

4. For non-PCBs, a dermal absorption rate of 12% per 12 hours multiplied by a soil matrix factor and a gastrointestinal absorption rate based on class of compound multiplied by a soil matrix factor. (Absorption data for all indicator constituents is in Table 11-4.)

The following Total Hazard Index and/or upper bound Total Cancer Risk for each compartment were determined under Site Condition 2:

Compartment	Total Hazard Index	Upper Bound Total Cancer Risk
Main Pond Sludge	1.23%	7.20E-05
Evaporative System Sludge	0.18%	1.09E-05

The Total Hazard Index for each compartment is much less than 100% and indicates that there is negligible risk to human health or the environment from direct exposure to non-carcinogens. Each compartment exceeds a 10^{-5} total upper bound Cancer Risk, due primarily to the presence of PCBs.

Air exposure pathways for volatile compounds and dust are the same as for the current site use scenario and show no significant increase in risk to human health.

For surface water exposure, a pathway which might result in an increase in risk to human health is IID: failure of the Brazos River Bank and subsequent erosion of the entire disposal area into the Brazos River. Risks associated with this pathway are difficult to quantify because too many rate estimates would have to be assumed.

Increased risks associated with potential food-chain uptake of constituents from plants growing on waste areas or animal consumption of these plants appears to be negligible.

These results will provide input into the Feasibility Study.

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