AP - 002

STAGE 1 & 2 REPORTS

DATE:

MAR. 12, 1998

3/12/98
OCD/Shell meeting
Wayne Hamilton handout

Hobbs, New Mexico
Grimes Lease: Environmental Assessment and Remediation
Meeting Agenda
OCD Office, Santa Fe New Mexico, March 12, 1998

Time: 8:30-9:30: Assessment and Remediation

a. **Tasker Road Site:** Assessment Report Review (***Hamilton: 15 minutes***)
   Assessment work completed

b. **Tasker Road Site:** Risk Based Corrective Action (***Devaull: 30 minutes***)
   Technical discussion & results

c. **Grimes Tank Battery** ***(Hamilton: 15 minutes)***
   Assessment and analytical results
   Proposed remediation

Time: 9:30-9:45: Land Issues *(Hamilton)*

a. **Monument Development** ***(5 minutes)***

b. **Los Cuatro** ***(5 minutes)***

c. **Perry's Home** ***(5 minutes)***
   Pilot excavation or sampling/modeling
   Excavation front and back yard
   Replace topsoil and lawn
   Foundation is barrier to hydrocarbons

Time: 9:45-10:30: Communication of Results *(OCD-Shell)*

a. **Analytical results communication**
   Soil and Groundwater: OCD and Shell Results

b. **Petition Reply: Options**
   Legal Representatives
   Flyers
   Town Meeting

Tasker Road Activities

Two Locations

1331 and 1329 Tasker Road, Hobbs, New Mexico

Work Started and Completed

January 20 & 26, 1998

Work Scope

Five sample sites: Two samples per location
Location based on aerial photo and access
OCD Wayne Price on site

Land Use

Lease operator
Normal operating practices

Analytical Results

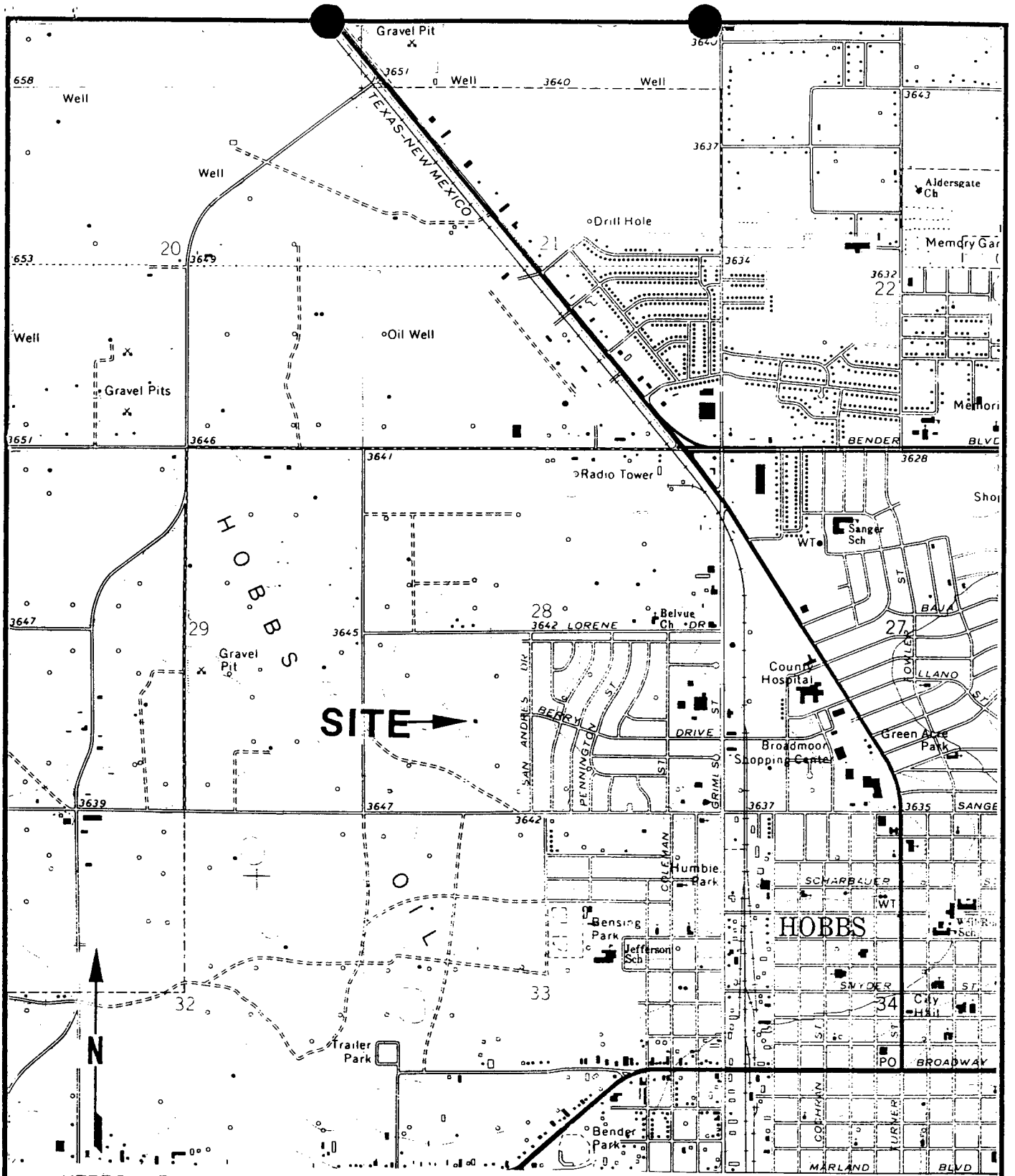
Laboratory: Trace Analysis in Lubbock

Analyses:

- No pesticides
- No chlorinated compounds
- No polycyclic aromatics hydrocarbons
- No semi-volatiles

Exceptions

- Tetrachlorethane
- Ethylbenzene
- m&p-xylenes



HOBBS WEST QUADRANGLE
NEW MEXICO - LEA Co
7.5 Minute Series (Topographic)
1969
Photo Revised 1979

PSC PHILIP SERVICES CORP

TITLE:
SHELL EXPLORATION & TECHNOLOGY COMPANY
GRIMES BATTERY
SITE LOCATION MAP

DWN:	DES.:
CHKD: seh	APPD: seh
DATE: FEB. 1998	REV.: 1

PROJECT NO.: 18906
GRIMES ASSESSMENT
Hobbs, New Mexico

FIGURE 1

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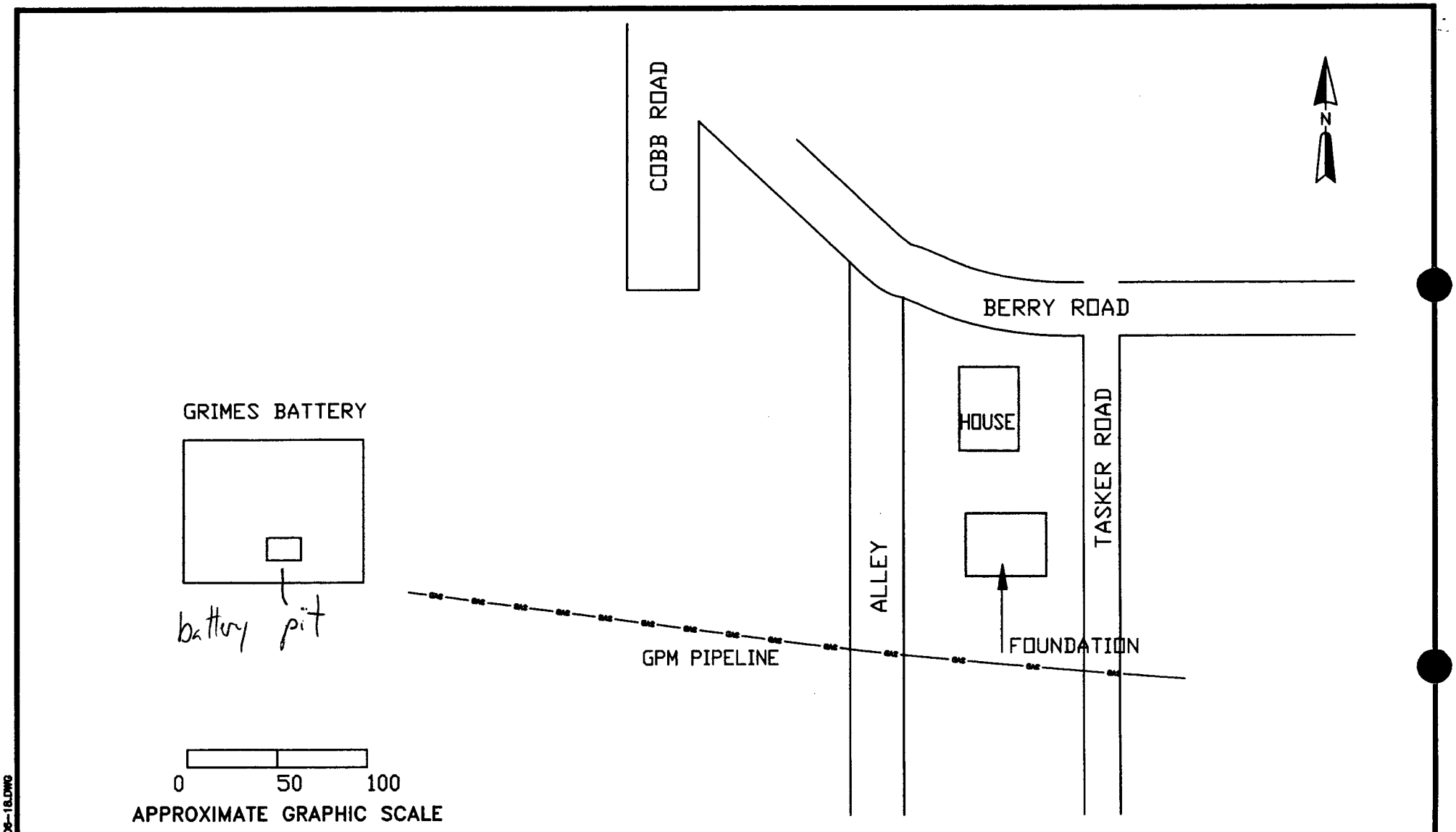
ko



TITLE:
SHELL EXPLORATION & TECHNOLOGY COMPANY
GRIMES BATTERY & TASKER ROAD
HOBBS, NEW MEXICO

DWN:	DES.:	PROJECT NO.: 18906
ko	seh	GRIMES BATTERY Hobbs, NM
CHKD:	APPD:	
seh	seh	FIGURE 4
DATE:	REV.:	
Mar. 1998	1	

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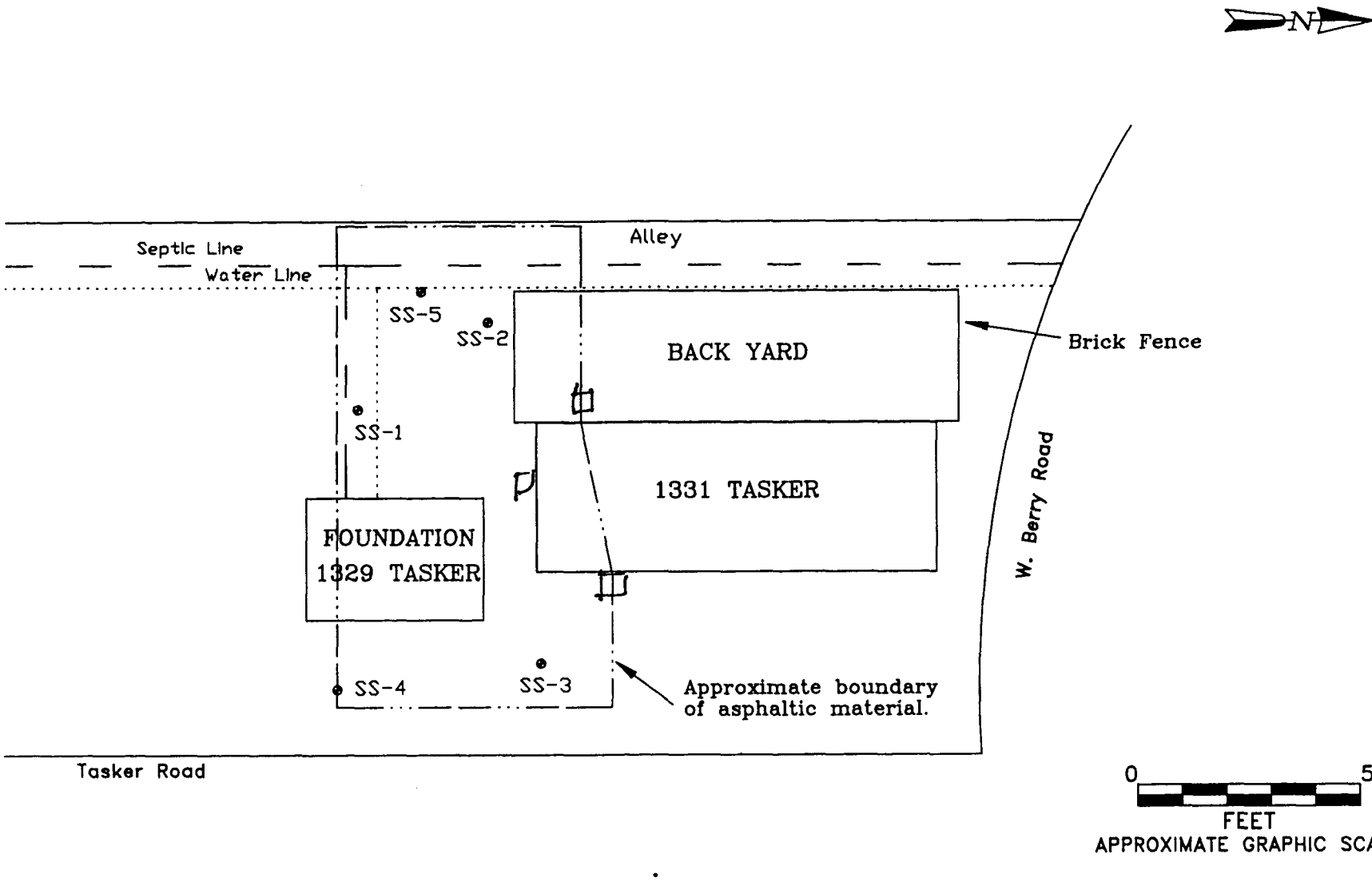

PHILIP SERVICES CORP

TITLE:

SHELL EXPLORATION & TECHNOLOGY COMPANY
TASKER ROAD
VISIBLE EXTENT OF ASPHALTIC MATERIAL

DWN:	DES.:	PROJECT NO.: 18906
koa	jwk	TASKER ROAD Hobbs, New Mexico
CHKD: seh	APPD: seh	
DATE: Jan 1998	REV.: 2	FIGURE 3

C:\PROJECTS\18906\18906-5.DWG

ko

Table 1
FIELD OBSERVATION OF SAMPLES

Sample ID	Staining	Odor	PID Reading
SS-1, 2-3 feet	Asphaltic Material	Hydrocarbon	8 du*
SS-1, 5 feet	None observed	Hydrocarbon	50 du
SS-2, 2-3 feet	Asphaltic	Hydrocarbon	346 du
SS-2, 6 feet	None observed	Hydrocarbon	511 du
SS-3, 2-3 feet	Asphaltic	Hydrocarbon	189 du
SS-3, 5.5 feet	None observed	Hydrocarbon	178 du
SS-4,1 foot	Asphaltic	Hydrocarbon	0 du
SS-4, 5 feet	None observed	Hydrocarbon	1 du
SS-5, 2 feet	Asphaltic	Hydrocarbon	60 du
SS-5, 5 feet	None observed	Hydrocarbon	320 du

* du = Deflection Units

Each of the samples were submitted to Trace Analysis in Lubbock, Texas for analysis of the compounds listed in New Mexico Water Quality Control Commission, Title 20, Chapter 6, Part 2, sections 3103 and 1101 (20 NMAC 6.2. 3103 and 1101) as requested by the NMOCD. Analytical results are discussed in Section 5.0 and included in **Appendix IV**.

4.2 DELINEATION

Philip representatives returned to the site on January 26, 1998 to perform additional site assessment activities. The purpose of this investigation was to identify the horizontal extent of the asphaltic material based on visual observation. A backhoe was used to trench the site, thereby allowing visual observation of the presence or absence of the asphaltic material. No samples were collected during this phase of the investigation. **Figure 3** is a site map depicting the horizontal extent of the asphaltic material as observed in the field.

TABLE 2
SUMMARY OF ANALYTICAL RESULTS

ANALYTE	SAMPLE IDENTIFICATION									
	SS-1 @ 2-3' (mg/kg)	SS-1 @ 5' (mg/kg)	SS-2 @ 2-3' (mg/kg)	SS-2 @ 6' (mg/kg)	SS-3 @ 2-3' (mg/kg)	SS-3 @ 5.5' (mg/kg)	SS-4 @ 1' (mg/kg)	SS-4 @ 5' (mg/kg)	SS-5 @ 2' (mg/kg)	SS-5 @ 5' (mg/kg)
EPA Method 8260										
1,1,1,2-Tertachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3-Trichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dibromo-3-chloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dibromoethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,2-Dichloropropane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chlorotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chlorotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Isopropyltoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = NOT DETECTED

TABLE 2
SUMMARY OF ANALYTICAL RESULTS

ANALYTE	SAMPLE IDENTIFICATION									
	SS-1 @ 2-3' (mg/kg)	SS-1 @ 5' (mg/kg)	SS-2 @ 2-3' (mg/kg)	SS-2 @ 6' (mg/kg)	SS-3 @ 2-3' (mg/kg)	SS-3 @ 5.5' (mg/kg)	SS-4 @ 1' (mg/kg)	SS-4 @ 5' (mg/kg)	SS-5 @ 2' (mg/kg)	SS-5 @ 5' (mg/kg)
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromomethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	7.00	9.70	1.40	0.66	ND	ND	0.100	9.200
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isopropylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
m & p-Xylene	ND	ND	31.00	37.00	4.90	2.00	ND	ND	0.130	39.000
Methylene chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
n-Butylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
n-Propylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
o-Xylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
sec-Butylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Styrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
tert-Butylbenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND	ND	ND	ND	0.540	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,2-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorofluoromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EPA Method 8270										
1,2,4,5-Tetrachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Chloronaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Napthylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,3,4,6-Tetrachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = NOT DETECTED

TABLE 2
SUMMARY OF ANALYTICAL RESULTS

ANALYTE	SAMPLE IDENTIFICATION									
	SS-1 @ 2-3' (mg/kg)	SS-1 @ 5' (mg/kg)	SS-2 @ 2-3' (mg/kg)	SS-2 @ 6' (mg/kg)	SS-3 @ 2-3' (mg/kg)	SS-3 @ 5.5' (mg/kg)	SS-4 @ 1' (mg/kg)	SS-4 @ 5' (mg/kg)	SS-5 @ 2' (mg/kg)	SS-5 @ 5' (mg/kg)
2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dichlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Napthylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Picoline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3,3-Dichlorobenzidine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-Methylcholanthrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,6-Dinitro-2-methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Aminobiphenyl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Bromophenyl-phenylether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chloroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chlorophenyl-phenylether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol/3-Methylphenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitroaniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
7,12-Dimethylbenz(a)anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
a,a-Dimethylphenethylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acetophenone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aniline	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzidine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[a]anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[a]pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[b]fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[g,h,i]perylene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[k]fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzoic acid	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

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SUMMARY OF ANALYTICAL RESULTS

ANALYTE	SAMPLE IDENTIFICATION									
	SS-1 @ 2-3' (mg/kg)	SS-1 @ 5' (mg/kg)	SS-2 @ 2-3' (mg/kg)	SS-2 @ 6' (mg/kg)	SS-3 @ 2-3' (mg/kg)	SS-3 @ 5.5' (mg/kg)	SS-4 @ 1' (mg/kg)	SS-4 @ 5' (mg/kg)	SS-5 @ 2' (mg/kg)	SS-5 @ 5' (mg/kg)
Benzyl alcohol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethoxy)methane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Chloroethyl)ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-chloroisopropyl)ether	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Butylbenzylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-octlphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenz[a,h]anthracene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzo(a,j)acridine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dimethylphthalate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diphenylhydrazine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno[1,2,3-cd]pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isophorone	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl methanesulfonate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitroso-di-n-butylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
n-Nitrosodi-n-propylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
n-Nitrosodiphenylamine & Diphenyl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosopiperidine	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
p-Dimethylaminoazobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachloronitrobenzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenacetin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND = NOT DETECTED

TABLE 2
SUMMARY OF ANALYTICAL RESULTS

ANALYTE	SAMPLE IDENTIFICATION									
	SS-1 @ 2-3' (mg/kg)	SS-1 @ 5' (mg/kg)	SS-2 @ 2-3' (mg/kg)	SS-2 @ 6' (mg/kg)	SS-3 @ 2-3' (mg/kg)	SS-3 @ 5.5' (mg/kg)	SS-4 @ 1' (mg/kg)	SS-4 @ 5' (mg/kg)	SS-5 @ 2' (mg/kg)	SS-5 @ 5' (mg/kg)
Phenanthrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenol	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pronamide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EPA METHODS 200.7, 245.1)										
Aluminum (Al)	4,900	4,700	1,900	4,100	5,800	5,700	9,200	7,500	7,800	4,200
Arsenic (As)	ND	ND	ND	ND	ND	3.8	ND	ND	ND	<0.50
Barium (Ba)	87	320	37	650	130	170	95	310	73	73
Boron (B)	ND	ND	ND	ND	ND	ND	ND	ND	ND	<10
Cadmium (Cd)	ND	ND	ND	ND	ND	ND	0.06	0.21	0.06	<0.05
Chromium (Cr)	ND	ND	ND	ND	ND	ND	ND	ND	ND	<10
Colbalt (Co)	ND	ND	ND	ND	ND	ND	ND	ND	ND	<10
Copper (Cu)	13	ND	ND	ND	ND	ND	ND	ND	ND	<10
Iron (Fe)	7,300	3,300	1,800	2,400	5,900	4,300	7,600	5,500	5,800	2,800
Lead (Pb)	ND	ND	ND	ND	ND	ND	ND	ND	ND	<10
Manganese (Mn)	91	38	47	20	93	51	120	60	81	19
Molybdenum (Mo)	ND	ND	ND	ND	ND	ND	ND	ND	ND	<2.0
Nickel (Ni)	11	6.1	7.6	8.1	8.9	6	9	7.7	7.1	6.1
Selenium (Se)	ND	ND	ND	ND	ND	1.8	ND	ND	ND	<1.0
Silver (Ag)	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.50
Zinc (Zn)	21	9.5	6.7	6.6	17	14	22	15	17	6.9
EPA METHODS SW 846-3051, 6010B, 7471.										
TOTAL Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TOTAL U	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EPA METHODS SW 846-3550, 8080										
TOTAL PCB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EPA METHODS: 150.1, 160.1, 375.4, SM 4500 CI-B, 353.3, 335.2, 340.2.										
CHLORIDE	340	220	300	350	120	79	39	59	99	260
CYANIDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FLUORIDE	0.26	8.0	0.77	11	0.85	3.3	0.92	7.0	0.66	11
N03-N	0.64	ND	ND	ND	ND	ND	0.40	2.5	ND	ND
pH	8.1	7.9	8.4	9.2	8.2	8.1	7.8	8.1	7.7	9.2
SULFATE	702	240	590	82	350	310	880	720	860	36
TDS	1,600	900	2,600	2,000	2,000	2,200	2,400	3,000	2,800	1,700
EPA METHODS 3550, 418.1										
TRPHC	24,800	14,100	200,000	30,900	134,000	21,900	2,930	1,800	68,200	50,200

ND = NOT DETECTED

TABLE 2
SUMMARY OF ANALYTICAL RESULTS

ANALYTE	SAMPLE IDENTIFICATION									
	SS-1 @ 2-3' (mg/kg)	SS-1 @ 5' (mg/kg)	SS-2 @ 2-3' (mg/kg)	SS-2 @ 6' (mg/kg)	SS-3 @ 2-3' (mg/kg)	SS-3 @ 5.5' (mg/kg)	SS-4 @ 1' (mg/kg)	SS-4 @ 5' (mg/kg)	SS-5 @ 2' (mg/kg)	SS-5 @ 5' (mg/kg)
EPA METHOD 901.1M										
	pCi/gm	**pCi/gm**	**pCi/gm**	**pCi/gm**	**pCi/gm**	**pCi/gm**	**pCi/gm**	**pCi/gm**	**pCi/gm**	**pCi/gm**
Ra-226	ND	ND	2.17	ND	ND	ND	ND	ND	ND	ND
Ra-228	ND	ND	ND	ND	0.78	ND	1.28	ND	0.76	ND
	Bq/gm	**Bq/gm**	**Bq/gm**	**Bq/gm**	**Bq/gm**	**Bq/gm**	**Bq/gm**	**Bq/gm**	**Bq/gm**	**Bq/gm**
Ra-226	ND	ND	0.08	ND	ND	ND	ND	ND	ND	ND
Ra-228	ND	ND	ND	ND	0.029	ND	0.047	ND	0.028	ND

ND = NOT DETECTED

3/12/98 OCD/Shell meeting
George DeVaull handout #1

Risk-Based Assessment of Soils

for

HOBBS TASKER ROAD SITE
Hobbs, New Mexico

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Table of Contents

Figures & Tables

Attachments

Executive Summary

This document is an assessment of possible human health risks or hazards due to soils at a site within the lot boundaries of 1331 and 1329 Tasker Road, Hobbs, NM. The evaluation was initiated after discovery of an asphalt-like layer, 2 to 3 feet below the soil surface, within a portion of the site.

Soil samples at five places and two depths (approximately 2 ft and 5 ft below the surface) have been taken from the site and analyzed for a range of chemical constituents in accordance with 20 NMAC 6.2 3103 and 1101. This includes all chemical analyses relevant to the identified previous site use.

For individual indicator chemicals, Risk-Based Screening Level (RBSL) concentration criteria are used in the assessment, in comparison with the relevant site data. For petroleum hydrocarbons in soils, a risk-based assessment of the mixture was completed, consistent with recently developed methodology (Weisman, 1998).

Of the chemicals detected, Total Petroleum Hydrocarbons (TPH) was found in a range of approximately 4000 mg/kg to 200000 mg/kg TPH. Acceptable average concentrations of TPH at the site, available for direct-contact exposure -- that is, at the soil surface -- range from approximately 7400 to 9900 mg/kg TPH. This estimate is based on measured site-specific composition of the TPH, conservative upper-bound residential site use exposure assumptions, and conservative estimates of non-carcinogenic human health effects for petroleum hydrocarbons. Human health risk due to indirect exposure to TPH at the levels currently in site soils, such as inhalation of evolved vapors or leaching from soil to groundwater, was found to be insignificant.

Concentrations of individual organic chemicals, including ethylbenzene and m- and p-xylenes detected at the site were all found to either be below the relevant RBSL criteria, or not present at levels of concern. No other individual organic chemicals were found above detection limits at the site, or at levels of concern. No other individual VOCs, SVOCs, PAHs, chlorinated compounds, or pesticides were detected in any soil samples. For inorganic chemicals, including metals, concentrations were either below the relevant RBSL criteria or present at levels consistent with natural background concentrations in soils.

The conservative risk-based screening level criteria used in this assessment are defined for a carcinogenic risk level of 10^{-6} or a non-carcinogenic hazard quotient of unity (HQ = 1) for individual chemicals. Reasonable assumptions for possible chemical transport pathways and upper-bound estimates for possible exposure scenarios (overpredicting exposure) at this site have been used throughout the analysis. All calculations, estimates, and parameters which have been used in this assessment are consistent with current USEPA risk assessment guidance.

Site Description and History

The site under analysis falls within the adjacent residential lots at 1331 and 1329 Tasker Road, Hobbs, NM. One site is currently occupied; one is currently under construction. During recent construction, an asphalt-like layer, 2 to 3 feet below the soil surface, was discovered within a portion of the site. The approximate boundary of the asphalt-like layer has been delineated, and soils within the identified boundary have been sampled and analyzed (Phillip Services, Feb. 1998: Tasker Road Site Assessment Report). Figure 1 is a map of the site vicinity. Figure 2 shows site detail, including the asphalt-like layer boundary and the soil sampling locations.

Previous Site Use

Beginning in the mid 1940s and continuing to 1993, the area adjacent to and previously including the site had been in crude oil production. Operations in the immediate area of the site (see Figure 1) had included several producing oil wells; a central production facility, including crude oil storage tanks; flow lines joining the wells and the central production facility; and a trunk line leading to another remote production facility. By common practice, oil produced from the site was transported off-site by underground pipeline over the duration of operations. Prior to the 1950s, water produced with the oil was separated and was likely disposed of in on-site pits. From the 1950s to the 1980s, produced water was transported off site to an underground injection well.

According to affidavit (Philip Services, 1998: Grimes Battery Soil and Water Assessment Report) the site under investigation was not used historically for waste disposal purposes.

Geologic and Hydrogeologic Summary

The site is located in an area of generally flat topography. The nearest surface water (identified from the topographic USGS quadrangle map for Hobbs West, N. Mex.) is a pond, approximately 0.5 acre in area, 0.4 miles from the site. There is no direct pathway for rain water runoff from the site to this surface water.

From National Oceanic and Atmospheric Administration data (http://www.cdc.noaa.gov), records (Wink, Winkler, TX and Midland, TX) in the vicinity of Hobbs, NM (approximately 32°42'30"N, 103°07'30"N), we find for the local area:

Mean Annual Precipitation: 12 to 15 inches
Mean Annual Snowfall: 3.3 to 4.8 inches
Maximum Temperature: 112 F (1961 to 1990)
Minimum Temperature: -11 to 2 F (1961 to 1990)

Given the relatively low rainfall and dry climate, net infiltration of rainwater in the vicinity of the site, through unsaturated soils to groundwater will be minimal, and in any case, will be a small fraction of the total annual rainfall.

Based on recent borings and installation of a groundwater monitoring well approximately 400 ft west of the site (Philip Services, Feb. 1998: Grimes Battery Soil and Water Assessment Report),

depth to ground water at this site is expected to be about 65 ft. Unsaturated zone stratigraphy at the site, from below any surface fill to groundwater at 65 ft, is expected to consist of intermixed layers of fine-grain silty sand, buff limestone (hard), fine-grain silty sand with chert, and fine-grain sand with sandstone intermixed.

Potential Exposure Pathways

A risk-based assessment requires identification of potential sources, exposure pathways, and receptors for the site. These are shown for the site in the conceptual model diagram of Figure 3. This flowchart is similar to the generic site conceptual model in the American Society for Testing and Materials Standard, *Risk-Based Corrective Action Applied at Petroleum Release Sites* (ASTM E 1739-95). The ASTM standard is consistent with USEPA guidance on risk assessment and was developed in consensus by a group comprised of representatives from USEPA, state regulatory agencies, state cleanup funds, environmental consulting firms, and petroleum, insurance, and banking industries.

The potential sources in the area of concern are based on previous site use. The chemicals of potential interest are those likely originating from historical oil field operations, primarily crude oil and its chemical components, and produced water, including salts. Relevant indicator compounds for crude oil potentially include benzene, ethyl benzene, toluene, xylenes, and polycyclic aromatic hydrocarbons. Other individual chemicals have also been included in the sample analysis, as shown in the list of Table 1, in accordance with 20 NMAC 6.2 3103 and 1101. The complete chemical analyte list is included in the site report (Phillip Services, Feb. 1998: Tasker Road Site Assessment Report).

The site currently includes residential development. Relevant exposure pathways for evaluating potential human exposure, as shown in Figure 3, for this site include:

1) Potential exposure to surficial soils, including combined soil ingestion, dermal contact, dust inhalation, and inhalation of volatiles, for residential receptors.

2) Potential exposure to volatile emissions from subsurface soils, through inhalation, for residential receptors.

3) Potential aqueous leaching of chemicals from soil to groundwater, with ingestion of groundwater. According to diagram (Phillip Services, Feb. 1998: Tasker Road Site Assessment Report), residents in the immediate area are supplied by municipal water. However, use of well water for drinking water use is not known to be precluded (by ordinance or restriction) in the immediate area.

4) Potential mobility of non-aqueous phase liquids (crude oil) in unsaturated soils. As in (3) the potential concern is with groundwater, but in terms of bulk migration of crude oil to ground water.

Each of the above four exposure scenarios is evaluated separately; results from each individual exposure pathway scenario are not summed. That is, the resident who may be exposed in (1) to surface soils is a different individual than the receptor who might be exposed in (3) to drinking water. The long-term residential receptor for scenario (2) is a subset of scenario (1) for the case where there is no direct contact with surficial soils. These relevant exposure routes and pathways

have been addressed in this assessment using risk assessment methodology consistent with USEPA Risk Assessment Guidance (USEPA, 1996; USEPA, 1991), with ASTM Standard E 1739-95, and with 20 NMAC 6.2.

Risk-Based Assessment

The risk-based assessment in this evaluation includes two parts. The first is an evaluation of detected individual indicator chemicals. These are handled with conventional risk assessment methodology, using conservative risk-based screening level (RBSL) concentrations. The second is an evaluation of the crude oil. Crude oil is a mixture of many thousands of petroleum hydrocarbon chemical constituents; evaluating each individual chemical using conventional risk assessment methods is impracticable. In this analysis we have used methodology developed by the Total Petroleum Hydrocarbon Working Group, for risk-based assessment of "Total Petroleum Hydrocarbon", or TPH (Weisman, 1998).

individual indictor chemicals

The equations and parameters used in estimating human health risk in this assessment are consistent with USEPA guidance. Generally, risk or hazard can be estimated as the product of concentration and toxicity:

$$\text{Risk} = \text{Concentration} \cdot \text{Toxicity}$$

For individual constituents, the estimate can be inverted -- a target risk (or hazard) is specified, and an acceptable concentration in the media of interest is estimated:

$$\text{Concentration} = \frac{\text{Risk}}{\text{Toxicity}}$$

We have followed this convention, which is consistent with ASTM Standard E 1739-95, *Risk-Based Corrective Action Applied at Petroleum Release Sites*, in defining concentration levels, or Risk-Based Screening Levels (RBSLs) which meet the desired risk or hazard targets for individual chemical constituents. Site concentrations in soil which are at or below this risk-based screening level concentration will meet the desired target risk.

A tiered assessment process is introduced in ASTM E 1739-95. This tiered approach is used in the present assessment. The first step, or tier, is in development of RBSLs applicable for all project areas using conservative, generic parameters and site assumptions. A refinement of the assessment, in calculating site-specific screening levels using site-specific information, is applied only to that portion of the measured concentration data which exceeds the generic RBSLs. This 'tiered' assessment expedites and simplifies the risk assessment process, with no loss in conservatism nor a loss in comprehensiveness.

All screening levels for individual chemicals used in this assessment are defined at the lower limit of the 10^{-4} to 10^{-6} acceptable risk range for carcinogens, or at a conservative risk level of 10^{-6}. For non-carcinogens, a hazard quotient of unity (HQ = 1) is specified. The screening level concentrations shown in Table 2 for the relevant exposure pathways and each chemical are the lowest calculated values for either the relevant carcinogenic or non-carcinogenic criteria.

Descriptions and reference for selected exposure factors, transport parameters, toxicity, and models, is presented in Attachment 2. This table is complete and up-to-date with respect to the current (30 September 1997) toxicological parameters available from the USEPA IRIS and

HEAST databases. The assumptions used in the models are generally conservative. Conservative upper-bound exposure parameters are defined for a Reasonable Maximum Exposure (RME). Transport assumptions used for the applicable exposure pathways (and documented in Attachment 1) are as follows:

1) Potential exposure to surficial soils due to combined soil ingestion, dermal contact, dust inhalation, and inhalation of volatiles, for a residential receptor. For soil ingestion, dermal contact, and dust inhalation, soil concentrations are assumed to remain at their original levels over the entire 25 year exposure period. For volatilization, soil concentrations are assumed to start at their initial concentration level, with a reduction in emissions over time as the volatile chemicals are depleted in the surface soil layer through the volatilization process. For this exposure pathway, the potential exposures due to soil ingestion, dermal contact, dust inhalation, and vapor inhalation are summed to determine an overall acceptable concentration level.

2) Potential exposure to volatile emissions from subsurface soils, through inhalation, for a residential receptor. The exposure duration for this scenario is assumed to be 25 years. The chemical is assumed to remain constant at its initial concentration over the exposure duration (an infinite source), with diffusion to the breathing zone through a one-meter layer of soil. Potential exposure for both indoor and outdoor air are included.

3) Aqueous leaching of chemicals from soil to ground water, with subsequent ingestion of ground water. The chemical is assumed to remain at constant levels in soil in this scenario. Conservative physical parameters are used in relating soil concentration to ground water concentrations directly below the source area. No additional dilution or attenuation for a spatially separated source area and ground water well is included in the modeling.

Concentrations used in deriving the RBSLs are defined as average concentrations over the site. In application, we first make comparisons of actual site sample analyses (point samples) directly to these RBSLs.

petroleum hydrocarbon mixtures

Risk-based assessment of petroleum hydrocarbon mixtures in soil at this site are included in the present evaluation, consistent with methodology discussed by Weisman (1998). In this evaluation, each soil sample was analyzed for TPH (total petroleum hydrocarbons) using gas chromatography / flame ionization detection in a simulated distillation analysis. This analysis yields a fractional distribution of the petroleum as a function of boiling point, molecular weight, or carbon number. These data were subsequently divided into an aliphatic fraction and an aromatic fraction determined from previous analysis of crude oils produced in the vicinity of Hobbs, NM. The result, for each TPH analysis, is a total of 13 aliphatic and aromatic petroleum fractions.

The toxicity of each petroleum fraction is conservatively assigned based on the non-carcinogenic toxicity of similar petroleum hydrocarbon chemicals within the fraction (TPHCWG, 1997, v. 4). Average properties for estimating fate and transport are also assigned to each fraction (TPHCWG, 1997, v. 3).

For each of the petroleum fractions, receptor point concentrations, C_i, (in air, water, and soil at the point of exposure) are estimated for each of the sample transport and exposure pathways identified in Figure 3, and which were discussed in the last section. A hazard quotient (HQ) is calculated for each fraction,

$$HQ_i = \frac{C_i}{RBSL_i}$$

where $RBSL_i$ is a risk-based screening level estimated for each petroleum fraction (in air, water, and soil at the point of exposure). A sum, or hazard index, HI, is calculated

$$HI = \sum_{n=1}^{13} HQ_i$$

The TPH screening level in soil is exceeded when the summed HI value is greater than one. Acceptable TPH concentrations for the petroleum mixture are estimated by fixing HI = 1 and the relative distribution of petroleum fractions, and varying (in calculation) the total TPH concentration in soil. The physical calculations are similar to those used for individual chemicals, but include mixture effects as discussed by Mariner (1997), Mott (1995), and Johnson (1990).

Analytical Summary

Soil samples at five places and two depths (approximately 2 ft and 5 ft below the surface) have been taken from the site and analyzed for a range of chemical constituents. A map of the sample locations is included as Figure 2. A concise list of the analytical methods and results of the analysis is given in Table 1. Detailed reporting of the results, including lists of all chemicals in the analyte list, is included in Phillip Services, Feb. 1998: Tasker Road Site Assessment Report. Further discussion in the present section is limited to chemicals which were found in site soils above analytical detection limits.

The individual detected chemicals included several organic compounds, mainly constituents of petroleum; metals and salts; and petroleum hydrocarbons. For VOCs, the detected chemicals include:

name:	range:	detected:
ethylbenzene	0.1 to 9.7 mg/kg	6 of 10 samples
m- & p-xylenes	0.13 to 39 mg/kg	6 of 10 samples
tetrachloroethene	0.54 mg/kg	1 of 10 samples

No other individual VOCs, SVOCs, PAHs, chlorinated compounds, or pesticides were detected in any samples. Two methods of analysis were used for petroleum hydrocarbons. Detection was shown in ten of ten soil samples, with results as follows:

name:	range:	detected:
Total Recoverable Petroleum Hydrocarbons (freon soil extraction, infrared detection)	1800 to 200000 mg/kg	10 of 10
Petroleum Hydrocarbons - simulated distillation analysis (carbon disulfide extraction, GC/FID analysis)	4000 to 182000 mg/kg	10 of 10

More detail for the simulated distillation analysis is shown in Attachment 1. For total metals, analysis results above detection limits showed results of:

name:	range:	detected:
arsenic (As)	3.8 mg/kg	1 of 10
selenium (Se)	1.8 mg/kg	1 of 10
cadmium (Cd)	0.06 to 0.21 mg/kg	3 of 10
barium (Ba)	37 to 650 mg/kg	10 of 10
nickel (Ni)	6 to 11 mg/kg	10 of 10
zinc (Zn)	6.7 to 22 mg/kg	10 of 10
aluminum (Al)	1900 to 9200 mg/kg	10 of 10
iron (Fe)	1800 to 7600 mg/kg	10 of 10
manganese (M)	19 to 120 mg/kg	10 of 10
copper (Cu)	10 mg/kg	1 of 10

For radium, analysis showed

name:	range:	detected:
Radium-226 (Ra226)	2.17 pC/g	1 of 10
Radium-228 (Ra228)	0.76 to 1.28 pC/g	3 of 10

No other metals or naturally occurring radioactive materials were detected. We note that many of metals are ubiquitous and present naturally in soils, discussion of which will be continued in the next section.

An ion and pH analysis on soils was also included. Results showed

name:	range:	detected:
chloride	39 to 350 mg/kg	10 of 10
fluoride	0.26 to 11 mg/kg	10 of 10
nitrate-N	0.4 to 2.5 mg/kg	3 of 10
sulphate	36 to 880 mg/kg	10 of 10
TDS	900 to 3000 mg/kg	
pH	7.7 to 9.2	

As with metals, all the detected ions are present naturally in soils. Analysis of ions is relevant not for human health (at least not at levels detected in these soils), but may help in determining the agricultural viability of the soil.

Risk-Based Evaluation

As discussed earlier, this assessment includes two parts: (1) evaluation of individual indicator chemicals, and (2) evaluation of the petroleum hydrocarbon mixture.

individual indictor chemicals

The detected chemical constituents at this site have been compared to derived risk-based screening level (RBSL) concentrations. The parameters and methodology for deriving the RBSL

values is discussed in Attachment 2, and is consistent with ASTM E 1739-95. Results of the comparison are shown in Table 2.1 to 2.2. The following discussion includes explanation and, where appropriate, discussion of refined modeling for chemicals which are flagged in the screening-level comparison.

organic chemicals

ethylbenzene and m- & p-xylenes - as shown in Table 2.1-a and 2.1-b, none of the detected chemical concentrations exceeded any RBSL value for any relevant exposure pathway. Therefore both ethylbenzene and m- & p-xylenes will not be considered further in this assessment as individual chemicals. They are considered as part of the evaluation of petroleum hydrocarbon mixtures in the next section.

tetrachloroethene - the screening comparison for this chemical in Table 2.1-a and 2.1-b shows exceedence of screening levels for leaching to ground water and indoor vapor exposure. However, given (1) the low frequency of detection (one in ten samples), (2) the low measured concentration level relative to the detection limit, and (3) that there is no reason to believe that the chemical may be present at the site, all three criteria in USEPA (1989, sec 5.9.3) guidance are met for eliminating this particular chemical from further investigation.

metals and naturally occurring radioactive material (NORM)

Many of the detected metals listed in Table 2.2a and 2.2b show no exceedence of conservative RBSL concentrations for any relevant exposure pathway. These metals are not considered further in this assessment. Several detected metals, including iron, aluminum, and manganese do not have RBSL values for soils. These metals (as oxides and salts) are natural constituents of mineral soil content. They will not be considered further in this assessment. Where available, nominal average natural background concentrations of metals are included in the comparison of Table 2.2b.

In investigation of naturally occurring radioactive material (NORM), the analysis show detection of both radium-226 and radium-228 for several samples. No other NORM material was detected. All sample concentrations were below the lowest NORM criteria cited for unrestricted site use, as presented in the review by White (1992).

arsenic - the screening comparison for arsenic is exceeded for surficial soils and leaching from soils to ground water. We note that the frequency of detection for this chemical is low (one in ten samples) and the measured concentration is within the average background level for arsenic. Given this information, arsenic will not be evaluated further in this assessment.

selenium - the screening comparison for selenium is exceeded for leaching from soils to ground water. The frequency of detection for this chemical is low (one in ten samples). We have refined the comparison for this chemical by using an average site concentration (linear average, including half detection limit for non-detected samples), and by using a soil/water partition coefficient (Davidoff, 1989) derived from experimental data, rather than the calculated value (USEPA, 1996) used in the initial screening. With this refinement, selenium is shown not to be of concern for the potential leaching to groundwater exposure pathway.

barium - the screening comparison for barium is exceeded for leaching from soils to ground water. We have refined the comparison for this chemical by using an average site concentration

(linear average, including half detection limit for non-detected samples). With this refinement, barium is shown not to be of concern for the potential leaching to groundwater exposure pathway. We also note that sulfate found in the ion analysis (Phillip Services, Feb. 1998: Tasker Road Site Assessment Report) would suggest that the barium found in soil is tied up as relatively insoluble barium sulfate, and is not likely to leach to ground water.

petroleum hydrocarbon mixtures

Petroleum hydrocarbons (TPH) were detected in ten of ten soil samples analyzed in this assessment. The chemical analysis included freon extraction and infrared detection (EPA method 418.1) as well as carbon disulfide extraction with gas chromatographic / flame ionization detection (Triton Analytics, 16 Feb 1998). The second method produces a high temperature simulated distillation, or boiling point distribution of petroleum. This risk-based assessment uses the boiling point distribution results.

In data analysis for each sample, the recovered hydrocarbons were organized into 13 aliphatic and aromatic petroleum fractions, as follows:

name	average carbon number
EC 5 to 6 aliphatic	C5.5
EC >6 to 8 aliphatic	C7
EC >8 to 10 aliphatic	C9
EC >10 to 12 aliphatic	C11
EC >12 to 16 aliphatic	C14
EC >16 to 21 aliphatic	C19
Benzene (EC 5 to 7) aromatic	C6.5
Toluene (EC >8 to 10) aromatic	C7.6
EC > 8 to 10 aromatic	C9
EC > 10 to 12 aromatic	C11
EC >12 to 16 aromatic	C14
EC >16 to 21 aromatic	C19
EC >21 to 35 aromatic	C28

More detail for the simulated distillation analysis and the fraction assignment is shown in Attachment 1, including data plots. We note that because no benzene or toluene was detected in any VOC analysis of the soil samples (Phillip Services, Feb. 1998: Tasker Road Site Assessment Report), no mass was assigned to these aromatic fractions in the data reduction. The assigned aromatic/aliphatic split was based on previous analysis of fresh crude oil produced from the Hobbs, NM area. The high temperature simulated distillation produces results up to apparent boiling points greater than 1000 degC, or equivalent to n-paraffins with carbon numbers up to greater than C100. A fraction of hydrocarbon in the simulated distillation results is heavier than the last fraction in the above list. This has been included in the heaviest fractions of the 13 cut distribution. No fraction of the analysis result is neglected in the data analysis.

Calculated hazard index (HI) values for each of the TPH analyses are shown in Table 3.1a and 3.1b for the same exposure pathways used in the previous indicator chemical analysis and illustrated in Figure 3.

From Table 3, we find that, in no case, is TPH a concern for either the leaching to ground water or vapor inhalation exposure pathways. For direct exposure to surficial soils, nine of ten soil samples listed in Table 3 show a calculated HI value greater than one. Where HI > 1, acceptable TPH soil concentrations, based on human health risk, have been estimated. These values range from 7400 to 9900 mg/kg TPH. This range of surficial soil screening levels is compared to the EPA Method 418.1 TPH results in Table 3. The results are reasonably consistent; in 9 of 10 comparisons the sample screening results are in agreement for both analysis methods.

We note that the potential surficial soil exposure pathway includes summed exposure due to direct ingestion of soils, direct dermal contact with soils, inhalation of vapors from soils, and inhalation of dust from soils. For the samples analyzed, the direct exposure routes (ingestion and dermal) account for 99.9% to 99.8% of total potential exposure.

mobility of petroleum hydrocarbons

Petroleum hydrocarbons, when released, can possibly leach as a non-aqueous phase liquid (NAPL) through unsaturated soils to ground water. A NAPL may be present in unsaturated soil, but may still be relatively immobile. The mobility of a NAPL is not governed by thermodynamic properties, but by capillary, viscous, and gravity forces acting on the bulk NAPL phase.

In this investigation, the determination of mobility for the identified petroleum hydrocarbon is qualitative. The site investigation report (Phillip Services, Feb. 1998: Tasker Road Site Assessment Report) describes the material as asphalt-like, with no report of flowing liquid. The simulated distillation results (Attachment 1) show weathered petroleum hydrocarbons which are depleted in light hydrocarbons and which include a significant fraction of heavy, high-boiling point material. Based on this observation, there is a very low likelihood of further migration of this petroleum in soil.

Conclusions

The present report is a screening-level risk-based assessment of conditions at a site within the lot boundaries of 1331 and 1329 Tasker Road, Hobbs, NM. The evaluation was initiated after discovery of an asphalt-like layer, 2 to 3 feet below the soil surface, within a portion of the site.

Based on sampling, analysis, and investigation, the primary potential concern at this site is long-term direct contact exposure to petroleum hydrocarbons (TPH) in the soil. Current concentrations of TPH in soil samples in a horizon 2 ft to 5 ft below the site surface range from approximately 4000 mg/kg to 200000 mg/kg TPH.

Acceptable average concentrations of TPH at the site, potentially available for direct-contact exposure -- that is, at the soil surface -- range from approximately 7400 to 9900 mg/kg TPH. This estimate is based on measured site-specific composition of the TPH, conservative upper-bound residential site use exposure assumptions, and conservative estimates of non-carcinogenic human health effects for petroleum hydrocarbons.

Several individual organic chemicals were detected with frequency in site samples, including ethylbenzene and xylenes. These chemicals are expected components of crude oil, and neither is present at levels of concern. No other individual organic chemicals were found above detection

limits at the site, or at levels of concern. No other individual VOCs, SVOCs, PAHs, chlorinated compounds, or pesticides were detected in any soil samples.

Potential aqueous leaching from soil to groundwater and potential evolution of vapors from soils, either to outdoors or indoors, was found to not be significant for any detected organic chemical, or for TPH, in a conservative estimates of potential human health effects.

Several inorganic chemicals and metals were detected in soils at the site. These were found to either be within normal background concentrations, or within acceptable levels, in all cases.

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Table 1. Summary of Chemical Analysis Methods and Results for Soil Samples.

chemical analysis	method	analyzed	detected	notes
Pesticides	EPA 8081A	■	❑	no detection
Chlorinated Pesticides and Polychlorinated Biphenyls (PCBs)	EPA 8080	■	❑	no detection
Volatile Organic Chemicals (VOCs), including benzene, toluene, ethylbenzene, and xylenes	EPA 8260	■	■	ethylbenzene, m- & p-xylenes tetra-chloroethene
metals	EPA 200.7, 245.1	■	■	see text
total U, Hg	6010B, 7471	■	❑	no detection
Semi-Volatile Organic Chemicals (SVOCs), including Polycyclic Aromatic Hydrocarbons (PAHs)	EPA 8270	■	❑	no detection
pH, TDS, sulfate, chloride, etc.	EPA 150.1, 160.1, ...	■	■	see text
Total Recoverable Petroleum Hydrocarbon (TRPH)	EPA 418.1	■	■	detected in all samples
High Temperature Simulated Distillation hydrocarbon analysis	--	■	■	detected in all samples
Naturally Occurring Radioactive Materials (Ra226, Ra228)	EPA 901.1M	■	■	radium detected

Site Name: Hobbs Tasker Road
Site Location: Hobbs, New Mexico

Completed by: George DeVaull
Revision Date: 28 February 1998

ANALYTICAL SUMMARY - SOIL CONCENTRATIONS

All detected chemical analysis results from site soil samples are tabulated. Each line corresponds to a specific sample and chemical constituent. Non-detects are omitted from this list. An analyte list is included in the site assessment report.
Notes, if needed, are added at the end of this table and are indexed to samples using the "note index no." column.

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/kg)	QA/QC code	measured chemical concentration (mg/kg)
	1												**Volatile Organic Chemicals:**			
	2	SS-2 2-3'	soil						T89561	1/29/98	EPA 8260	100-41-4	ethylbenzene	0.5		7
	3	SS-2 2-3'	soil						T89561	1/29/98	EPA 8260	1330-20-7	m- & p-xylene	0.5		31
	4	SS-2 6'	soil						T89562	1/29/98	EPA 8260	100-41-4	ethylbenzene	0.5		9.7
	5	SS-2 6'	soil						T89562	1/29/98	EPA 8260	1330-20-7	m- & p-xylene	0.5		37
	6	SS-3 2-3'	soil						T89563	1/29/98	EPA 8260	100-41-4	ethylbenzene	0.5		1.4
	7	SS-3 2-3'	soil						T89563	1/29/98	EPA 8260	1330-20-7	m- & p-xylene	0.5		4.9
	8	SS-3 5-6'	soil						T89564	1/29/98	EPA 8260	100-41-4	ethylbenzene	0.5		0.66
	9	SS-3 5-6'	soil						T89564	1/29/98	EPA 8260	1330-20-7	m- & p-xylene	0.5		2
	10	SS-5 2'	soil						T89567	1/29/98	EPA 8260	100-41-4	ethylbenzene	0.05		0.1
	11	SS-5 2'	soil						T89567	1/29/98	EPA 8260	1330-20-7	m- & p-xylene	0.05		0.13
	12	SS-5 5'	soil						T89568	1/29/98	EPA 8260	100-41-4	ethylbenzene	0.5		9.2
	13	SS-5 5'	soil						T89568	1/29/98	EPA 8260	1330-20-7	m- & p-xylene	0.5		39
	14	SS-3 5-6'	soil						T89564	1/29/98	EPA 8260	127-18-4	tetrachloroethene	0.1		0.54

Notes (where applicable):

All detected VOCs are included in the above table.

A complete analyte list is included in *Phillip Services, Feb 1998: Tasker Road Site Assessment Report.*

RBCA SITE ASSESSMENT

Table 2.1b

Site Name: Hobbs Tasker Road
Site Location: Hobbs, New Mexico

Completed By: George DeVaull
Revision Date: 28 February 1998

ANALYTICAL SUMMARY - SOIL CONCENTRATIONS

This table is a comparison of chemical analysis results to screening level concentrations.
The line index number is identical to that in the first half of this table (Table 2.1a).

Screening Level Criteria Descriptions
(residential exposure, minimum of HQ = 1 or Risk = 1E-6):

1) direct soil exposure, ingestion, dermal contact, dust & vapor inhalation
2) volatilization from subsurface soil to ambient (outdoor) air
3) volatilization from subsurface soil to indoor air
4) leaching from soil to groundwater, drinking water ingestion
5) leaching from soil to groundwater, MCL drinking water standard

						3		4		5		6		35			
						Screening Level comparison against site analytical data. Exceedences are noted by a filled box (■).											
line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concentration (mg/kg)	1) surficial soil, direct exposure (mg/kg)		2) soil volatilization indoor (mg/kg)		3) soil volatilization outdoor (mg/kg)		4) soil leaching to gw ingestion (mg/kg)		5) soil leaching to gw ing (MCL) (mg/kg)			
1				**Volatile Organic Chemicals:**		☐		☐		☐		☐		☐		☐	☐
2	SS-2 2-3'		100-41-4	ethylbenzene	7	☐	1.9E+3	☐	1.2E+2	☐	NA	☐	6.4E+1	☐	1.2E+1	☐	☐
3	SS-2 2-3'		1330-20-7	m- & p-xylene	31	☐	2.9E+4	☐	NA	☐	NA	☐	NA	☐	1.2E+2	☐	☐
4	SS-2 6'		100-41-4	ethylbenzene	9.7	☐	1.9E+3	☐	1.2E+2	☐	NA	☐	6.4E+1	☐	1.2E+1	☐	☐
5	SS-2 6'		1330-20-7	m- & p-xylene	37	☐	2.9E+4	☐	NA	☐	NA	☐	NA	☐	1.2E+2	☐	☐
6	SS-3 2-3'		100-41-4	ethylbenzene	1.4	☐	1.9E+3	☐	1.2E+2	☐	NA	☐	6.4E+1	☐	1.2E+1	☐	☐
7	SS-3 2-3'		1330-20-7	m- & p-xylene	4.9	☐	2.9E+4	☐	NA	☐	NA	☐	NA	☐	1.2E+2	☐	☐
8	SS-3 5-6'		100-41-4	ethylbenzene	0.66	☐	1.9E+3	☐	1.2E+2	☐	NA	☐	6.4E+1	☐	1.2E+1	☐	☐
9	SS-3 5-6'		1330-20-7	m- & p-xylene	2	☐	2.9E+4	☐	NA	☐	NA	☐	NA	☐	1.2E+2	☐	☐
10	SS-5 2'		100-41-4	ethylbenzene	0.1	☐	1.9E+3	☐	1.2E+2	☐	NA	☐	6.4E+1	☐	1.2E+1	☐	☐
11	SS-5 2'		1330-20-7	m- & p-xylene	0.13	☐	2.9E+4	☐	NA	☐	NA	☐	NA	☐	1.2E+2	☐	☐
12	SS-5 5'		100-41-4	ethylbenzene	9.2	☐	1.9E+3	☐	1.2E+2	☐	NA	☐	6.4E+1	☐	1.2E+1	☐	☐
13	SS-5 5'		1330-20-7	m- & p-xylene	39	☐	2.9E+4	☐	NA	☐	NA	☐	NA	☐	1.2E+2	☐	☐
14	SS-3 5-6'		127-18-4	tetrachloroethene	0.54	☐	2.7E+0	■	1.0E-1	☐	1.7E+0	■	1.3E-2	■	4.1E-2	☐	☐
						☐		☐		☐		☐		☐		☐	☐

Notes (where applicable):
Indicators in the screening level comparison table include NA (not applicable), [blank] (not calculated).

Site Name: Hobbs Tasker Road
Site Location: Hobbs, New Mexico

Completed by: George DeVaull
Revision Date: 28 February 1998

ANALYTICAL SUMMARY - SOIL CONCENTRATIONS

All detected chemical analysis results from site soil samples are tabulated. Each line corresponds to a specific sample and chemical constituent. Non-detects are omitted from this list. An analyte list is included in the site assessment report.
Notes, if needed, are added at the end of this table and are indexed to samples using the "note index no." column.

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/kg)	QA/QC code	measured chemical concentration (mg/kg)
	1												**Total Metals Analysis:**			
	2		soil					1/20/98	max.	1/23/98	EPA 245.1	7440-38-2	Arsenic (As)	0.5		3.8
	3		soil					1/20/98	max.	1/23/98	EPA 245.1	7782-49-2	Selenium (Se)	1		1.8
	4		soil					1/20/98	max.	1/23/98	EPA 245.1	7440-43-9	Cadmium (Cd)	0.05		0.21
	5		soil					1/20/98	max.	1/23/98	EPA 245.1	7440-39-3	Barium (Ba)	0.5		650
	6		soil					1/20/98	max.	1/23/98	EPA 245.1	7440-02-0	Nickel (Ni)	0.5		11
	7		soil					1/20/98	max.	1/23/98	EPA 245.1	7440-66-6	Zinc (Zn)	0.3		22
	8		soil					1/20/98	max.	1/23/98	EPA 245.1	7429-90-5	Aluminum (Al)	20		9200
	9		soil					1/20/98	max.	1/23/98	EPA 245.1	7439-89-6	Iron (Fe)	10		7600
	10		soil					1/20/98	max.	1/23/98	EPA 245.1	7439-96-5	Manganese (M)	0.3		120
	11		soil					1/20/98	max.	1/23/98	EPA 245.1	7440-50-8	Copper (Cu)	10		13
	12												**Naturally Occuring Radioactive Materials:**			(pC/g
	13		soil						max.	1/30/98	PA 501.1	7440-14-4	Radium-226 (Ra226)			2.17
	14		soil						max.	1/30/98	PA 501.1	7440-14-4	Radium-228 (Ra228)			1.28
	15															
	1		soil					1/20/98	avg.	1/23/98	EPA 245.1	7440-38-2	Arsenic (As) [average concentration]	0.5		0.605
	2		soil					1/20/98	avg.	1/23/98	EPA 245.1	7782-49-2	Selenium (Se) [average concentration]	1		0.63
	3		soil					1/20/98	avg.	1/23/98	EPA 245.1	7440-39-3	Barium (Ba) [average concentration]	0.5		194.5

Notes (where applicable):

The maximum detected concentrations for metals and NORM chemicals are included in the above table.
A complete analyte list is included in *Phillip Services, Feb 1998: Tasker Road Site Assessment Report.*
Average concentrations include half non-detect concentration levels for non-detected samples.

Site Name: Hobbs Tasker Road
Site Location: Hobbs, New Mexico

Completed By: George DeVaull
Revision Date: 28 February 1998

ANALYTICAL SUMMARY - SOIL CONCENTRATIONS

This table is a comparison of chemical analysis results to screening level concentrations.
The line index number is identical to that in the first half of this table (Table 2.2a).

Screening Level Criteria Descriptions
(residential exposure, minimum of HQ = 1 or Risk = 1E-6):
1) direct soil exposure, ingestion, dermal contact, dust & vapor inhalation
2) volatilization from subsurface soil to ambient (outdoor) air
3) volatilization from subsurface soil to indoor air
4) leaching from soil to groundwater, drinking water ingestion
5) leaching from soil to groundwater, MCL drinking water standard
6) nominal background
7) acceptable levels of naturally occurring radioactive materials in surface soils

						3		4		5		6		35		19	
						Screening Level comparison against site analytical data. Exceedences are noted by a filled box (■).											
line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concentration (mg/kg)	1) surficial soil, direct exposure (mg/kg)		2) soil volatilization indoor (mg/kg)		3) soil volatilization outdoor (mg/kg)		4) soil leaching to gw ingestion (mg/kg)		5) soil leaching to gw ing (MCL) (mg/kg)		6) nominal background (mg/kg)		NORM (pCi/g)	
1				**Total Metals Analysis:**		☐		☐		☐		☐		☐		☐		☐	
2			7440-38-2	Arsenic (As)	3.8	■	4.3E-1	☐	NA	☐	NA	■	8.3E-3	☐	7.3E+0	☐	7.2E+0	☐	
3			7782-49-2	Selenium (Se)	1.8	☐	3.9E+2	☐	NA	☐	NA	☐	2.0E+0	■	5.3E-1	■	3.9E-1	☐	
4			7440-43-9	Cadmium (Cd)	0.21	☐	3.9E+1	☐	NA	☐	NA	☐	3.7E+2	☐	1.0E+2	☐		☐	
5			7440-39-3	Barium (Ba)	650	☐	5.5E+3	☐	NA	☐	NA	■	6.3E+2	■	4.9E+2	■	5.8E+2	☐	
6			7440-02-0	Nickel (Ni)	11	☐	1.6E+3	☐	NA	☐	NA	☐	6.5E+3	☐	8.9E+2	☐	1.8E+1	☐	
7			7440-66-6	Zinc (Zn)	22	☐	2.3E+4	☐	NA	☐	NA	☐	2.7E+4	☐		☐		☐	
8			7429-90-5	Aluminum (Al)	9200	☐		☐		☐		☐		☐		☐	4.7E+4	☐	
9			7439-89-6	Iron (Fe)	7600	☐		☐		☐		☐		☐		☐	1.8E+4	☐	
10			7439-96-5	Manganese (M)	120	☐		☐		☐		☐		☐		☐		☐	
11			7440-50-8	Copper (Cu)	13	☐	2.9E+3	☐	NA	☐	NA	☐	3.2E+2	☐	3.1E+2	☐		☐	
12				**Naturally Occuring Radioactive Materials:**	(pC/g)	☐		☐		☐		☐		☐		☐		☐	
13			7440-14-4	Radium-226 (Ra226)	2.17	☐		☐		☐		☐		☐		☐		☐	5.0E+0
14			7440-14-4	Radium-228 (Ra228)	1.28	☐		☐		☐		☐		☐		☐		☐	5.0E+0
15						☐		☐		☐		☐		☐		☐		☐	
1			7440-38-2	Arsenic (As) [average concentration]	0.605	■	4.3E-1	☐	NA	☐	NA	■	8.3E-3	☐	7.3E+0	☐	7.2E+0	☐	
2			7782-49-2	Selenium (Se) [average concentration]	0.63	☐	3.9E+2	☐	NA	☐	NA	☐	7.9E+0	☐	2.2E+0	■	3.9E-1	☐	
3			7440-39-3	Barium (Ba) [average concentration]	194.5	☐	5.5E+3	☐	NA	☐	NA	☐	6.3E+2	☐	4.9E+2	☐	5.8E+2	☐	

Notes (where applicable):
Indicators in the screening level comparison table include NA (not applicable), [blank] (not calculated).
Nominal Background is average soil concentrationfor indicated chemical (USGS).
The NORM screening criteria included above for radium is proposed by Lousiana DEQ for unresticted site use (White, 1992).
For [avg] Se, USEPA(1996) Kd value is replaced with Friendlich isotherm data from Buchter (1989) in calculations.

Site Name: Hobbs Tasker Road
Site Location: Hobbs, New Mexico

Completed by: George DeVault
Revision Date: 28 February 1998

ANALYTICAL SUMMARY - SOIL CONCENTRATIONS

All detected chemical analysis results from site soil samples are tabulated. Each line corresponds to a specific sample and chemical constituent. Non-detects are omitted from this list. An analyte list is included in the site assessment report.
Notes, if needed, are added at the end of this table and are indexed to samples using the "note index no." column.

note index no.	line index no.	location description	sample type	field sample ID	sampling unit	sampling depth (ft)	sample interval (ft)	field sampling date	analysis ID code	analysis date	analytical method number	Chemical Abstracts Service No. (CASRN)	chemical name	detection limit (mg/kg)	QA/QC code	measured chemical concentration (mg/kg)
		Petroleum Hydrocarbons (CS2 extraction, GC/FID sim. dist. anal., C8 to C100):														
	1	SS-1 2-3'	soil			2 - 3'		1/20/98	89559		HTSD		total petroleum			182000
	2	SS-1 5'	soil			5'		1/20/98	89560		HTSD		total petroleum			17000
	3	SS-2 2-3'	soil			2 - 3'		1/20/98	89561		HTSD		total petroleum			158000
	4	SS-2 6'	soil			6'		1/20/98	89562		HTSD		total petroleum			27000
	5	SS-3 2-3'	soil			2-3'		1/20/98	89563		HTSD		total petroleum			71000
	6	SS-3 5.5'	soil			5.5'		1/20/98	89564		HTSD		total petroleum			11000
	7	SS-4 1'	soil			1'		1/20/98	89565		HTSD		total petroleum			13000
	8	SS-4 5'	soil			5'		1/20/98	89566		HTSD		total petroleum			4000
	9	SS-5 2'	soil			2'		1/20/98	89567		HTSD		total petroleum			62000
	10	SS-5 5'	soil			5'		1/20/98	89568		HTSD		total petroleum			39000
		Total Recoverable Petroleum Hydrocarbons (freon soil extraction, infrared detection):														
	1	SS-1 2-3'	soil			2 - 3'		1/20/98		1/22/98	EPA 418.1		TRPH			24800
	2	SS-1 5'	soil			5'		1/20/98		1/22/98	EPA 418.1		TRPH			14100
	3	SS-2 2-3'	soil			2 - 3'		1/20/98		1/22/98	EPA 418.1		TRPH			200000
	4	SS-2 6'	soil			6'		1/20/98		1/22/98	EPA 418.1		TRPH			30900
	5	SS-3 2-3'	soil			2-3'		1/20/98		1/22/98	EPA 418.1		TRPH			134000
	6	SS-3 5.5'	soil			5.5'		1/20/98		1/22/98	EPA 418.1		TRPH			21900
	7	SS-4 1'	soil			1'		1/20/98		1/22/98	EPA 418.1		TRPH			2930
	8	SS-4 5'	soil			5'		1/20/98		1/22/98	EPA 418.1		TRPH			1800
	9	SS-5 2'	soil			2'		1/20/98		1/22/98	EPA 418.1		TRPH			68200
	10	SS-5 5'	soil			5'		1/20/98		1/22/98	EPA 418.1		TRPH			50200

Notes (where applicable):

Site Name: Hobbs Tasker Road
Site Location: Hobbs, New Mexico

Completed By: George DeVaull
Revision Date: 28 February 1998

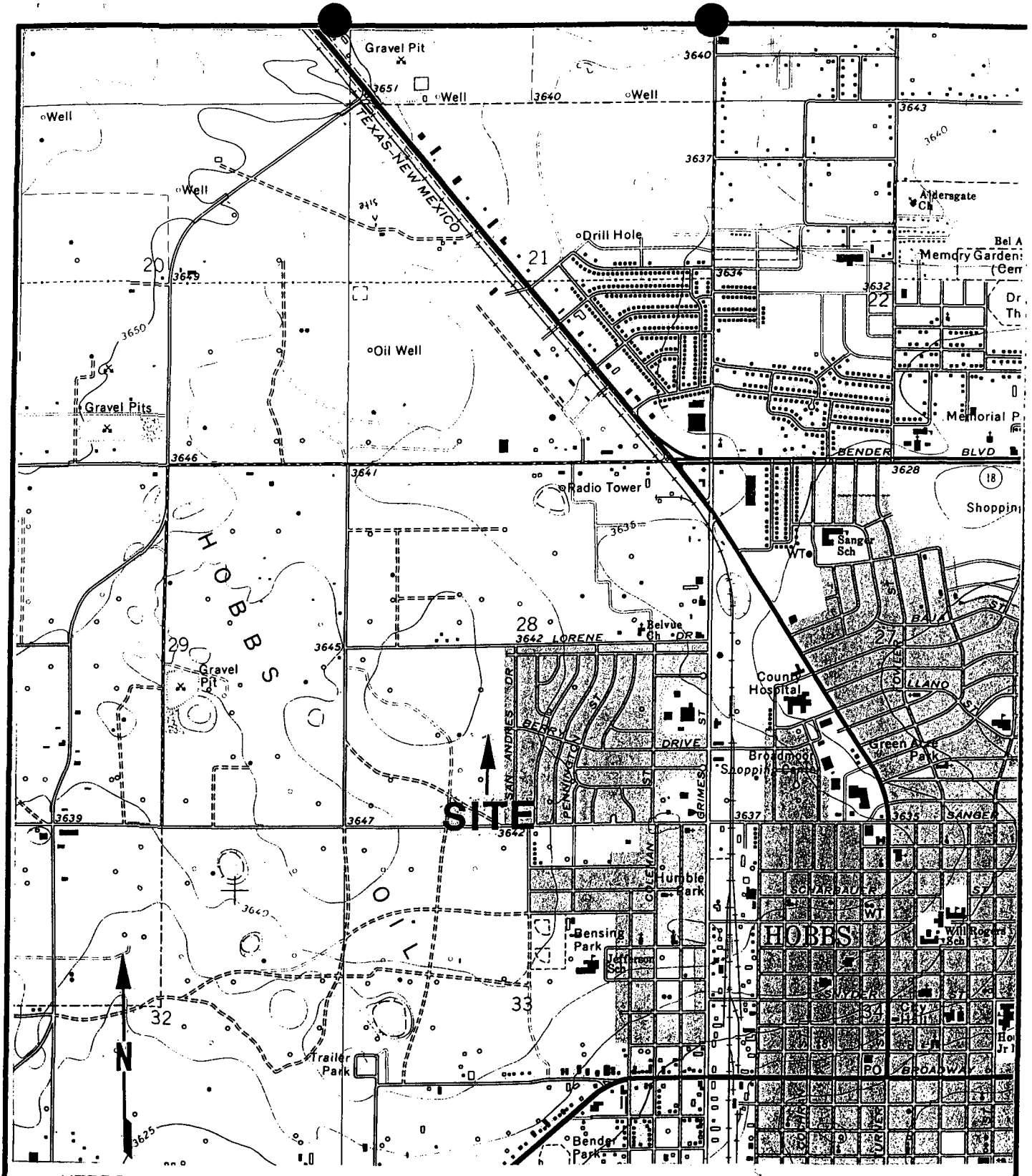
ANALYTICAL SUMMARY - SOIL CONCENTRATIONS

This table is a comparison of chemical analysis results to screening level concentrations. The line index number is identical to that in the first half of this table (Table 3.1a).

Screening Level Criteria Descriptions
(residential exposure, (1) to (4) are HI values, (5) is screening criteria:
1) direct soil exposure, ingestion, dermal contact, dust & vapor inhalation
2) volatilization from subsurface soil to ambient (outdoor) air
3) volatilization from subsurface soil to indoor air
4) leaching from soil to groundwater, drinking water ingestion
5) direct soil exposure, ingestion, dermal contact, dust & vapor inhalation

						Screening Level comparison against site analytical data. Exceedences are noted by a filled box (■).															
line index no.	location description	field sample ID	Chemical Abstracts Service No. (CASRN)	chemical name	measured chemical concentration (mg/kg)		1) surficial soil, direct exposure HI = Σ HQ		2) soil volatilization indoor HI = Σ HQ		3) soil volatilization outdoor HI = Σ HQ		4) soil leaching to gw ingestion HI = Σ HQ		5) surficial soil, direct exposure (mg/kg)					
	Petroleum Hydrocarbons (CS2 extraction, GC/FID sim. dist. anal., C8 to C100):																				
1	SS-1 2-3'			total petroleum	182000	■	1.9E+1	□	3.7E-4	□	1.6E-5	□	1.5E-4	■	9.5E+3	□		□			
2	SS-1 5'			total petroleum	17000	■	2.2E+0	□	1.3E-3	□	5.8E-5	□	4.6E-4	■	7.8E+3	□		□			
3	SS-2 2-3'			total petroleum	158000	■	1.8E+1	□	1.7E-3	□	7.4E-5	□	5.6E-4	■	8.9E+3	□		□			
4	SS-2 6'			total petroleum	27000	■	3.6E+0	□	4.6E-3	□	2.1E-4	□	1.4E-3	■	7.5E+3	□		□			
5	SS-3 2-3'			total petroleum	71000	■	8.1E+0	□	8.2E-4	□	3.6E-5	□	3.5E-4	■	8.7E+3	□		□			
6	SS-3 5.5'			total petroleum	11000	■	1.4E+0	□	2.0E-3	□	8.8E-5	□	7.0E-4	■	7.6E+3	□		□			
7	SS-4 1'			total petroleum	13000	■	1.3E+0	□	1.1E-3	□	4.7E-5	□	1.5E-4	■	9.9E+3	□		□			
8	SS-4 5'			total petroleum	4000	□	4.0E-1	□	2.1E-3	□	9.1E-5	□	2.9E-4	□		□		□			
9	SS-5 2'			total petroleum	62000	■	6.6E+0	□	6.0E-5	□	2.7E-6	□	8.7E-5	■	9.4E+3	□		□			
10	SS-5 5'			total petroleum	39000	■	5.2E+0	□	4.3E-3	□	1.9E-4	□	1.4E-3	■	7.4E+3	□		□			
	Total Recoverable Petroleum Hydrocarbons (freon soil extraction, infrared detection):																				
1	SS-1 2-3'			TRPH	24800	□		□		□		□		■	9.5E+3	□		□			
2	SS-1 5'			TRPH	14100	□		□		□		□		■	7.8E+3	□		□			
3	SS-2 2-3'			TRPH	200000	□		□		□		□		■	8.9E+3	□		□			
4	SS-2 6'			TRPH	30900	□		□		□		□		■	7.5E+3	□		□			
5	SS-3 2-3'			TRPH	134000	□		□		□		□		■	8.7E+3	□		□			
6	SS-3 5.5'			TRPH	21900	□		□		□		□		■	7.6E+3	□		□			
7	SS-4 1'			TRPH	2930	□		□		□		□		□	9.9E+3	□		□			
8	SS-4 5'			TRPH	1800	□		□		□		□		□		□		□			
9	SS-5 2'			TRPH	68200	□		□		□		□		■	9.4E+3	□		□			
10	SS-5 5'			TRPH	50200	□		□		□		□		■	7.4E+3	□		□			

Notes (where applicable): Indicators in the screening level comparison table include NA (not applicable), [blank] (not calculated).



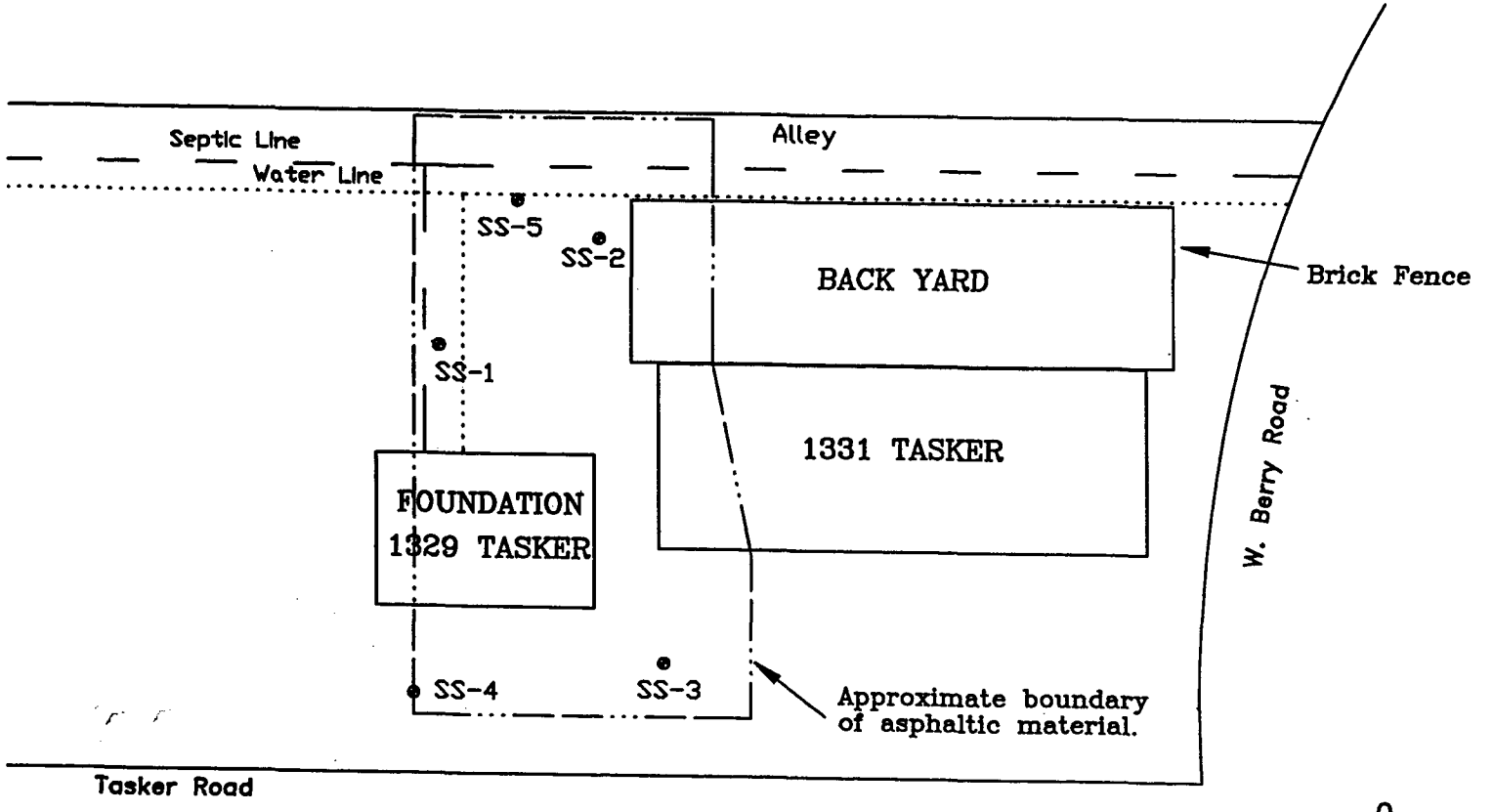
HOBBS WEST QUADRANGLE
NEW MEXICO - LEA Co
7.5 Minute Series (Topographic)
1969
Photo Revised 1979

C:\PROJECTS\18906\18906-BLDWG

PHILIP SERVICES CORP

TITLE:
SHELL EXPLORATION & TECHNOLOGY COMPANY
TASKER ROAD
SITE LOCATION MAP

DWN:	DES.:	PROJECT NO.: 18906
CHKD: seh	APPD: seh	TASKER ROAD Hobbs, New Mexico
DATE: FEB. 1998	REV.: 1	FIGURE 1



PHILIP SERVICES CORP

TITLE:

SHELL EXPLORATION & TECHNOLOGY COMPANY
TASKER ROAD
VISIBLE EXTENT OF ASPHALTIC MATERIAL

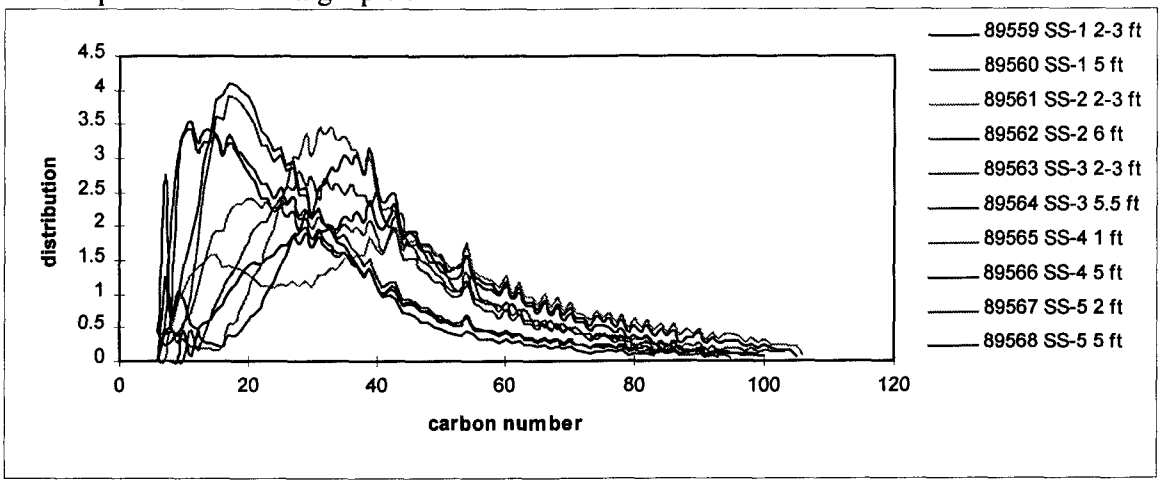
DWN:	DES.:	PROJECT NO.: 18906
koa	jwk	TASKER ROAD Hobbs, New Mexico
CHKD:	APPD:	
seh	seh	
DATE:	REV.:	FIGURE 2
Jan 1998	2	

C:\PROJECTS\18906\18906-5.DWG

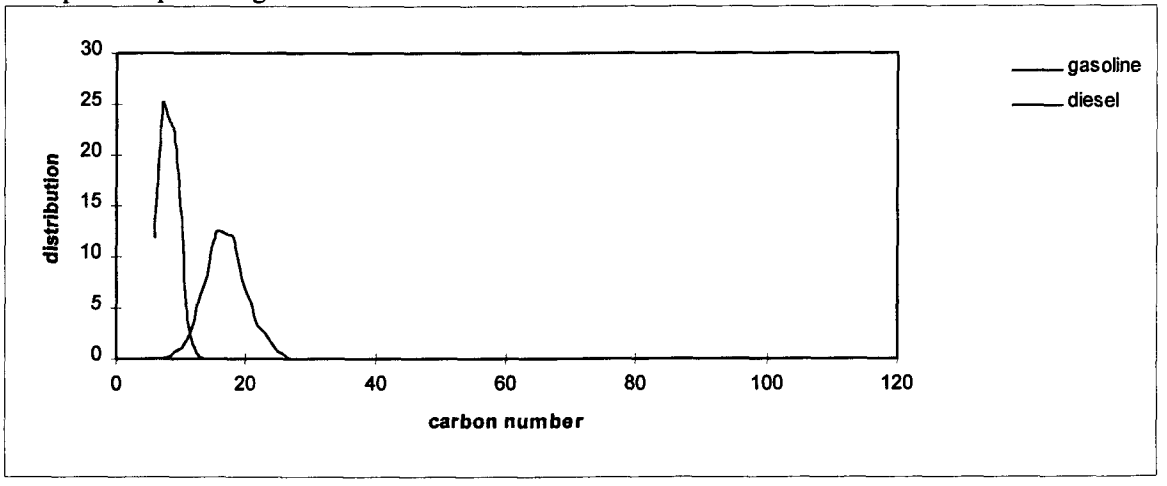
Attachment 1

The following figures are plots of the high temperature simulated distillation results from Triton Analytics Corp. (Feb 16, 1998), for soil samples taken at the SEPTCO Hobbs Tasker Road Site (Phillip Services, Feb. 1998). The area under each curve sums to 99.5% or 100%. The "carbon number axis" is scaled as an equivalent n-paraffin elution time.

All sample results on a single plot.



Comparison plot for gasoline and diesel fuel simulated distillation.



Note that the site sample analysis shows a broad distribution, typical of crude oil, while the analysis of refined products -- gasoline and diesel fuel -- is relatively narrow. The soil samples are also depleted in light volatile hydrocarbons, and extend to the range of very heavy hydrocarbons.

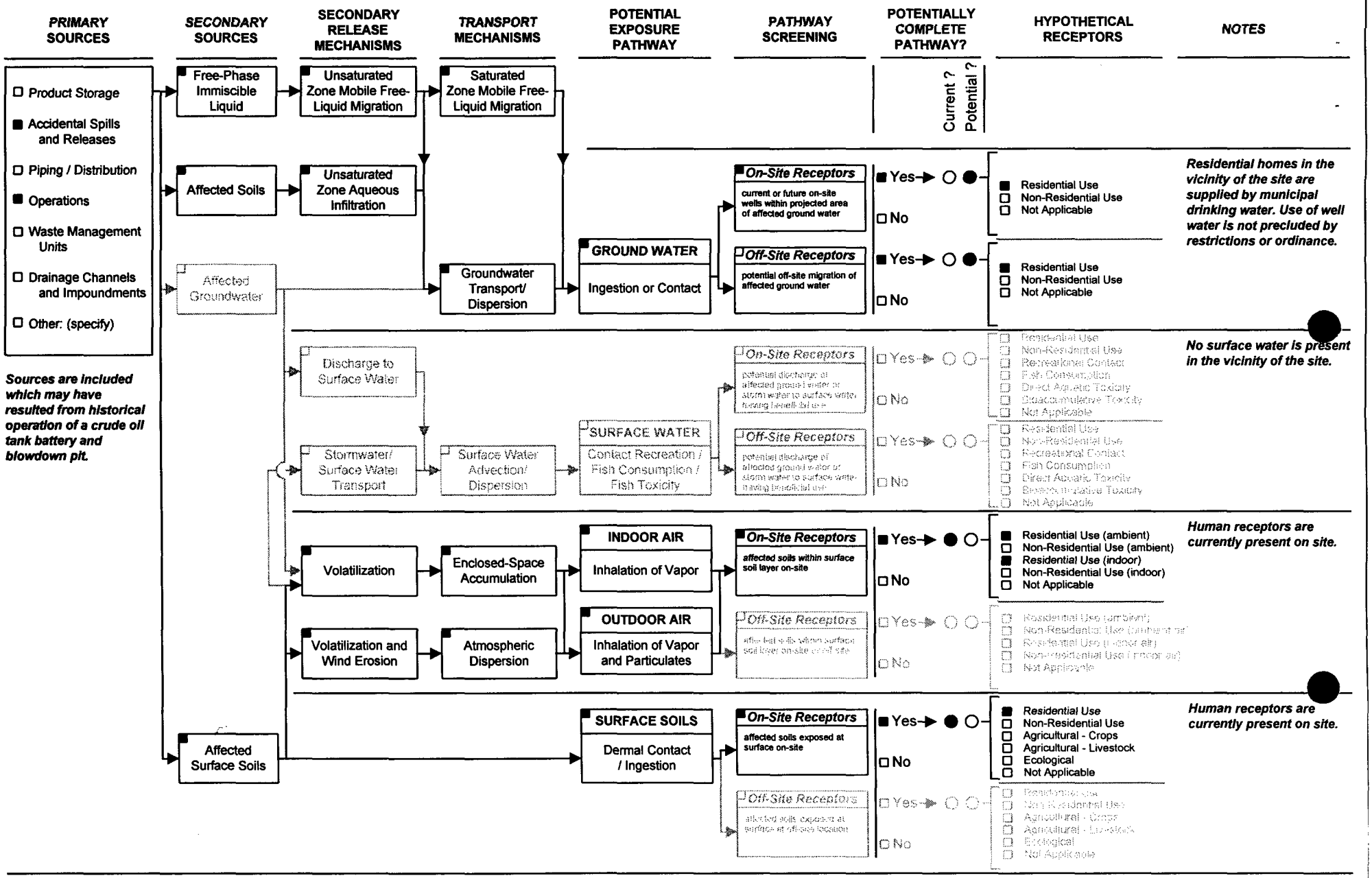


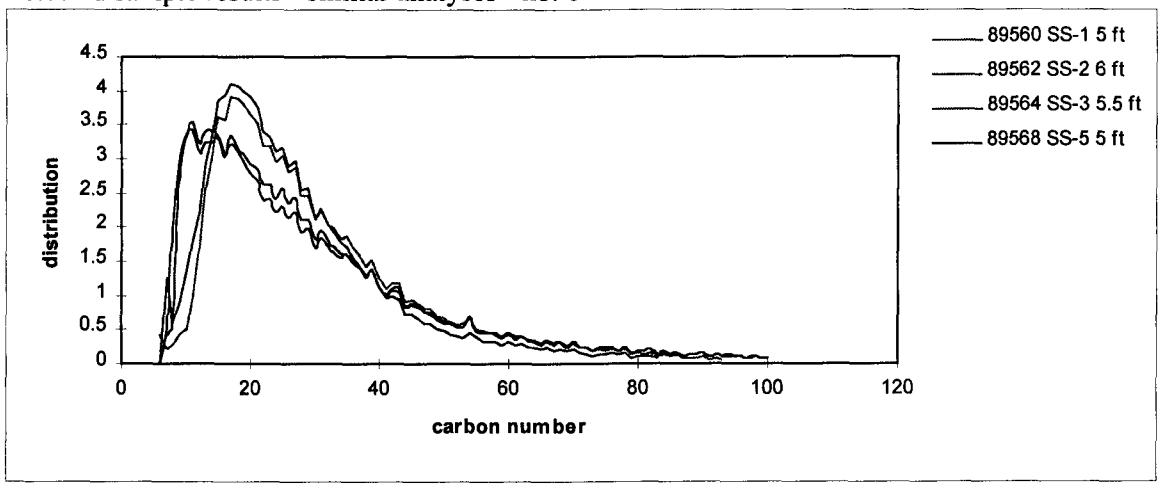
FIGURE 3. EXPOSURE SCENARIO EVALUATION FLOWCHART

Based on ASTM E 1739-95, Risk-Based Corrective Action for Petroleum Release Sites.
-- G. E. DeVaull, 12/3/97 conmodl.vsd:Page-7

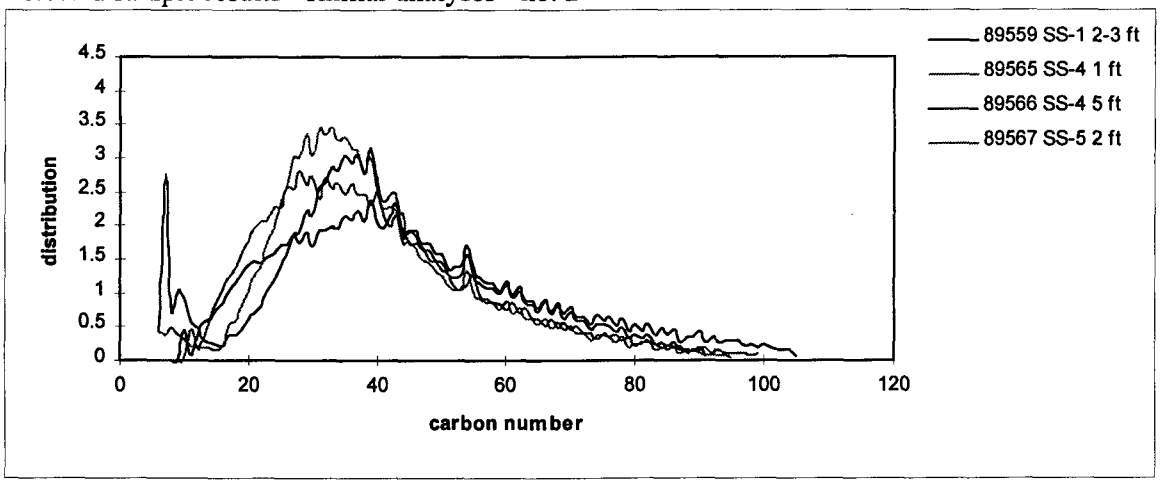
Information Key

site name: **HOBBS TASKER ROAD**				site location: **1331 to 1329 Tasker Road, Hobbs, New Mexico**	
	completion / revision: **GED**		approval:		description:
no.	by:	date:	by:	date:	

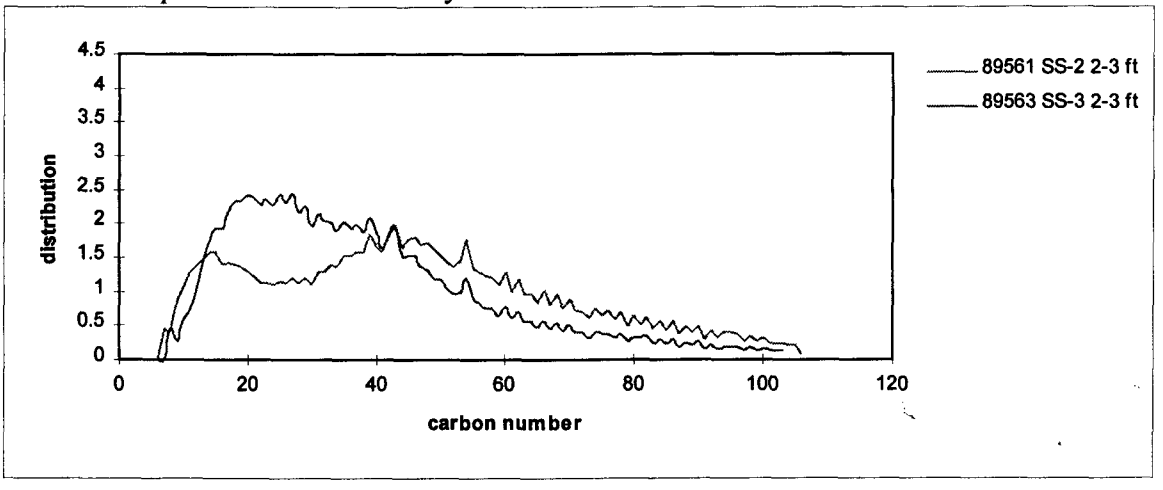
Selected sample results - similar analyses - no. 1



Selected sample results - similar analyses - no. 2



Selected sample results - similar analyses - no. 3



The above plots are the same as shown on the previous page, with samples of similar composition superposed.

Table of assigned petroleum fractions for the measured carbon number distributions.

sample number	89559	89560	89561	89562	89563	89564	89565	89566	89567	89568
sample identifier	SS-1 2-3'	SS-1 5'	SS-2 2-3'	SS-2 6'	SS-3 2-3'	SS-3 5.5'	SS-4 1'	SS-4 5'	SS-5 2'	SS-5 5'
total concentration (mg/kg-soil):	182000	17000	158000	27000	71000	11000	13000	4000	62000	39000
Distribution with high end fractions separate.										
EC 5 to 6 aliphatic	0.000	0.004	0.000	0.000	0.000	0.000	0.004	0.004	0.000	0.000
EC >6 to 8 aliphatic	0.000	0.004	0.007	0.021	0.004	0.016	0.007	0.029	0.000	0.008
EC >8 to 10 aliphatic	0.004	0.008	0.016	0.054	0.007	0.019	0.006	0.016	0.000	0.052
EC >10 to 12 aliphatic	0.004	0.023	0.022	0.056	0.015	0.034	0.003	0.009	0.005	0.055
EC >12 to 16 aliphatic	0.023	0.107	0.050	0.111	0.059	0.118	0.006	0.008	0.024	0.107
EC >16 to 21 aliphatic	0.053	0.157	0.056	0.124	0.097	0.166	0.035	0.021	0.066	0.128
> 21 aliphatic	0.748	0.530	0.680	0.467	0.650	0.480	0.771	0.744	0.737	0.482
Benzene (EC 5 to 7) aromatic	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene (EC >8 to 10) aromatic	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EC > 8 to 10 aromatic	0.001	0.002	0.003	0.011	0.001	0.004	0.001	0.003	0.000	0.010
EC > 10 to 12 aromatic	0.001	0.005	0.005	0.011	0.003	0.007	0.001	0.002	0.001	0.011
EC >12 to 16 aromatic	0.005	0.022	0.010	0.022	0.012	0.024	0.001	0.002	0.005	0.022
EC >16 to 21 aromatic	0.011	0.032	0.011	0.025	0.020	0.033	0.007	0.004	0.013	0.026
EC >21 to 35 aromatic	0.042	0.059	0.029	0.047	0.052	0.061	0.066	0.047	0.059	0.050
>35 aromatic	0.109	0.048	0.108	0.048	0.080	0.036	0.089	0.103	0.090	0.047
Distribution with high end cut added into the last fraction. This distribution was used in the data analysis.										
EC 5 to 6 aliphatic	0.000	0.004	0.000	0.000	0.000	0.000	0.004	0.004	0.000	0.000
EC >6 to 8 aliphatic	0.000	0.004	0.007	0.021	0.004	0.016	0.007	0.029	0.000	0.008
EC >8 to 10 aliphatic	0.004	0.008	0.016	0.054	0.007	0.019	0.006	0.016	0.000	0.052
EC >10 to 12 aliphatic	0.004	0.023	0.022	0.056	0.015	0.034	0.003	0.009	0.005	0.055
EC >12 to 16 aliphatic	0.023	0.107	0.050	0.111	0.059	0.118	0.006	0.008	0.024	0.107
EC >16 to 21 aliphatic	0.792	0.662	0.728	0.573	0.731	0.621	0.802	0.767	0.792	0.591
Benzene (EC 5 to 7) aromatic	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Toluene (EC >8 to 10) aromatic	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EC > 8 to 10 aromatic	0.001	0.002	0.003	0.011	0.001	0.004	0.001	0.003	0.000	0.010
EC > 10 to 12 aromatic	0.001	0.005	0.005	0.011	0.003	0.007	0.001	0.002	0.001	0.011
EC >12 to 16 aromatic	0.005	0.022	0.010	0.022	0.012	0.024	0.001	0.002	0.005	0.022
EC >16 to 21 aromatic	0.011	0.032	0.011	0.025	0.020	0.033	0.007	0.004	0.013	0.026
EC >21 to 35 aromatic	0.160	0.134	0.147	0.116	0.148	0.125	0.162	0.155	0.160	0.119

Receptor-Point (water, soil, and air) Concentration Criteria derived using RfD and RfC values from TPHCWG (1997) v. 4.

Residential Maximally Exposed Individual (MEI) exposure factors are used in the calculation.

							adult drinking water	child soil ingestion	child dermal soil	adult air outdoor	adult air indoor
						IR	2 (L/day)	200 (mg/day)		20 (m3/day)	15 (m3/day)
		RfDo	RfCi	RAFo	RAFd	BW	70 (kg)	15 (kg)	15 (kg)		
						EF	350 (dy/yr)	350 (dy/yr)	350 (days/year)	350 (dy/yr)	350 (dy/yr)
						SA			2023 (cm2)		
						M			0.5 (mg/cm2)		
							Cwater (mg/L)	Csoil (mg/kg)	Csoil (mg/kg)	Cair (mg/m3)	Cair (mg/m3)
EC 5 to 6 aliphatic	C5.5	5	18.4	1	0.05		182.50	391071	1546501	19.19	25.58
EC >6 to 8 aliphatic	C7	5	18.4	1	0.05		182.50	391071	1546501	19.19	25.58
EC >8 to 10 aliphatic	C9	0.1	1	1	0.05		3.65	7821	30930	1.04	1.39
EC >10 to 12 aliphatic	C11	0.1	1	1	0.05		3.65	7821	30930	1.04	1.39
EC >12 to 16 aliphatic	C14	0.1	1	1	0.05		3.65	7821	30930	1.04	1.39
EC >16 to 21 aliphatic	C19	2		1	0.05		73.00	156429	618600	0.00	0.00
Benzene (EC 5 to 7) aromatic	C6.5	0.2	0.4	1	0.5		7.30	15643	6186	0.42	0.56
Toluene (EC >8 to 10) aromatic	C7.6	0.04	0.4	1	0.5		1.46	3129	1237	0.42	0.56
EC > 8 to 10 aromatic	C9	0.04	0.2	1	0.05		1.46	3129	12372	0.21	0.28
EC > 10 to 12 aromatic	C11	0.04	0.2	1	0.05		1.46	3129	12372	0.21	0.28
EC >12 to 16 aromatic	C14	0.04	0.2	1	0.05		1.46	3129	12372	0.21	0.28
EC >16 to 21 aromatic	C19	0.03		1	0.05		1.10	2346	9279	0.00	0.00
EC >21 to 35 aromatic	C28	0.03		1	0.05		1.10	2346	9279	0.00	0.00

Notes:

Exposure factors are consistent with OSWER Directive 9285.6-03, "Standard Default Exposure Factors", USEPA, PB91-921314.

Calculation methods are consistent with ASTM E 1739-95 and USEPA (1991).

Dermal relative absorption factors (RAFd) are consistent with USEPA (1989): Supplemental Risk Assessment Guidance, (USEPA, Region I), EPA/901/5-89-001, PB89-220974.

The ingestion, dermal, and inhalation concentration values tabulated on this page are not independently applicable, but are summed (as on the follwoing pages) in calculation of a hazard index for each particular TPH sample.

Sample													
89559		Calculation results for potential exposure point concentrations:						Calculated HI and HQ values:					
list index	name		C gw (mg/L)	C air out (mg/m3)	C air in (mg/m3)	C air out ss(mg/m3)	C soil (mg/kg)	drinking water HI	soil ingestion HI	dermal contact HI	outdoor surficial soil air HI	indoor air HI	
1	EC 5 to 6 aliphatic		0	0		0	0	0	0	0	0	0	
2	EC >6 to 8 aliphatic		0	0		0	0	0	0	0	0	0	
3	EC >8 to 10 aliphatic		3.49E-06	1.00E-05	0.000225	0.0003966	686.5036	9.56E-07	0.087772	0.022195	0.00038	0.000162	
4	EC >10 to 12 aliphatic		2.40E-07	1.03E-06	2.32E-05	0.0001318	734.459	6.58E-08	0.093903	0.023746	0.000126	1.67E-05	
5	EC >12 to 16 aliphatic		2.49E-08	4.65E-07	1.05E-05	0.0002128	4259.978	6.82E-09	0.544655	0.13773	0.000204	7.52E-06	
6	EC >16 to 21 aliphatic		2.14E-09	3.75E-07	8.44E-06	0.0011125	144123.6	2.93E-11	0.921338	0.232983	0	0	
7	Benzene (EC 5 to 7) aromatic		0	0		0	0	0	0	0	0	0	
8	Toluene (EC >8 to 10) aromatic		0	0		0	0	0	0	0	0	0	
9	EC > 8 to 10 aromatic		0.000114	1.97E-06	4.42E-05	7.90E-05	138.6209	7.82E-05	0.044308	0.011204	0.000379	0.000159	
10	EC > 10 to 12 aromatic		4.36E-05	2.19E-07	4.92E-06	2.725E-05	148.3042	2.99E-05	0.047403	0.011987	0.000131	1.77E-05	
11	EC >12 to 16 aromatic		5.11E-05	9.70E-08	2.18E-06	4.37E-05	860.1878	3.5E-05	0.274946	0.069527	0.00021	7.85E-06	
12	EC >16 to 21 aromatic		1.02E-05	4.77E-09	1.07E-07	1.46E-05	1946.476	9.35E-06	0.829548	0.209772	0	0	
13	EC >21 to 35 aromatic		1.23E-06	2.96E-11	6.66E-10	4.44E-06	29101.88	1.12E-06	12.40263	3.136314	0	0	
		Total:	0.000224	1.42E-05	0.000319	0.0020226	182000	0.000155	15.2465	3.855459	0.001429	0.000371	
									19.10339	overall soil HQ			

Sample													
89560		Calculation results for potential exposure point concentrations:						Calculated HI and HQ values:					
list index	name		C gw (mg/L)	C air out (mg/m3)	C air in (mg/m3)	C air out ss(mg/m3)	C soil (mg/kg)	drinking water HI	soil ingestion HI	dermal contact HI	outdoor surficial soil air HI	indoor air HI	
1	EC 5 to 6 aliphatic		0.000378	0.000447	0.010063	0.000783	59.90145	2.07E-06	0.000153	3.87E-05	4.08E-05	0.000393	
2	EC >6 to 8 aliphatic		5.44E-05	9.75E-05	0.002193	0.0003899	68.14215	2.98E-07	0.000174	4.41E-05	2.03E-05	8.57E-05	
3	EC >8 to 10 aliphatic		6.61E-06	1.90E-05	0.000427	0.0002399	132.6245	1.81E-06	0.016957	0.004288	0.00023	0.000307	
4	EC >10 to 12 aliphatic		1.25E-06	5.36E-06	1.21E-04	0.0002176	386.0708	3.41E-07	0.049361	0.012482	0.000209	8.67E-05	
5	EC >12 to 16 aliphatic		1.05E-07	1.96E-06	4.42E-05	0.0002856	1816.023	2.88E-08	0.232186	0.058714	0.000274	3.18E-05	
6	EC >16 to 21 aliphatic		1.66E-09	2.91E-07	6.55E-06	0.0002738	11254.27	2.27E-11	0.071945	0.018193	0	0	
7	Benzene (EC 5 to 7) aromatic		0	0		0	0	0	0	0	0	0	
8	Toluene (EC >8 to 10) aromatic		0	0		0	0	0	0	0	0	0	
9	EC > 8 to 10 aromatic		0.000198	3.40E-06	7.66E-05	4.57E-05	26.77994	0.000135	0.00856	0.002165	0.000219	0.000275	
10	EC > 10 to 12 aromatic		2.15E-04	1.08E-06	2.42E-05	4.385E-05	77.9566	0.000147	0.024918	0.006301	0.00021	8.72E-05	
11	EC >12 to 16 aromatic		0.000211	4.01E-07	9.03E-06	5.80E-05	366.6969	0.000145	0.117209	0.029639	0.000278	3.25E-05	
12	EC >16 to 21 aromatic		2.80E-05	1.31E-08	2.94E-07	1.27E-05	539.0371	2.56E-05	0.229727	0.058092	0	0	
13	EC >21 to 35 aromatic		9.56E-07	2.30E-11	5.17E-10	1.09E-06	2272.497	8.73E-07	0.968492	0.244907	0	0	
		Total:	0.001093	0.000576	0.012964	0.0023511	17000	0.000458	1.71968	0.434864	0.001481	0.001299	
									2.156026	overall soil HQ			

Sample													
89561		Calculation results for potential exposure point concentrations:						Calculated HI and HQ values:					
list index	name		C gw (mg/L)	C air out (mg/m3)	C air in (mg/m3)	C air out ss(mg/m3)	C soil (mg/kg)	drinking water HI	soil ingestion HI	dermal contact HI	outdoor surficial soil air HI	indoor air HI	
1	EC 5 to 6 aliphatic		0	0		0	0	0	0	0	0	0	
2	EC >6 to 8 aliphatic		0.000103	0.000184	0.004136	0.0021832	1133.258	5.62E-07	0.002898	0.000733	0.000114	0.000162	
3	EC >8 to 10 aliphatic		1.41E-05	4.05E-05	0.000911	0.0015351	2543.189	3.87E-06	0.325157	0.082224	0.001472	0.000655	
4	EC >10 to 12 aliphatic		1.26E-06	5.44E-06	1.22E-04	0.0006642	3543.367	3.46E-07	0.453033	0.114561	0.000637	8.81E-05	
5	EC >12 to 16 aliphatic		5.07E-08	9.45E-07	2.13E-05	0.0004141	7932.503	1.39E-08	1.014201	0.256466	0.000397	1.53E-05	
6	EC >16 to 21 aliphatic		1.86E-09	3.27E-07	7.36E-06	0.0009277	115006.9	2.55E-11	0.735204	0.185915	0	0	
7	Benzene (EC 5 to 7) aromatic		0	0		0	0	0	0	0	0	0	
8	Toluene (EC >8 to 10) aromatic		0	0		0	0	0	0	0	0	0	
9	EC > 8 to 10 aromatic		0.000461	7.94E-06	1.79E-04	3.05E-04	513.5286	0.000316	0.164142	0.041507	0.001465	0.000643	
10	EC > 10 to 12 aromatic		2.30E-04	1.15E-06	2.59E-05	0.0001374	715.4876	0.000157	0.228695	0.057831	0.000659	9.32E-05	
11	EC >12 to 16 aromatic		0.000104	1.97E-07	4.44E-06	8.50E-05	1601.755	7.11E-05	0.511977	0.129466	0.000408	1.6E-05	
12	EC >16 to 21 aromatic		1.03E-05	4.79E-09	1.08E-07	1.40E-05	1787.495	9.38E-06	0.761794	0.192639	0	0	
13	EC >21 to 35 aromatic		1.07E-06	2.58E-11	5.80E-10	3.70E-06	23222.54	9.8E-07	9.896974	2.502697	0	0	
		Total:	0.000924	0.00024	0.005407	0.0062699	158000	0.000559	14.09407	3.564039	0.005151	0.001672	
									17.66326	overall soil HQ			

Sample													
89562		Calculation results for potential exposure point concentrations:						Calculated HI and HQ values:					
list index	name		C gw (mg/L)	C air out (mg/m3)	C air in (mg/m3)	C air out ss(mg/m3)	C soil (mg/kg)	drinking water HI	soil ingestion HI	dermal contact HI	outdoor surficial soil air HI	indoor air HI	
1	EC 5 to 6 aliphatic		0	0		0	0	0	0	0	0	0	
2	EC >6 to 8 aliphatic		0.00026	0.000466	0.010481	0.002439	558.0507	1.42E-06	0.001427	0.000361	0.000127	0.00041	
3	EC >8 to 10 aliphatic		4.17E-05	1.20E-04	0.002693	0.0019906	1446.747	1.14E-05	0.184972	0.046775	0.001909	0.001937	
4	EC >10 to 12 aliphatic		2.84E-06	1.22E-05	2.75E-04	0.0006522	1523.622	7.77E-07	0.194801	0.04926	0.000625	0.000197	
5	EC >12 to 16 aliphatic		9.96E-08	1.86E-06	4.18E-05	0.0003563	2986.101	2.73E-08	0.381785	0.096544	0.000342	3.01E-05	
6	EC >16 to 21 aliphatic		1.31E-09	2.30E-07	5.18E-06	0.0002856	15482.88	1.8E-11	0.098977	0.025029	0	0	
7	Benzene (EC 5 to 7) aromatic		0	0		0	0	0	0	0	0	0	
8	Toluene (EC >8 to 10) aromatic		0	0		0	0	0	0	0	0	0	
9	EC > 8 to 10 aromatic		0.0013	2.24E-05	5.04E-04	3.87E-04	292.1317	0.000891	0.093375	0.023612	0.001855	0.001811	
10	EC > 10 to 12 aromatic		5.01E-04	2.51E-06	5.66E-05	0.000133	307.6544	0.000343	0.098337	0.024867	0.000638	0.000203	
11	EC >12 to 16 aromatic		0.000202	3.84E-07	8.63E-06	7.28E-05	602.9628	0.000138	0.192728	0.048736	0.000349	3.1E-05	
12	EC >16 to 21 aromatic		2.02E-05	9.41E-09	2.12E-07	1.20E-05	673.4931	1.84E-05	0.287029	0.072582	0	0	
13	EC >21 to 35 aromatic		7.56E-07	1.82E-11	4.09E-10	1.14E-06	3126.352	6.9E-07	1.332387	0.336927	0	0	
		Total:	0.002328	0.000625	0.014065	0.0063294	27000	0.001405	2.865819	0.724694	0.005844	0.004619	
									3.596357	overall soil HQ			

Sample													
89563		Calculation results for potential exposure point concentrations:						Calculated HI and HQ values:					
list index	name		C gw (mg/L)	C air out (mg/m3)	C air in (mg/m3)	C air out ss(mg/m3)	C soil (mg/kg)	drinking water HI	soil ingestion HI	dermal contact HI	outdoor surficial soil air HI	indoor air HI	
1	EC 5 to 6 aliphatic		0	0		0	0	0	0	0	0	0	
2	EC >6 to 8 aliphatic		5.5E-05	9.87E-05	0.00222	0.0007815	270.5231	3.02E-07	0.000692	0.000175	4.07E-05	8.68E-05	
3	EC >8 to 10 aliphatic		6.22E-06	1.79E-05	0.000402	0.0004506	497.085	1.7E-06	0.063554	0.016071	0.000432	0.000289	
4	EC >10 to 12 aliphatic		8.68E-07	3.74E-06	8.41E-05	0.0003036	1078.093	2.38E-07	0.137838	0.034856	0.000291	6.05E-05	
5	EC >12 to 16 aliphatic		6.03E-08	1.12E-06	2.53E-05	0.0003279	4180.46	1.65E-08	0.534488	0.135159	0.000314	1.82E-05	
6	EC >16 to 21 aliphatic		1.90E-09	3.34E-07	7.51E-06	0.0006297	51934.61	2.6E-11	0.332002	0.083955	0	0	
7	Benzene (EC 5 to 7) aromatic		0	0		0	0	0	0	0	0	0	
8	Toluene (EC >8 to 10) aromatic		0	0		0	0	0	0	0	0	0	
9	EC > 8 to 10 aromatic		0.0002	3.45E-06	7.76E-05	8.90E-05	100.3729	0.000137	0.032083	0.008113	0.000427	0.000279	
10	EC > 10 to 12 aromatic		1.56E-04	7.85E-07	1.77E-05	6.253E-05	217.6918	0.000107	0.069582	0.017596	0.0003	6.35E-05	
11	EC >12 to 16 aromatic		0.000123	2.34E-07	5.27E-06	6.72E-05	844.1314	8.43E-05	0.269814	0.068229	0.000322	1.89E-05	
12	EC >16 to 21 aromatic		1.80E-05	8.41E-09	1.89E-07	1.64E-05	1390.24	1.65E-05	0.592492	0.149826	0	0	
13	EC >21 to 35 aromatic		1.10E-06	2.63E-11	5.92E-10	2.51E-06	10486.8	1E-06	4.469258	1.130164	0	0	
		Total:	0.000561	0.000126	0.002839	0.002731	71000	0.000348	6.501803	1.644143	0.002127	0.000816	
									8.148074	overall soil HQ			

Sample													
89564		Calculation results for potential exposure point concentrations:						Calculated HI and HQ values:					
list index	name		C gw (mg/L)	C air out (mg/m3)	C air in (mg/m3)	C air out ss(mg/m3)	C soil (mg/kg)	drinking water HI	soil ingestion HI	dermal contact HI	outdoor surficial soil air HI	indoor air HI	
1	EC 5 to 6 aliphatic		0	0		0	0	0	0	0	0	0	
2	EC >6 to 8 aliphatic		0.000202	0.000362	0.008139	0.0011929	171.9196	1.11E-06	0.00044	0.000111	6.22E-05	0.000318	
3	EC >8 to 10 aliphatic		1.57E-05	4.50E-05	0.001013	0.0004674	212.0105	4.3E-06	0.027106	0.006855	0.000448	0.000729	
4	EC >10 to 12 aliphatic		1.78E-06	7.64E-06	1.72E-04	0.0002541	369.2161	4.87E-07	0.047206	0.011937	0.000244	0.000124	
5	EC >12 to 16 aliphatic		1.12E-07	2.09E-06	4.71E-05	0.000249	1294.925	3.07E-08	0.165561	0.041866	0.000239	3.39E-05	
6	EC >16 to 21 aliphatic		1.50E-09	2.64E-07	5.94E-06	0.0002031	6826.558	2.06E-11	0.04364	0.011035	0	0	
7	Benzene (EC 5 to 7) aromatic		0	0		0	0	0	0	0	0	0	
8	Toluene (EC >8 to 10) aromatic		0	0		0	0	0	0	0	0	0	
9	EC > 8 to 10 aromatic		0.000449	7.73E-06	1.74E-04	8.70E-05	42.80981	0.000307	0.013684	0.00346	0.000417	0.000625	
10	EC > 10 to 12 aromatic		2.98E-04	1.49E-06	3.36E-05	5.05E-05	74.55325	0.000204	0.02383	0.006026	0.000242	0.000121	
11	EC >12 to 16 aromatic		0.000222	4.23E-07	9.51E-06	5.03E-05	261.4751	0.000152	0.083577	0.021134	0.000241	3.42E-05	
12	EC >16 to 21 aromatic		2.85E-05	1.33E-08	2.99E-07	1.06E-05	368.093	2.6E-05	0.156874	0.039669	0	0	
13	EC >21 to 35 aromatic		8.67E-07	2.08E-11	4.69E-10	8.11E-07	1378.44	7.92E-07	0.587463	0.148555	0	0	
		Total:	0.001218	0.000426	0.009594	0.0025656	11000	0.000696	1.149379	0.290649	0.001893	0.001984	
									1.441922	overall soil HQ			

Sample													
89565		Calculation results for potential exposure point concentrations:						Calculated HI and HQ values:					
list index	name		C gw (mg/L)	C air out (mg/m3)	C air in (mg/m3)	C air out ss(mg/m3)	C soil (mg/kg)	drinking water HI	soil ingestion HI	dermal contact HI	outdoor surficial soil air HI	indoor air HI	
1	EC 5 to 6 aliphatic		0.000398	0.000472	0.010608	0.0007085	46.53608	2.18E-06	0.000119	3.01E-05	3.69E-05	0.000415	
2	EC >6 to 8 aliphatic		0.0001	0.00018	0.004043	0.0006121	91.11995	5.49E-07	0.000233	5.89E-05	3.19E-05	0.000158	
3	EC >8 to 10 aliphatic		5.22E-06	1.50E-05	0.000337	0.0001609	75.452	1.43E-06	0.009647	0.002439	0.000154	0.000243	
4	EC >10 to 12 aliphatic		1.98E-07	8.52E-07	1.92E-05	2.928E-05	44.01545	5.42E-08	0.005628	0.001423	2.81E-05	1.38E-05	
5	EC >12 to 16 aliphatic		6.38E-09	1.19E-07	2.68E-06	1.465E-05	78.84929	1.75E-09	0.010081	0.002549	1.41E-05	1.93E-06	
6	EC >16 to 21 aliphatic		2.14E-09	3.77E-07	8.48E-06	0.0002998	10426.82	2.94E-11	0.066655	0.016856	0	0	
7	Benzene (EC 5 to 7) aromatic		0	0		0	0	0	0	0	0	0	
8	Toluene (EC >8 to 10) aromatic		0	0		0	0	0	0	0	0	0	
9	EC > 8 to 10 aromatic		0.000151	2.59E-06	5.84E-05	3.01E-05	15.2355	0.000103	0.00487	0.001231	0.000144	0.00021	
10	EC > 10 to 12 aromatic		3.34E-05	1.67E-07	3.77E-06	5.836E-06	8.887736	2.28E-05	0.002841	0.000718	2.8E-05	1.35E-05	
11	EC >12 to 16 aromatic		1.27E-05	2.41E-08	5.42E-07	2.96E-06	15.92149	8.68E-06	0.005089	0.001287	1.42E-05	1.95E-06	
12	EC >16 to 21 aromatic		6.64E-06	3.10E-09	6.96E-08	2.55E-06	91.74368	6.06E-06	0.039099	0.009887	0	0	
13	EC >21 to 35 aromatic		1.24E-06	2.97E-11	6.69E-10	1.20E-06	2105.416	1.13E-06	0.897285	0.226901	0	0	
		Total:	0.000709	0.00067	0.015081	0.0018678	13000	0.000146	1.041547	0.263381	0.000452	0.001056	
									1.30538	overall soil HQ			

Sample													
89566		Calculation results for potential exposure point concentrations:						Calculated HI and HQ values:					
list index	name		C gw (mg/L)	C air out (mg/m3)	C air in (mg/m3)	C air out ss(mg/m3)	C soil (mg/kg)	drinking water HI	soil ingestion HI	dermal contact HI	outdoor surficial soil air HI	indoor air HI	
1	EC 5 to 6 aliphatic		0.000321	0.00038	0.008547	0.0002619	14.57477	1.76E-06	3.73E-05	9.42E-06	1.36E-05	0.000334	
2	EC >6 to 8 aliphatic		0.000367	0.000658	0.014799	0.0013278	117.1448	2.01E-06	0.0003	7.57E-05	6.92E-05	0.000578	
3	EC >8 to 10 aliphatic		1.37E-05	3.93E-05	0.000884	0.0002432	65.77842	3.75E-06	0.00841	0.002127	0.000233	0.000636	
4	EC >10 to 12 aliphatic		4.83E-07	2.08E-06	4.67E-05	4.076E-05	34.95148	1.32E-07	0.004469	0.00113	3.91E-05	3.36E-05	
5	EC >12 to 16 aliphatic		8.51E-09	1.59E-07	3.57E-06	1.107E-05	33.73481	2.33E-09	0.004313	0.001091	1.06E-05	2.57E-06	
6	EC >16 to 21 aliphatic		1.98E-09	3.48E-07	7.82E-06	0.0001563	3069.819	2.71E-11	0.019624	0.004963	0	0	
7	Benzene (EC 5 to 7) aromatic		0	0		0	0	0	0	0	0	0	
8	Toluene (EC >8 to 10) aromatic		0	0		0	0	0	0	0	0	0	
9	EC > 8 to 10 aromatic		0.000314	5.41E-06	1.22E-04	4.06E-05	13.28218	0.000215	0.004245	0.001074	0.000194	0.000438	
10	EC > 10 to 12 aromatic		7.01E-05	3.52E-07	7.92E-06	7.539E-06	7.05751	4.8E-05	0.002256	0.00057	3.61E-05	2.85E-05	
11	EC >12 to 16 aromatic		1.58E-05	3.00E-08	6.75E-07	2.16E-06	6.811837	1.08E-05	0.002177	0.000551	1.04E-05	2.43E-06	
12	EC >16 to 21 aromatic		3.77E-06	1.76E-09	3.96E-08	8.27E-07	16.97822	3.45E-06	0.007236	0.00183	0	0	
13	EC >21 to 35 aromatic		1.14E-06	2.75E-11	6.18E-10	6.24E-07	619.8672	1.04E-06	0.264175	0.066803	0	0	
		Total:	0.001107	0.001085	0.024419	0.0020927	4000	0.000286	0.317242	0.080223	0.000607	0.002053	
									0.398071	overall soil HQ			

Sample													
89567		Calculation results for potential exposure point concentrations:						Calculated HI and HQ values:					
list index	name		C gw (mg/L)	C air out (mg/m3)	C air in (mg/m3)	C air out ss(mg/m3)	C soil (mg/kg)	drinking water HI	soil ingestion HI	dermal contact HI	outdoor surficial soil air HI	indoor air HI	
1	EC 5 to 6 aliphatic		0	0		0	0	0	0	0	0	0	
2	EC >6 to 8 aliphatic		0	0		0	0	0	0	0	0	0	
3	EC >8 to 10 aliphatic		0.00E+00	0.00E+00		0	0	0	0	0	0	0	
4	EC >10 to 12 aliphatic		3.11E-07	1.34E-06	3.01E-05	9.969E-05	324.1428	8.53E-08	0.041443	0.01048	9.56E-05	2.17E-05	
5	EC >12 to 16 aliphatic		2.56E-08	4.76E-07	1.07E-05	0.0001273	1485.374	7E-09	0.189911	0.048024	0.000122	7.71E-06	
6	EC >16 to 21 aliphatic		2.14E-09	3.76E-07	8.46E-06	0.00065	49083.8	2.93E-11	0.313778	0.079347	0	0	
7	Benzene (EC 5 to 7) aromatic		0	0		0	0	0	0	0	0	0	
8	Toluene (EC >8 to 10) aromatic		0	0		0	0	0	0	0	0	0	
9	EC > 8 to 10 aromatic		0	0.00E+00		0.00E+00	0	0	0	0	0	0	
10	EC > 10 to 12 aromatic		5.59E-05	2.81E-07	6.31E-06	2.05E-05	65.45191	3.83E-05	0.020921	0.00529	9.83E-05	2.27E-05	
11	EC >12 to 16 aromatic		5.21E-05	9.91E-08	2.23E-06	2.61E-05	299.9312	3.57E-05	0.095868	0.024243	0.000125	8.01E-06	
12	EC >16 to 21 aromatic		1.28E-05	5.98E-09	1.35E-07	1.07E-05	830.1501	1.17E-05	0.353793	0.089465	0	0	
13	EC >21 to 35 aromatic		1.23E-06	2.97E-11	6.67E-10	2.59E-06	9911.152	1.13E-06	4.223931	1.068126	0	0	
		Total:	0.000122	2.58E-06	5.8E-05	0.0009367	62000	8.69E-05	5.239644	1.324975	0.000441	6.01E-05	
									6.56506	overall soil HQ			

Sample													
89568		Calculation results for potential exposure point concentrations:						Calculated HI and HQ values:					
list index	name		C gw (mg/L)	C air out (mg/m3)	C air in (mg/m3)	C air out ss(mg/m3)	C soil (mg/kg)	drinking water HI	soil ingestion HI	dermal contact HI	outdoor surficial soil air HI	indoor air HI	
1	EC 5 to 6 aliphatic		0	0		0	0	0	0	0	0	0	
2	EC >6 to 8 aliphatic		0.000101	0.000182	0.004087	0.0011281	306.1898	5.55E-07	0.000783	0.000198	5.88E-05	0.00016	
3	EC >8 to 10 aliphatic		4.12E-05	1.18E-04	0.002657	0.002334	2015.717	1.13E-05	0.257717	0.06517	0.002238	0.001911	
4	EC >10 to 12 aliphatic		2.80E-06	1.20E-05	2.71E-04	0.0007653	2125.878	7.67E-07	0.271802	0.068732	0.000734	0.000195	
5	EC >12 to 16 aliphatic		9.86E-08	1.84E-06	4.13E-05	0.0004192	4179.321	2.7E-08	0.534342	0.135122	0.000402	2.97E-05	
6	EC >16 to 21 aliphatic		1.38E-09	2.42E-07	5.45E-06	0.0003571	23031.05	1.89E-11	0.14723	0.037231	0	0	
7	Benzene (EC 5 to 7) aromatic		0	0		0	0	0	0	0	0	0	
8	Toluene (EC >8 to 10) aromatic		0	0		0	0	0	0	0	0	0	
9	EC > 8 to 10 aromatic		0.001305	2.25E-05	5.05E-04	4.57E-04	407.0199	0.000894	0.130098	0.032898	0.002193	0.001817	
10	EC > 10 to 12 aromatic		4.99E-04	2.51E-06	5.64E-05	0.0001569	429.2639	0.000342	0.137208	0.034696	0.000752	0.000203	
11	EC >12 to 16 aromatic		0.0002	3.81E-07	8.57E-06	8.58E-05	843.9013	0.000137	0.26974	0.068211	0.000411	3.08E-05	
12	EC >16 to 21 aromatic		2.14E-05	9.99E-09	2.25E-07	1.52E-05	1011.153	1.96E-05	0.430933	0.108972	0	0	
13	EC >21 to 35 aromatic		7.94E-07	1.91E-11	4.29E-10	1.43E-06	4650.501	7.25E-07	1.981949	0.501185	0	0	
		Total:	0.002172	0.000339	0.007632	0.0057204	39000	0.001406	4.161802	1.052416	0.006789	0.004346	
									5.221007	overall soil HQ			

Attachment 2:

Summary of Exposure Parameters and Model Equations

George DeVaull

March 9, 1998

The following is a summary of the applicable equations and exposure parameters used in calculating risk-based screening levels and risk levels. These equations and parameters are consistent with those used in USEPA risk assessment guidance (USEPA, 1991b, 1989b, 1989a), in the ASTM Standard, *Risk-Based Corrective Action Applied at Petroleum Release Sites* (ASTM E 1739-95), and in the recently approved ASTM *Standard Guide for Risk Based Corrective Action* (number not yet assigned). Several listed exposure parameters are not relevant in this assessment, but are included here for completeness. Where a site-specific parameter is used, it is noted.

Parameters are defined as follows:

exposure parameters and definitions				
The following parameters are consistent with the Maximally Exposed Individual (MEI) definition for upper range exposure.				
AT_c	defined carcinogen averaging time		70 yrs	Lifetime (EPA, 1991b)
AT_n	defined averaging time for non-carcinogens	residential: commercial:	30 yrs 25 yrs	equal to ED, corresponds to assumed exposure duration
BW	body weight	residential: commercial:	70 kg 70 kg	used directly and in calculating age-adjusted exposure values: residential: 70 kg adult, 15 kg child (1-6 yrs), (EPA, 1991b), 35 kg (1-17 yrs) EPA, 1989b commercial/industrial, EPA (1989b)
ED	exposure duration	residential: commercial:	30 yrs 25 yrs	residential: 24 yr adult (ages 7 to 31 years), 6 yr child (ages 1 to 6 years) = 30 years total, Default value (EPA, 1991b)
EF	exposure frequency	residential: commercial:	350 dys/yr 250 dys/yr	Default value (EPA, 1991b)
$IR_{s,\ adj.}$ IR_s	Soil ingestion rate	residential: commercial:	114 mg-yr/ kg-day 50 mg/day	residential: 100 mg/dy adult Default value (EPA, 1991b), 200 mg/dy child Default value (EPA, 1991b) [The calculated age-adjusted value is listed] commercial/industrial: Default value (EPA, 1991b)
AA_s	age adjustment on soil ingestion	residential: commercial:	yes no	residential: for carcinogens, age-adjusted values, 1-6 yrs child, 7-31 yrs adult. For non-carcinogens, child and adult expsoure is evaluated separately. adult receptor only.
IR_a	Daily inhalation rate	residential: commercial:	15 m^3/dy (indoors) 20 m^3/dy (outdoors) 20 m^3/dy	residential: Default value (EPA, 1991b) commercial/industrial: assumed 8 hr per dy exposure of 60 m^3/dy total

IR_w	Daily water ingestion rate	residential: commercial:	2 L/dy 1 L/dy	EPA (1991a)
$SA_{adj.}$	Skin Surface Area	residential:	1567 cm^2-yr/kg	residential: 3176 cm^2 adult - seasonally varying exposure (10-30% of average of mean adult male and female total surface area) (EPA, 1992a); 2023 cm^2 1 to 17 year olds - seasonally varying exposure (10-30% of average of mean male and female total surface area) = 1567 cm^2-yr/kg-dy age-adjusted value.
SA		commercial:	3160 cm^2	commercial/industrial: Based on mean surface area of head, hands, and forearms of adult males (EPA, 1992a)
AA_{SA}	age adjustment on skin surface area	residential: commercial:	yes no	residential: for carcinogens, age-adjusted values, 1-17 yrs, 18-31 yrs adult. For non-carcinogens, child and adult fectors are evaluated separately adult receptor only.
M	Soil to Skin Adherence Factor		0.5 mg/cm^2/dy	EPA dermal exposure assessment guidance (EPA, 1992a) states values should range between 0.2 to 1.0 mg/cm^2/dy

soil parameters and definitions

The listed parameters in this section are consistent with a sandy soil. In this analysis these parameters are applied in estimating vapor emissions from soils. These parameters are conservative (tend to overestimate vapor transport and exposure) compared to actual site soils which are less porous (e. g., silts, silty clays) and which contain a higher fraction of organic carbon. The parameters definitions and values are consistent with ASTM E 1739-95.

θ_w	soil water content - unsaturated (vadose) zone	0.12 cm^3-water/cm^3-soil	
θ_a	soil air content - unsaturated (vadose) zone	0.26 cm^3-air/cm^3-soil	(= θ_T - θ_w)
ρ_s	Soil bulk density	1.7 g/cm^3	
f_{oc}	mass fraction of organic carbon in soil	0.01g-oc / g-soil	
θ_T	Soil porosity	0.38 cm^3-void/cm^3-soil)	
L_s	Depth to contaminated soil	100 cm	assumed depth to subsurface contaminated soil is 1 m; shallower soil is considered surficial soil.

surface parameters and definitions

The listed parameters are used primarily to estimate dispersion in the atmosphere. The parameters lead to relatively conservative results for a receptor located at the center of an areal source. The parameters definitions and values are consistent with ASTM E 1739-95.

τ	Exposure duration	residential: commercial:	30 yr 25 yr	value is equal to ED for undisturbed soils.
U	Ambient air velocity in mixing zone		225 cm/s	
δ	Mixing zone height		200 cm	
A	Contaminated Area		20250000 cm^2	area in this assessment is assumed to be equal to approximately 21800 ft^2 (0.55 acre)
W	Width of Contaminated Area		4500 cm	= [A] $^{1/2}$

L_{ss}	Thickness of Surficial Soils		100 cm	this is the assumed depth of surficial soils. contamination at greater depth is classified as subsurface contamination. Because of the potential for construction activity at this site, all soil measurements are screened against both surface and subsurface soil criteria.
P_e	Particulate areal emission rate	residential & commercial:	6.86E-14 g/cm^2-s	Cowherd, 1985. Estimated dust emissions from bare, uncrusted dry soil with unlimited erosion potential

Indoor air parameters and definitions				
The listed parameters are used primarily to estimate indoor air infiltration from subsurface soils. The parameters definitions and values in this section are consistent with ASTM E 1739-95, and with Johnson and Ettinger (1991).				
L_b	enclosed space volume/infiltration area ratio	residential: commercial:	200 cm 300 cm	For a slab foundation, this is the building height. For a basement, the subsurface walls and floor are included in this ratio.
ER	enclosed space air exchange rate	residential: commercial:	12 /day 20 /day	nominal values for occupied buildings
L_{crack}	enclosed-space foundation or wall thickness		15 cm	
η	foundation crack fraction		0.01 cm^2-cracks/cm^2-total area	
dP	indoor/outdoor differential pressure		0 g/cm-s^2	
k_v	soil permeability		10^{-8} cm^2	
Z_{crack}	depth to bottom of slab		15 cm	
X_{crack}	slab perimeter		3400 cm	
A_b	slab area		700000 cm^2	

chemical parameters			
all of the following are chemical-specific. they are tabulated for the Target Contaminant List at the end of this section.			
CAS	chemical-specific		Chemical Abstracts Service Reference Number
MW		g/g-mol	molecular weight
D_{air}		cm^2/s	molecular diffusion coefficient in air
D_{water}		cm^2/s	molecular diffusion coefficient in water
K_{oc}		L-water/kg-oc	organic carbon - water partition coefficient
K_d		L-water/kg-soil	soil- water partition coefficient
H'		atm-m^3/g-mol	Henry's law coefficient
H		cm^3-water / cm^3-air	Henry's law coefficient = H' · (1000 cm^3/L) / R T_a
P_{vap}		mm Hg	saturated vapor pressure
S		mg/L	aqueous solubility limit
pK_a		(–)	acid ionization equilibrium constant
pK_b		(–)	base ionization equilibrium constant
RfD_o		mg/kg-dy	chronic oral reference dose
RfD_i		mg/kg-dy	chronic inhalation reference dose
SF_o		(mg/kg-dy) $^{-1}$	chronic oral slope factor
SF_i		(mg/kg-dy) $^{-1}$	chronic inhalation slope factor
RAF_o			relative absorption factor, oral (= 1)
RAF_d			relative absorption factor, dermal

global parameters		
μ	g/cm-s	viscosity of air (= $1.81 \cdot 10^{-4}$)
ρ_a	g/cm^3	ambient air density (= 0.0012)
T_a	K	average ambient air temperature (= 293)
R	atm-L/g-mol-K	ideal gas constant (= 0.08206)

target risk or hazard quotients	
HQ	specified hazard quotient (= 1.0)
Risk	specified risk level or range (10^{-4} to 10^{-6})

References

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Equations Used to Develop Example Tier 1 Risk-Based Screening Levels (RBSLs)

The following equations have been used in developing Risk-Based Screening Levels (RBSLs). The equations are consistent with the ASTM Standard, *Risk-Based Corrective Action Applied at Petroleum Release Sites* (ASTM E 1739-95), and are consistent and similar in nomenclature to the recently approved (Oct 97) ASTM *Standard Guide for Risk Based Corrective Action* (number not yet assigned).

The RBSL table in ASTM E 1739-95 is written as an example. Additions have been included here, in particular, evaluation of surface soils for residential receptors include evaluation of child exposure, as well as adult exposure.

Risk-Based Screening Level Concentration for Air: Inhalation - indoor and outdoor vapors

for non-carcinogens:

$$RBSL_{air} = \frac{THQ \cdot RfC_i \cdot AT_n \cdot 365\ days/year}{ED \cdot EF}$$

for carcinogens:

$$RBSL_{air} = \frac{Risk \cdot BW \cdot AT_c \cdot 365\ days/year}{SF_i \cdot IR_{air} \cdot ED \cdot EF}$$

For $RBSL_{air} > C_{sat,vap}$, the calculated concentration is greater than the pure chemical component saturated vapor concentration limit, and the specified risk or hazard level cannot be achieved in the defined scenario (unless an aerosol of the chemical is inhaled).

$RBSL_{air}$	Risk-Based Screening Level for air inhalation (mg/m^3)
AT_c	defined carcinogen averaging time (years)
AT_n	defined averaging time for non-carcinogen (years), = ED
BW	body weight (kg)
$C_{sat,vap}$	pure chemical saturated vapor concentration (mg/m^3)
ED	exposure duration (years)
EF	exposure frequency (days/year)
IR_{air}	daily inhalation rate (m^3/day) - indoor or outdoor
RfC_i	chronic inhalation reference concentration (mg/m^3)
Risk	target excess individual lifetime cancer risk (TR_U to TR_L range)
SF_i	carcinogenic slope factor - inhalation $(mg/kg\text{-}day)^{-1}$
THQ	target hazard quotient for individual chemicals (unitless)

Risk-Based Screening Level Concentration for Ground Water: Ingestion (potable water supply only)

for non-carcinogens:

$$RBSL_{gw} = \frac{THQ \cdot RfD_o \cdot BW \cdot AT_n \cdot 365\ days/year}{IR_w \cdot ED \cdot EF}$$

for carcinogens:

$$RBSL_{gw} = \frac{Risk \cdot BW \cdot AT_c \cdot 365\ days/year}{SF_o \cdot IR_w \cdot ED \cdot EF}$$

For $RBSL_{gw} > S$, the calculated concentration is greater than the pure chemical component aqueous solubility limit and the specified risk or hazard level cannot be achieved in the defined scenario (unless free-phase chemical is mixed with the ingested water).

other relevant criteria:

$$RBSL_{gw} = MCL$$

$RBSL_{gw}$	Risk-Based Screening Level for ground water ingestion (mg/L)
AT_c	defined carcinogen averaging time (years)
AT_n	defined averaging time for non-carcinogen (years), = ED
BW	body weight (kg)
ED	exposure duration (years)
EF	exposure frequency (days/year)
IR_w	daily water ingestion rate (L/day)
RfD_o	chronic oral reference dose (mg/kg-day)
Risk	target excess individual lifetime cancer risk (TR_U to TR_L)
S	pure chemical aqueous solubility limit (mg/L)
SF_o	carcinogenic slope factor - oral $(mg/kg\text{-}day)^{-1}$
THQ	target hazard quotient for individual chemicals (unitless)
MCL	Federal drinking water criteria concentration (mg/L)

Risk-Based Screening Level Concentration for Ground Water: enclosed-space (indoor) vapor inhalation

$$RBSL_{gw} = \frac{RBSL_{air}}{VF_{gw,esp}} \cdot 10^{-3}\,\frac{m^3}{L}$$

For $RBSL_{gw} > S$, the calculated concentration is greater than the pure chemical component aqueous solubility limit and the specified risk or hazard level cannot be achieved in the defined scenario.

$RBSL_{gw}$	Risk-Based Screening Level for ground water ingestion (mg/L)
$RBSL_{air}$	Risk-Based Screening Level for air inhalation (mg/m^3)
$VF_{gw,esp}$	volatilization factor, ground water to enclosed space air (cm^3-water/cm^3-air)

Risk-Based Screening Level for Surficial Soil: ingestion of soil, inhalation of vapors and particulates, and dermal contact

for non-carcinogens:

$$RBSL_{ss} = \frac{THQ \cdot BW \cdot AT_n \cdot (365\ days/year)}{EF \cdot ED} \Big/ \left[10^{-6}\,\frac{kg}{mg} \cdot \left(\frac{IR_s \cdot RAF_o}{RfD_o} + \frac{SA \cdot M \cdot RAF_d}{RfD_o} \right) + \frac{BW \cdot (VF_{ss} + VF_p)}{RfC_i} \cdot 10^3\,\frac{cm^3}{m^3}\frac{kg}{g} \right]$$

for carcinogens:

$$RBSL_{ss} = \frac{Risk \cdot BW \cdot AT_c \cdot (365\ days/year)}{EF \cdot ED} \Big/ \left[10^{-6}\,\frac{kg}{mg} \cdot \left(SF_o \cdot IR_s \cdot RAF_o + SF_o \cdot SA \cdot M \cdot RAF_d \right) + SF_i \cdot IR_{air} (VF_{ss} + VF_p) \cdot 10^3\,\frac{cm^3}{m^3}\frac{kg}{g} \right]$$

$RBSL_{ss}$	Risk-Based Screening Level for Surficial Soil (mg/kg)
AT_c	defined carcinogen averaging time (years)
AT_n	defined averaging time for non-carcinogen (years, = ED)
BW	body weight (kg)
ED	exposure duration (years)

EF	exposure frequency (days/year)
IR_{air}	daily inhalation rate (m^3/day) - outdoor
IR_s	soil ingestion rate (mg/day)
M	*soil to skin adherence factor* (mg/cm^2)
RAF_d	dermal relative absorption factor
RAF_o	dermal relative absorption factor
RfC_i	chronic inhalation reference concentration (mg/m^3)
RfD_o	chronic oral reference dose (mg/kg-day)
Risk	target excess individual lifetime cancer risk (TR_U to TR_L)
SA	seasonally-averaged skin surface area (cm^2/day)
SF_i	slope factor - inhalation $(mg/kg\text{-}day)^{-1}$
SF_o	slope factor - oral $(mg/kg\text{-}day)^{-1}$
THQ	target hazard quotient for individual chemicals (unitless)
VF_{ss}	volatilization factor, surficial soil to ambient air (g-soil/cm^3-air)
VF_p	total respirable particulate concentration from soil source (g-soil/cm^3-air)

The $RBSL_{ss}$ value for surficial soil may also include age-adjusted exposure factors. For non-carcinogens:

$$RBSL_{ss} = \frac{THQ \cdot BW \cdot AT_n \cdot (365\ days/year)}{EF \cdot ED} \Bigg/ \left[10^{-6}\frac{kg}{mg} \cdot \frac{BW}{ED} \cdot \left(\frac{IR_{s,adj} \cdot RAF_o}{RfD_o} + \frac{SA_{adj} \cdot M \cdot RAF_d}{RfD_o} \right) + \frac{BW \cdot (VF_{ss} + VF_p)}{RfC_i} \cdot 10^3 \frac{cm^3}{m^3}\frac{kg}{g} \right]$$

for carcinogens:

$$RBSL_{ss} = \frac{Risk \cdot BW \cdot AT_c \cdot (365\ days/year)}{EF \cdot ED} \Bigg/ \left[10^{-6}\frac{kg}{mg} \cdot \frac{BW}{ED} \cdot \left(SF_o \cdot IR_{s,adj} \cdot RAF_o + SF_o \cdot SA_{adj} \cdot M \cdot RAF_d \right) + SF_i \cdot IR_{air} (VF_{ss} + VF_p) \cdot 10^3 \frac{cm^3}{m^3}\frac{kg}{g} \right]$$

with parameters as before, except

$IR_{s,adj.}$	soil ingestion rate (mg-yr/kg-day)
$SA_{adj.}$	seasonally-averaged skin surface area (cm^2-yr/kg)

For age-adjusted dermal surface area and for the residential exposure scenario (example),

$$SA_{adj} = \frac{SA_{age\ 1\text{-}17} \cdot ED_{age\ 1\text{-}17}}{BW_{age\ 1\text{-}17}} + \frac{SA_{age\ 18\text{-}31} \cdot ED_{age\ 18\text{-}31}}{BW_{age\ 18\text{-}31}}$$

$$SA_{adj} = \frac{2023\ cm^2 \cdot 16\ yr}{35\ kg} + \frac{3176\ cm^2 \cdot 14\ yr}{70\ kg} = 1563\ \frac{cm^2\text{-}yr}{kg}$$

For soil ingestion and the residential exposure scenario (example),

$$IR_{s,adj} = \frac{IR_{s,age\ 1\text{-}6} \cdot ED_{age\ 1\text{-}6}}{BW_{age\ 1\text{-}6}} + \frac{IR_{s,age\ 7\text{-}31} \cdot ED_{age\ 7\text{-}31}}{BW_{age\ 7\text{-}31}}$$

$$IR_{s,adj} = \frac{200\ mg/dy \cdot 6\ yr}{15\ kg} + \frac{100\ mg/dy \cdot 24\ yr}{70\ kg} = 114\ \frac{mg\text{-}yr}{kg\text{-}dy}$$

Risk-Based Screening Level Concentration for Ground Water: ambient (outdoor) vapor inhalation

$$RBSL_{gw} = \frac{RBSL_{air}}{VF_{gw,amb}} \cdot 10^{-3}\frac{m^3}{L}$$

For $RBSL_{gw} > S$, the calculated concentration is greater than the pure chemical component aqueous solubility limit and the specified risk or hazard level cannot be achieved in the defined scenario.

$RBSL_{gw}$ Risk-Based Screening Level for ground water ingestion (mg/L)
$RBSL_{air}$ Risk-Based Screening Level for air inhalation (mg/m^3)
$VF_{gw,amb}$ volatilization factor, ground water to ambient air (cm^3-water/cm^3-air)

Risk-Based Screening Level for Subsurface Soil: ambient (outdoor) vapor inhalation

$$RBSL_s = \frac{RBSL_{air}}{VF_{s,amb}} \cdot 10^{-3} \frac{g}{kg} \frac{m^3}{cm^3}$$

For $RBSL_s > C_{sat,soil}$, the calculated value requires a pore air concentration greater than the pure chemical component saturated vapor concentration limit and the specified risk or hazard level cannot be achieved in the defined scenario.

$RBSL_s$ Risk-Based Screening Level for soil (mg/kg)
$RBSL_{air}$ Risk-Based Screening Level for air inhalation (mg/m^3)
$VF_{s,amb}$ volatilization factor, soil to ambient air (g-soil/cm^3-air)

Risk-Based Screening Level for Subsurface Soil: enclosed space (indoor) vapor inhalation

$$RBSL_s = \frac{RBSL_{air}}{VF_{s,esp}} \cdot 10^{-3} \frac{g}{kg} \frac{m^3}{cm^3}$$

For $RBSL_s > C_{sat,soil}$, the calculated value requires a pore air concentration greater than the pure chemical component saturated vapor concentration limit and the specified risk or hazard level cannot be achieved in the defined scenario.

$RBSL_s$ Risk-Based Screening Level for soil (mg/kg)
$RBSL_{air}$ Risk-Based Screening Level for air inhalation (mg/m^3)
$VF_{s,esp}$ volatilization factor, soil to enclosed space (g-soil/cm^3-air)

Risk-Based Screening Level for Soil: leaching to ground water

$$RBSL_s = \frac{RBSL_{gw}}{LF_{sw}} \cdot 10^{0} \frac{g}{kg} \frac{L}{cm^3}$$

For $RBSL_s > C_{sat,soil}$, the calculated value requires a pore water concentration greater than the pure chemical component solubility limit and the specified risk or hazard level cannot be achieved in the defined scenario.

$RBSL_s$ Risk-Based Screening Level for soil (mg/kg)
LF_{sw} leaching factor, soil to groundwater (g-soil/cm^3-water)
$RBSL_{gw}$ Risk-Based Screening Level for ground water ingestion (mg/L)

Apportionment of Risk-Based Screening Level for Surficial Soil: ingestion of soil, inhalation of vapors and particulates, and dermal contact

for non-carcinogens:

$$\text{ingestion (\%)} = 100 \cdot \left[10^{-6} \frac{kg}{mg} \cdot \left(\frac{IR_s \cdot RAF_o}{RfD_o} \right) \right] / D$$

$$\text{dermal (\%)} = 100 \cdot \left[10^{-6} \frac{kg}{mg} \cdot \left(\frac{SA \cdot M \cdot RAF_d}{RfD_o} \right) \right] / D$$

$$\text{particulate (\%)} = 100 \cdot \left[BW \cdot \frac{VF_p}{RfC_i} \cdot 10^3 \frac{cm^3}{m^3} \frac{kg}{g} \right] / D$$

inhalation (%) = 1 – ingestion – dermal – particulate

with

$$D = \left[10^{-6} \frac{kg}{mg} \cdot \left(\frac{IR_s \cdot RAF_o}{RfD_o} + \frac{SA \cdot M \cdot RAF_d}{RfD_o} \right) + \frac{BW \cdot (VF_{ss} + VF_p)}{RfC_i} \cdot 10^3 \frac{cm^3}{m^3} \frac{kg}{g} \right]$$

for carcinogens:

$$\text{ingestion (\%)} = 100 \cdot \left[10^{-6} \frac{kg}{mg} \cdot \left(SF_o \cdot IR_s \cdot RAF_o \right) \right] / D$$

$$\text{dermal (\%)} = 100 \cdot \left[10^{-6} \frac{kg}{mg} \cdot \left(SF_o \cdot SA \cdot M \cdot RAF_d \right) \right] / D$$

$$\text{particulate (\%)} = 100 \cdot \left[SF_i \cdot IR_{air} \cdot VF_p \cdot 10^3 \frac{cm^3}{m^3} \frac{kg}{g} \right] / D$$

inhalation (%) = 1 – ingestion – dermal – particulate

with

$$D = \left[10^{-6} \frac{kg}{mg} \cdot \left(SF_o \cdot IR_s \cdot RAF_o + SF_o \cdot SA \cdot M \cdot RAF_d \right) + SF_i \cdot IR_{air} (VF_{ss} + VF_p) \cdot 10^3 \frac{cm^3}{m^3} \frac{kg}{g} \right]$$

percentage of surficial soil exposure due to:

ingestion	- direct soil ingestion
dermal	- dermal contact
particulate	- inhalation of respirable soil particulates
inhalation	- inhalation of vapors

IR_{air}	daily inhalation rate (m^3/day) - outdoor
IR_s	soil ingestion rate (mg/day)
M	soil to skin adherence factor (mg/cm^2)
RAF_d	dermal relative absorption factor
RAF_o	dermal relative absorption factor
RfC_i	chronic inhalation reference dose (mg/m^3)
RfD_o	chronic oral reference dose (mg/kg-day)
SA	seasonally-averaged skin surface area (cm^2/day)
SF_i	slope factor - inhalation $(mg/kg\text{-}day)^{-1}$
SF_o	slope factor - oral $(mg/kg\text{-}day)^{-1}$
VF_{ss}	volatilization factor, surficial soil to ambient air (g-soil/cm^3-air)
VF_p	total respirable particulate concentration from soil source (g-soil/cm^3-air)

The apportionment, as it relates to surficial soils, may also include age-adjusted exposure factors. For non-carcinogens:

$$\text{ingestion (\%)} = 100 \cdot \left[10^{-6} \frac{kg}{mg} \cdot \frac{BW}{ED} \cdot \left(\frac{IR_{s,adj} \cdot RAF_o}{RfD_o} \right) \right] / D$$

$$\text{dermal (\%)} = 100 \cdot \left[10^{-6} \frac{kg}{mg} \cdot \frac{BW}{ED} \cdot \left(\frac{SA_{adj} \cdot M \cdot RAF_d}{RfD_o} \right) \right] / D$$

$$\text{particulate (\%)} = 100 \cdot \left[BW \cdot \frac{VF_p}{RfC_i} \cdot 10^3 \frac{cm^3}{m^3} \frac{kg}{g} \right] / D$$

inhalation (%) = 1 – ingestion – dermal – particulate

with

$$D = \left[10^{-6} \frac{kg}{mg} \cdot \frac{BW}{ED} \cdot \left(\frac{IR_{s,adj.} \cdot RAF_o}{RfD_o} + \frac{SA_{adj} \cdot M \cdot RAF_d}{RfD_o} \right) + \frac{BW \cdot (VF_{ss} + VF_p)}{RfC_i} \cdot 10^3 \frac{cm^3}{m^3} \frac{kg}{g} \right]$$

for carcinogens:

$$\text{ingestion (\%)} = 100 \cdot \left[10^{-6} \frac{kg}{mg} \cdot \frac{BW}{ED} \cdot \left(SF_o \cdot IR_{s,adj.} \cdot RAF_o \right) \right] / D$$

$$\text{dermal (\%)} = 100 \cdot \left[10^{-6} \frac{kg}{mg} \cdot \frac{BW}{ED} \cdot \left(SF_o \cdot SA_{adj} \cdot M \cdot RAF_d \right) \right] / D$$

$$\text{particulate (\%)} = 100 \cdot \left[SF_i \cdot IR_{air} \cdot VF_p \cdot 10^3 \frac{cm^3}{m^3} \frac{kg}{g} \right] / D$$

inhalation (%) = 1 – ingestion – dermal – particulate

with

$$D = \left[10^{-6} \frac{kg}{mg} \cdot \frac{BW}{ED} \cdot \left(SF_o \cdot IR_{s,adj.} \cdot RAF_o + SF_o \cdot SA_{adj} \cdot M \cdot RAF_d \right) + SF_i \cdot IR_{air} (VF_{ss} + VF_p) \cdot 10^3 \frac{cm^3}{m^3} \frac{kg}{g} \right]$$

with adge-adjustment, parameters are as before, except:

$IR_{s,adj.}$ soil ingestion rate (mg-yr/kg-day)
$SA_{adj.}$ seasonally-averaged skin surface area (cm^2-yr/kg)

Calculated Intermediate Parameters

Volatilization Factor: ground water to enclosed-space (indoor) vapor inhalation

For $Q_s = 0$,

$$VF_{gw,esp} = \frac{1}{\frac{1}{H_{eff}} \left(1 + \frac{D_{eff,ws}}{DF_{esp} L_{gw}} + \frac{D_{eff,ws} \cdot L_{crk}}{D_{eff,crk} \cdot L_{gw} \cdot \eta} \right) \cdot \frac{DF_{esp}}{D_{eff,ws}} \cdot L_{gw}}$$

for $Q_s > 0$,

$$VF_{gw,esp} = \frac{1}{\frac{1}{H_{eff}} \left(e^{\xi} + \frac{D_{eff,ws}}{DF_{esp} L_{gw}} + \frac{D_{eff,ws} \cdot A_b}{Q_s \cdot L_{gw}} \cdot (e^{\xi} - 1) \right) \cdot \frac{DF_{esp} \cdot L_{gw}}{D_{eff,ws} \cdot e^{\xi}}}$$

with

$$\xi = \frac{Q_s \cdot L_{crk}}{A_b \cdot D_{crk} \cdot \eta}$$

$VF_{gw,esp}$ volatilization factor, ground water to enclosed space air (cm^3-water/cm^3-air)
$D_{eff,crk}$ effective diffusivity in soil-filled foundation cracks (cm^2/sec)
$D_{eff,ws}$ effective diffusivity - averaged water table to surface (cm^2/sec)
DF_{esp} dispersion factor for indoor air (cm/s)

H_{eff} effective Henry's law coefficient (cm^3-water/cm^3-air)
L_{gw} depth to ground water (cm)
L_{crk} enclosed-space foundation or wall thickness (cm)
Q_s convective flow through basement slab (cm^3/sec)
η *foundation crack fraction* (cm^2/cm^2)

Volatilization Factor: ground water to ambient (outdoor) vapor inhalation

$$VF_{gw,amb} = \frac{1}{\left(1 + \frac{DF_{amb} \cdot L_{gw}}{D_{eff,ws}}\right)\frac{1}{H_{eff}}}$$

$VF_{gw,amb}$ volatilization factor, groundwater to ambient air (cm^3-water/cm^3-air)
$D_{eff,ws}$ *effective diffusivity - averaged water table to surface* (cm^2/sec)
DF_{amb} dispersion factor for ambient air (cm/s)
H_{eff} effective Henry's law coefficient (cm^3-water/cm^3-air)
L_{gw} depth to ground water (cm)

Volatilization Factor: surficial soils to ambient air (vapors)

$$VF_{ss,amb,1} = \frac{\rho_s}{DF_{amb}} \cdot \sqrt{\frac{4 \cdot D_{eff,vad}}{\pi \cdot \tau \cdot 31536000 \text{ sec/year}} \cdot \frac{H_{eff}}{K_{sw} \cdot \rho_s}} \quad (1)$$

or

$$VF_{ss,amb,2} = \frac{L_{ss} \cdot \rho_s}{DF_{amb} \cdot \tau \cdot 31536000 \text{ sec/year}} \quad (2)$$

Choose whichever is less, VF_{ss} = minimum of (1) and (2)

VF_{ss} volatilization factor, surficial soil to ambient air (g-soil/cm^3-air)
$D_{eff,vad}$ effective diffusion coefficient for vadose-zone soils (cm^2/sec)
DF_{amb} dispersion factor for ambient air (cm/s)
H_{eff} effective Henry's law coefficient (cm^3-water/cm^3-air)
K_{sw} soil to water partition coefficient (cm^3-water/g-soil)
L_{ss} *thickness of surficial soils (cm)*
ρ_s dry soil bulk density (g/cm^3)
τ averaging time for surface emission vapor flux (years)

Particulate Concentration: total respirable particulate concentration originating from surficial soil source

$$VF_p = \frac{P_e}{DF_{amb}}$$

VF_p total respirable particulate concentration from soil source (g-soil/cm^3-air)
DF_{amb} dispersion factor for ambient air (cm/sec)
P_e Areal total respirable particulate emission flux from source (g/cm^2-sec)

Cowherd, C., G. E. Muleski, P. J. Englehart, and D. A. Gillette, 1985: Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites, Midwest Research Institute, PB85-192219.

Volatilization Factor: subsurface soil to ambient (outdoor) vapor inhalation

$$VF_{s,amb} = \frac{1}{\left(1 + \frac{DF_{amb} \cdot L_s}{D_{eff,vad}}\right) \cdot \frac{K_{sw}}{H_{eff}}}$$

$VF_{s,amb}$	volatilization factor, subsurface soil to ambient air (g-soil/cm^3-air)
$D_{eff,vad}$	effective diffusion coefficient - vadose zone soils (cm^2/sec)
DF_{amb}	dispersion factor for ambient air (cm/s)
H_{eff}	effective Henry's law coefficient (cm^3-water/cm^3-air)
K_{sw}	soil to water partition coefficient (cm^3-water/g-soil)
L_s	depth to subsurface soils (cm)

Volatilization Factor: subsurface soil to enclosed-space (indoor) vapor inhalation

For $Q_s = 0$,

$$VF_{s,esp} = \frac{1}{\frac{K_{sw}}{H_{eff}}\left(1 + \frac{D_{eff,vad}}{DF_{esp} L_s} + \frac{D_{eff,vad} \cdot L_{crk}}{D_{eff,crk} \cdot L_s \cdot \eta}\right) \cdot \frac{DF_{esp}}{D_{eff,vad}} \cdot L_s}$$

for $Q_s > 0$,

$$VF_{s,esp} = \frac{1}{\frac{K_{sw}}{H_{eff}}\left(e^{\xi} + \frac{D_{eff,vad}}{DF_{esp} L_s} + \frac{D_{eff,vad} \cdot A_b}{Q_s \cdot L_s} \cdot (e^{\xi} - 1)\right) \cdot \frac{DF_{esp} \cdot L_s}{D_{eff,vad} \cdot e^{\xi}}}$$

with

$$\xi = \frac{Q_s \cdot L_{crk}}{A_b \cdot D_{crk} \cdot \eta}$$

$VF_{s,esp}$	volatilization factor, subsurface soil to enclosed-space air (g-soil/cm^3-air)
A_b	slab area (cm^2)
$D_{eff,crk}$	effective diffusivity in soil-filled foundation cracks (cm^2/sec)
$D_{eff,vad}$	effective diffusion coefficient - vadose zone soils (cm^2/sec)
DF_{esp}	dispersion factor for enclosed-space air (cm/s)
H_{eff}	effective Henry's law coefficient (cm^3-water/cm^3-air)
K_{sw}	soil to water partition coefficient (cm^3-water/g-soil)
L_s	depth to subsurface soils (cm)
L_{crk}	enclosed-space foundation or wall thickness (cm)
Q_s	convective flow through basement slab (cm^3/sec)
η	foundation crack fraction (cm^2/cm^2)

Leaching Factor: soil to groundwater

$$LF_{sw} = \frac{LF_{pw,gw}}{K_{sw}}$$

with

$$LF_{pw,gw} = \frac{1}{\left[1 + \frac{U_{gw} \cdot \delta_{gw}}{I \cdot W}\right]}$$

LF_{sw}	leaching factor, soil to groundwater (g-soil/cm^3-wat)
I	water infiltration rate (cm/year)
K_{sw}	soil to water partition coefficient (cm^3-water/g-soil)
$LF_{pw,gw}$	*leaching factor, soil pore water / ground water concentration* ratio (cm^3-water/cm^3-water)
U_{gw}	groundwater Darcy velocity (cm/year)
W	width of source-zone area (cm)
δ_{gw}	groundwater mixing zone height (cm)

Ground water transport attenuation factor

$$\frac{c(x, y, 0)}{c(0, 0, 0)} = AF_{gw}$$

$$AF_{gw} = \frac{1}{4} \cdot \exp\left[\frac{x}{2 \cdot \alpha_x} \cdot \left(1 - \sqrt{\frac{4 \cdot \lambda \cdot \alpha_x}{v}}\right)\right] \cdot \left\{\operatorname{erf}\left[\frac{y + Y/2}{2 \cdot \sqrt{\alpha_y \cdot x}}\right] - \operatorname{erf}\left[\frac{y - Y/2}{2 \cdot \sqrt{\alpha_y \cdot x}}\right]\right\} \cdot \left\{\operatorname{erf}\left[\frac{Z}{2 \cdot \sqrt{\alpha_z \cdot x}}\right] - \operatorname{erf}\left[\frac{-Z}{2 \cdot \sqrt{\alpha_z \cdot x}}\right]\right\}$$

with

$$v = \frac{K \cdot i}{\theta_e \cdot R}$$

c(x, y, z)	groundwater concentration at distance x downstream from source (mg/L)
c(0, 0, 0)	groundwater concentration in source zone (mg/L)
x	distance downgradient from downgradient edge of source (m)
y	distance crossgradient with respect to vertical plane of symetry along plume centerline (m)
z	distance from water table (z = 0)
α_x	longitudinal groundwater dispersivity (m)
α_y	transverse groundwater dispersivity (m)
α_z	vertical groundwater dispersivity (m)
θ_e	effective soil porosity
λ	first order degradation rate (day^{-1})
v	contaminant transport velocity (ft/yr)
K	hydraulic conductivity (ft/yr)
R	*constituent retardation factor*
I	hydraulic gradient (cm/cm)
Y	source width (m)
Z	source depth (m)

Refs:
Dominico, P. A., 1987: An Analytical Model for Multidimensional Transport of a Decaying Contaminant Species, Journal of Hydrogeology, 91, 49-58.
Nevin, J. P., C. J. Newell, T. Kahn, J. Gustafson, 1997: User's Manual for FATE 5 Groundwater Plume Calibration Tool, (Groundwater Services, Inc., Houston, Texas), ISBN 1-882713-07-9.

Effective Diffusion Coefficient in homogeneous soil layers

$$D_{eff} = D_{air} \cdot \left(\frac{\theta_{air}^{3.33}}{\theta_T^2} \right) + D_{water} \cdot \left(\frac{\theta_{water}^{3.33}}{H_{eff} \cdot \theta_T^2} \right)$$

This semi-empirical equation is applicable for estimating the effective diffusion coefficient for porous media in homogeneous soil. It is used here in calculating a value for the vadose zone ($D_{eff,vad}$), the water table capillary fringe region ($D_{eff,cap}$), and in soil-filled enclosed space basement foundation cracks ($D_{eff,crk}$).

D_{eff}	effective diffusion coefficient (cm^2/sec)
D_{air}	molecular diffusion coefficient in air (cm^2/sec)
D_{water}	molecular diffusion coefficient in water (cm^2/sec)
H_{eff}	effective Henry's law coefficient (cm^3-water/cm^3-air)
θ_{air}	soil air content (cm^3-air/cm^3-soil)
θ_{water}	soil water content (cm^3-water/cm^3-soil)
θ_T	soil porosity (cm^3-air/cm^3-soil), = $\theta_{air} + \theta_{water}$

Refs:
Millington and Quirk (1961): Transactions of the Faraday Society, 57, 1200-1207; Jury, W. A., W. F. Spencer, and W. J. Farmer, 1983: Behavior Assessment Model for Trace Organics in Soil: I. Model Description, Journal of Environmental Quality, 12, 558-564; Bruell, C. J., and G. E. Hoag, 1986: The Diffusion of Gasoline-Range Hydrocarbon Vapors in Porous Media, Experimental Methodologies, in Proceedings of the NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Groundwater: Prevention, Detection, and Restoration, November 12-14, Houston.

Effective Diffusion Coefficient: averaged value - water table to soil surface

$$D_{eff,ws} = \frac{L_{gw}}{(h_v / D_{eff,vad}) + (h_{cap} / D_{eff,cap})}$$

$D_{eff,ws}$	effective diffusivity - averaged water table to surface (cm^2/sec)
$D_{eff,vad}$	effective diffusivity - vadose zone soils (cm^2/sec)
$D_{eff,cap}$	effective diffusivity - capillary fringe zone (cm^2/sec)
h_v	vadose zone thickness (cm)
h_{cap}	capillary zone thickness (cm)
L_{gw}	depth to groundwater (cm), $L_{gw} = h_v + h_{cap}$

Equation for Calculating Total Soil Concentration to Pore Water Concentration Ratio

$$K_{sw} = \frac{\theta_w + (K_d \cdot \rho_s) + (H_{eff} \cdot \theta_a)}{\rho_s}$$

This equation is used in calculating the ratio between total soil concentration and pore-water concentration for vadose zone soils. Equilibrium partitioning of the chemical between soil (sorbed), pore water, and pore vapors, at concentrations below the pure component pore water (S) or pore vapor saturation limit ($C_{sat,vap}$) is assumed.

K_{sw}	soil to water partition coefficient (cm^3-water/g-soil)
$C_{sat,vap}$	saturated vapor concentration (mg/m^3-air)
H_{eff}	effective Henry's law coefficient (cm^3-water/cm^3-air)
K_d	soil (sorbed) / water partition coefficient (cm^3-wat/g-soil)
S	pure chemical aqueous solubility limit (mg/L)
ρ_s	dry soil bulk density (g/cm^3)
θ_a	soil air content (cm^3-air/cm^3-soil)
θ_w	soil water content (cm^3-water/cm^3-soil)

The above equation considers a linear isotherm for chemical between soil-sorbed and pore-water phases in the soil matrix. With the more general presumption of a Freundlich isotherm, we have the equation

$$K_{sw} = \frac{c_{soil}}{c_{pw}} = \frac{\theta_w + (K_d \cdot \rho_s) \cdot (c_{pw})^{n-1} + (H_{eff} \cdot \theta_a)}{\rho_s}$$

K_d	soil (sorbed) / water partition coefficient (cm^3-wat/g-soil) or (mg/kg-soil)/(mg/L-wat)
n	*dimensionless exponent*
c_{pw}	chemical concentration in pore water (mg/L)
c_{soil}	chemical concentration in soil water (mg/kg)

Equation for calculating dispersion factor for ambient (outdoor) air

$$DF_{amb} = \frac{U_{air} \cdot W \cdot \delta_{air}}{A}$$

DF_{amb}	dispersion factor for ambient air (cm/sec), or source emission flux / vapor concentration (g/cm^2-sec)/(g/cm^3)
A	source-zone area (cm^2)
U_{air}	ambient air velocity in mixing zone (cm/s)
W	width of source-zone area (cm)
δ_{air}	mixing zone height (cm)

Equation for calculating dispersion factor for enclosed-space (indoor) air

$$DF_{esp} = L_b \cdot ER \cdot \frac{1}{86400 \text{ sec/day}}$$

DF_{esp}	dispersion factor for enclosed-space air (cm/sec), or source emission flux / vapor concentration (g/cm^2-sec)/(g/cm^3)
ER	enclosed space air exchange rate (1/day)
L_b	enclosed space volume/infiltration area ratio (cm)

Equation for calculating effective Henry's law coefficient

$$H_{eff} = H' \cdot UF$$

with

$$H' = \frac{H}{R \cdot T_{amb}} \cdot 10^3 \frac{L}{m^3}$$

H_{eff}	effective Henry's law coefficient (cm^3-water/cm^3-air)
H'	Henry's law coefficient (cm^3-water/cm^3-air)
H	Henry's law coefficient (atm-m^3/mol)
R	ideal gas constant (atm-L/g-mol-K), = 0.08206
T_{amb}	ambient temperature (K), = 293
UF	fraction of unionized chemical in water (g-mol/g-mol)

$$H = \frac{\alpha_{wat} \cdot P_v \cdot MW_{wat}}{\rho_{wat} \cdot (760 \text{ mm Hg/atm}) \cdot (10^6 \text{ cm}^3/\text{m}^3)}$$

α_{wat}	activity coefficient in aqueous phase (g-mol-water/g-mol)
P_v	saturated vapor pressure (mm Hg)
MW_{wat}	molecular weight of water (g-water/g-mol-water), = 18.015
ρ_{wat}	density of water (g-water/cm^3-water), = 1.00

With fractionally soluble chemicals (immiscible), for activity coefficient in water, we use

$$\alpha_{wat} = \frac{\rho_{wat}}{MW_{wat}} \cdot \frac{MW}{S} \cdot 10^6 \frac{cm^3}{L}\frac{mg}{g} \quad \text{for} \quad \frac{P_v}{P_{atm}} < 1$$

$$\alpha_{wat} = \frac{\rho_{wat}}{MW_{wat}} \cdot \frac{MW}{S} \cdot \left(\frac{P_{atm}}{P_v}\right) \cdot 10^6 \frac{cm^3}{L}\frac{mg}{g} \quad \text{for} \quad \frac{P_v}{P_{atm}} > 1$$

MW	molecular weight of chemical (g-water/g-mol-water)
S	pure chemical aqueous solubility limit (mg/L)
P_{atm}	atmospheric pressure (mm Hg), = 760

Equation for pressure-driven convective flow through basement slab

$$Q_s = \frac{2 \cdot \pi \cdot dP \cdot k_v \cdot X_{crk}}{\mu_a \cdot \ln\left(\frac{2 \cdot Z_{crk}}{R_{crk}}\right)}$$

with

$$R_{crk} = \frac{A_b \cdot \eta}{X_{crk}}$$

This equation describes volumetric flow through a crack of total length X_{crk}, width R_{crk}, and a cylinderical pressure field and orthogonal flow field which extends into the soil.

Q_s	convective flow through basement slab (cm^3/sec)
A_b	slab area (cm^2)
dP	indoor/outdoor differential pressure (g/cm-s^2)
k_v	soil permeability (cm^2)
X_{crk}	slab perimeter - total crack length (cm)
Z_{crk}	depth to bottom of slab (cm)
μ_{air}	viscosity of air (g/cm-s), = $1.81 \cdot 10^{-4}$
η	foundation crack fraction (cm^2-cracks/cm^2-total area)

Ref: Johnson, P. C. and R. A. Ettinger, 1991: "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings", Environmental Science & Technology, 25, 1445-1452.

Equation for Calculating Saturated Vapor Concentration

$$C_{sat,vap} = \frac{P_v}{760 \text{ mm Hg/atm}} \cdot \frac{MW}{R\,T_{amb}} \cdot 10^6 \frac{mg/m^3}{g/L}$$

This equation is used in calculating the saturated vapor concentration for a pure chemical constiuent. Saturated vapor concentration is the highest concentration achievable in air for a pure chemical constituent under thermodynamic equilibrium at a specified temperature. Saturated vapor concentration is a defined thermodynamic property.

$C_{sat,vap}$	saturated vapor concentration (mg/m^3-air)
MW	molecular weight (g/g-mol)
P_v	saturated vapor pressure (mm Hg)
R	ideal gas constant (atm-L/g-mol-K), = 0.08206
T_{amb}	ambient temperature (K), = 293

Equation for soil / water partition coefficient

For organic chemicals,

$$K_d = K_{oc} \cdot f_{oc}$$

K_d soil (sorbed) / water partition coefficient (cm^3-wat/g-soil)
f_{oc} mass fraction of organic carbon in soil (g-oc/g-soil)
K_{oc} organic carbon / water partition coefficient (L-water/kg-oc)

for inorganic chemicals, K_d is specified directly.

Equation for Calculating Unionized Fraction of Ionizing Chemicals

For acids,

$$UF = \frac{1}{1 + 10^{pH - pK_a}}$$

for bases,

$$UF = \frac{1}{1 + 10^{14 - pH - pK_b}}$$

otherwise,

$$UF = 1$$

For chemicals capable of forming ions in the normal soil/water pH range, the unionized fraction of the chemical in water is calculated. Only the unionized chemical is available for volatilization. Some chemicals may form multiple-charged ions (X++ or X--, etc.). Only singly-charged ions are included in the current equations.

UF fraction of unionized chemical in water (g-mol/g-mol)
pH Soil/water pH
pK_a acid ionization equilibrium constant (log10(g-mol/g-mol))
pK_b base ionization equilibrium constant(log10(g-mol/g-mol))

Ref:
Values of pK_a and pK_b as defined in Waucoupe, 1992: Reviews of Environmental Contamination and Toxicology, 123, 1-155.
Aalund, Leo R., 1986: "One-Step Method Determines Sour Water H_2S Hazard, Oil and Gas Journal, 24 February, 55 - 58.

Equation for Calculating Residual Soil Concentration

$$C_{sat,soil} = S \cdot K_{sw}$$

For a pure chemical constituent, $C_{sat,soil}$ is a value at and above which the chemical is present in soil pore water at its aqueous solubility limit and is present in soil pore air at its saturated vapor concentration.

$C_{sat,soil}$ residual soil concentration (mg/kg)
K_{sw} soil to water partition coefficient (cm^3-water/g-soil)
S pure chemical aqueous solubility limit (mg/L)

Equation for dermal and oral relative absorption factors

The bioavailability of chemicals absorbed on ingested soils affects the amount of contaminant exposure. A relative absorption factor is used to account for the differing bioavailability between the contaminant in the soil matrix and the contaminant in the experimentally administered medium such as solvent or food. In the absence of guidance, we use RAF_o = 1.0 for all chemicals.

The relative absorption factor for the dermal exposure pathway refers to the fraction of chemical, after contact, which is likely to be absorbed through the skin relative to the absorption of the chemical in a laboratory study for which the RfD or SF was derived. We have used USEPA (1989) recomendations:

RAF_d = 0.05	semivolatile organic compounds (PAHs, PCBs) and pesticides with high sorption to soil (taken as $\log_{10}(K_{oc})$ > 2.75)
RAF_d = 0.5	volatile organic compounds and pesticides with low sorption to soil (taken as $\log_{10}(K_{oc})$ < 2.75)
RAF_d = 0	inorganics (negligible)

We note that in separate guidance (USEPA, 1996), has chosen to neglect dermal exposure (RAF_d = 0) for most chemicals, including it in development of soil screening level estimates only for pentachlorophenol.

refs:
USEPA, 1989: Soil Screening Guidance: Technical Background Document, (United States Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC), EPA/540/R-95/128, PB96-963502.
USEPA, 1989: Supplemental Risk Assessment Guidance for the Superfund Program, (United States Environmental Protection Agency, Region I), EPA 901/5-89-001, PB 89-220974.

Equation for water phase chemical retardation factor in saturated flow

$$R_c = 1 + \frac{K_d \cdot \rho_s}{\theta_T}$$

R_c	ratio of groundwater linear velocity to the phase velocity of dissolved chemical species (cm/s-wat / cm/s-phase)
K_d	soil (sorbed) / water partition coefficient (cm^3-wat/g-soil)
ρ_s	dry soil bulk density (g/cm^3)
θ_T	soil porosity (cm^3-void/cm^3-soil)

Equation for water phase chemical retardation factor in vadose zone aqueous leaching

$$R_l = \frac{K_{sw} \cdot \rho_s}{\theta_{wvad}}$$

R_c	ratio of water infiltration linear velocity to the phase velocity of dissolved chemical species (cm/s-wat / cm/s-phase)
K_{sw}	soil to water partition coefficient (cm^3-water/g-soil)
ρ_s	dry soil bulk density (g/cm^3)
θ_{wvad}	vadose zone soil water content (cm^3-water/cm^3-soil)

Site and Scenario-Specific Parameters

parameter	residential	industrial	definition, units
specified risk or hazard criteria			
THQ	1	1	target hazard quotient for individual chemicals (unitless)
TR_U	1.00E-04	1.00E-04	target excess individual lifetime cancer risk - upper range value (unitless)
TR_L	1.00E-06	1.00E-06	target excess individual lifetime cancer risk - lower range value (unitless)
exposure parameters			
AT_c	70	70	defined carcinogen averaging time (years)
AT_n	30	25	defined averaging time for non-carcinogen (years), = ED
BW	70	70	body weight (kg) - adult
BW	15		body weight (kg) - child, 1-6 years
ED	30	25	exposure duration (years)
ED	6		exposure duration (years) - child, 1-6 years
EF	350	250	exposure frequency (days/year)
IR_{soil}	100	50	soil ingestion rate (mg/day) - adult
IR_{soil}	200		soil ingestion rate (mg/day) - child (1-6 yrs)
IR_{soil}	114		soil ingestion rate (mg-yr/kg-day) -- age-adjusted
IR_{air} -indoor	15	20	daily inhalation rate (m^3/day) - indoor
IR_{air} -outdoor	20	20	daily inhalation rate (m^3/day) - outdoor
IR_w	2	1	daily water ingestion rate (L/day)
SA	3160	3160	seasonally-averaged skin surface area (cm^2/day) - adult
SA	2023		seasonally-averaged skin surface area (cm^2/day) - child (1-17yrs)
SA	1567		seasonally-averaged skin surface area (cm^2-yr/day) -- age-adjusted
M	0.5	0.5	soil to skin adherence factor (mg/cm^2)
building parameters			
L_b	200	300	enclosed space volume/infiltration area ratio (cm)
ER	12	20	enclosed space air exchange rate (1/day)
L_{crack}	15	15	enclosed-space foundation or wall thickness (cm)
η	0.01	0.01	foundation crack fraction (cm^2-cracks/cm^2-total area)
dP	0	0	indoor/outdoor differential pressure ($g/cm\text{-}s^2$)
k_v	1.00E-08	1.00E-08	soil permeability (cm^2)
Z_{crack}	15	15	depth to bottom of slab (cm)
X_{crack}	3400	3400	slab perimeter (cm)
A_b	700000	700000	slab area (cm^2)
surface parameters			
τ	30	25	averaging time for surface emission vapor flux (years)
U_{air}	225	225	ambient air velocity in mixing zone (cm/s)
δ_{air}	200	200	mixing zone height (cm)
A	20250000	20250000	source-zone area (cm^2)
W	4500	4500	width of source-zone area (cm)
L_{ss}	100	100	thickness of surficial soils (cm)
P_e	6.90E-14	6.90E-14	Areal total respirable particulate emission flux from source (g/cm^2-s)
derived parameters			
$LF_{pw,gw}$	4.70E+00	4.70E+00	leaching factor, pore water / ground water ratio (cm^3-wat/cm^3-wat)
Q_s	0	0	convective flow through basement slab (cm^3-air/sec)
DF_{esp}	2.78E-02	6.94E-02	dispersion factor for enclosed-space air ($g\text{-}cm^2/s$)/(g/cm^3)
DF_{amb}	10	10	dispersion factor for ambient air ($g\text{-}cm^2/s$)/(g/cm^3)
VF_p	6.9E-15	6.9E-15	total respirable particulate concentration from soil source (g-soil/cm^3-air)
soil parameters			
h_{cap}	5		capillary zone thickness (cm)
h_v	295		vadose zone thickness (cm)
θ_{wcap}	0.342		soil water content - capillary fringe region (cm^3-water/cm^3-soil)
θ_{wvad}	0.12		soil water content - vadose zone (cm^3-water/cm^3-soil)
θ_{wcrk}	0.12		soil water content - soil filled foundation cracks (cm^3-water/cm^3-soil)
θ_{acap}	0.038		soil air content - capillary fringe region (cm^3-air/cm^3-soil)
θ_{avad}	0.26		soil air content - vadose zone (cm^3-air/cm^3-soil)
θ_{acrk}	0.26		soil air content - soil filled foundation cracks (cm^3-air/cm^3-soil)
ρ_s	1.7		soil bulk density - dry soil (g/cm^3)
f_{oc}	0.01		mass fraction of organic carbon in soil (g-oc/g-soil)
θ_T	0.38		soil porosity (cm^3-void/cm^3-soil)
L_{gw}	300		depth to ground water (cm)
L_s	100		thickness of surficial soils (cm)
pH	6.8		soil / water pH (unitless)
groundwater parameters			
δ_{gw}	200		groundwater mixing zone height (cm)
I	30		water infiltration rate (cm/year)
U_{gw}	6.85		groundwater Darcy velocity (cm/day)
derived parameters			
I / θ_w	250		water infiltration linear velocity (cm/yr)
U_{gw} / θ_T	18.0		groundwater linear velocity (cm/day)

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

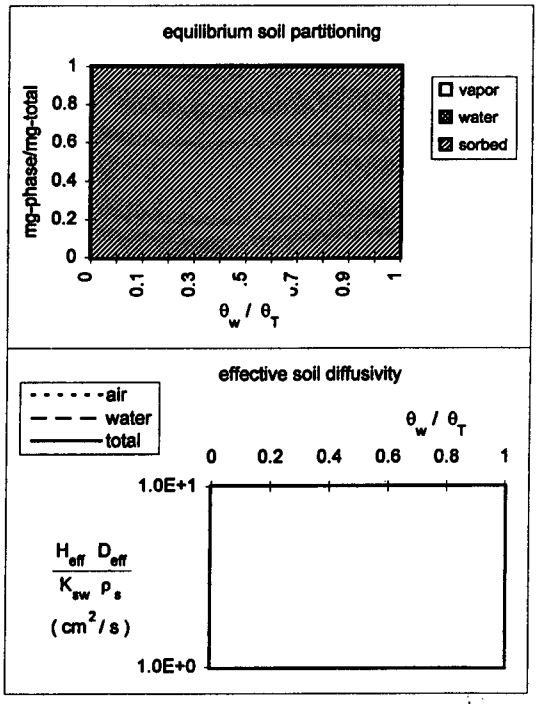
CASRN	7440-38-2
name	arsenic

Risk-Based Screening-Level Concentrations [1]

risk or hazard scenario:		criteria:	residential	industrial
ambient vapor inhalation				
$RBSL_{air}$	THQ = 1		P< (1.10E+00)	P< (1.53E+00)
($\mu g/m^3$)	$TR_U = 10^{-4}$		P< (1.70E-02)	P< (2.86E-02)
	$TR_L = 10^{-6}$		P< (1.70E-04)	P< (2.86E-04)
enclosed space vapor inhalation				
$RBSL_{air}$	THQ = 1		P< (1.46E+00)	P< (1.53E+00)
($\mu g/m^3$)	$TR_U = 10^{-4}$		P< (2.27E-02)	P< (2.86E-02)
	$TR_L = 10^{-6}$		P< (2.27E-04)	P< (2.86E-04)
groundwater ingestion				
$RBSL_{gw}$	THQ = 1		1.10E-02	3.07E-02
(mg/L)	$TR_U = 10^{-4}$		5.68E-03	1.91E-02
	$TR_L = 10^{-6}$		5.68E-05	1.91E-04
	MCL		5.00E-02	5.00E-02
soil leaching to groundwater ingestion				
$RBSL_s$	THQ = 1		1.60E+00	4.48E+00
(mg/kg)	$TR_U = 10^{-4}$		8.30E-01	2.79E+00
	$TR_L = 10^{-6}$		8.30E-03	2.79E-02
	MCL		7.31E+00	7.31E+00
groundwater to ambient vapor inhalation				
$RBSL_{gw}$	THQ = 1		NA	NA
(mg/L)	$TR_U = 10^{-4}$		NA	NA
	$TR_L = 10^{-6}$		NA	NA
groundwater to enclosed space vapor inhalation				
$RBSL_{gw}$	THQ = 1		NA	NA
(mg/L)	$TR_U = 10^{-4}$		NA	NA
	$TR_L = 10^{-6}$		NA	NA
subsurface soil volatilization to ambient air				
$RBSL_s$	THQ = 1		NA	NA
(mg/kg)	$TR_U = 10^{-4}$		NA	NA
	$TR_L = 10^{-6}$		NA	NA
subsurface soil volatilization to enclosed space				
$RBSL_s$	THQ = 1		NA	NA
(mg/kg)	$TR_U = 10^{-4}$		NA	NA
	$TR_L = 10^{-6}$		NA	NA
surficial soil exposure				
$RBSL_{ss}$	THQ = 1		2.19E+02	6.13E+02
(mg/kg)	$TR_U = 10^{-4}$		1.14E+02	3.82E+02
	$TR_L = 10^{-6}$		1.14E+00	3.82E+00
(child)	THQ		2.35E+01	
	TR_U		6.08E+01	
	TR_L		6.08E-01	
(age-adj.)	THQ		8.23E+01	
	TR_U		4.27E+01	
	TR_L		4.27E-01	
surficial soil exposure apportionment [2]				
(%)	THQ = 1		99-00-00-00	99-00-00-00
(i-d-v-p)	$TR_U = 10^{-4}$		99-00-00-00	99-00-00-00
	$TR_L = 10^{-6}$		99-00-00-00	99-00-00-00
(child)	THQ		99-00-00-00	
	TR_U		99-00-00-00	
	TR_L		99-00-00-00	
(age-adj.)	THQ		99-00-00-00	
	TR_U		99-00-00-00	
	TR_L		99-00-00-00	
derived parameters:				
$VF_{s,esp}$			NA	NA (g-soil/cm^3-air)
$VF_{gw,esp}$			NA	NA (cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$			0.00E+00	0.00E+00 (g-soil/cm^3-air)
$VF_{ss,amb,2}$			1.80E-08	2.16E-08 (g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$			0.00E+00	0.00E+00 (g-soil/cm^3-air)
LF_{sw}			6.84E-03	6.84E-03 (g-soil/cm^3-wat)
$VF_{s,amb}$			NA	NA (g-soil/cm^3-air)
$VF_{gw,amb}$			NA	NA (cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	74.91	(g/mole)	USEPA(1996)
D_{air}	NA	(cm^2/sec)	
D_{wat}	NA	(cm^2/sec)	
Kd	1.4913617	log10(L-water/kg-so	USEPA(1996); pH=8.0, As+3
H	0.00E+00	(atm-m^3/mol)	(nonvolatile)
H	0.00E+00	(L-water/L-air)	
P_v	0.00E+00	(mm Hg)	(nonvolatile)
S	NA	(mg/L)	(no limit imposed)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	3.00E-04	(mg/kg-day)	IRIS (1994)
RfC_i	1.05E-03	(mg/m^3)	Route-to-Route
SF_o	1.50E+00	(1/(mg/kg-day))	IRIS (06/01/95)
SF_i	5.00E+01	(1/(mg/kg-day))	HEAST (07/93)
W of E	A		IRIS (1994)
MCL	5.00E-02	(mg/L-wat)	50 FR 46936 (13 Nov 85)
RAF_o	1.00E+00		
RAF_d	0.00E+00		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	0.00E+00	(L-wat/L-air)
$C_{sat,vap}$	0.00E+00	($\mu g/m^3$-air)
K_{sw}	3.11E+01	(L-wat/kg-soil)
$C_{sat,soil}$	NA	(mg/kg-soil)
$D_{eff,vad}$	NA	(cm^2/sec)
$D_{eff,cap}$	NA	(cm^2/sec)
$D_{eff,ws}$	NA	(cm^2/sec)
$D_{eff,crk}$	NA	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN	7782-49-2	
name	selenium	

Risk-Based Screening-Level Concentrations [1]

risk or hazard scenario:	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	P< (1.83E+01)	P< (2.56E+01)
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	P< (2.43E+01)	P< (2.56E+01)
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	1.83E-01	5.11E-01
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	5.00E-02	5.00E-02
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	1.95E+00	5.46E+00
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	5.34E-01	5.34E-01
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	3.65E+03	1.02E+04
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	3.91E+02	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	1.37E+03	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	99-00-00-00	99-00-00-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	99-00-00-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	99-00-00-00	
	TR_U		
	TR_L		

derived parameters:

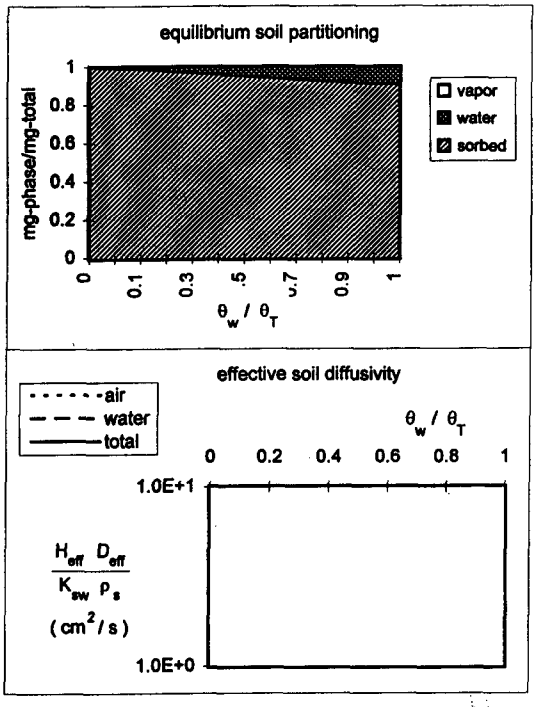
$VF_{s,esp}$	NA	NA	(g-soil/cm^3-air)
$VF_{gw,esp}$	NA	NA	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	0.00E+00	0.00E+00	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	0.00E+00	0.00E+00	(g-soil/cm^3-air)
LF_{sw}	9.36E-02	9.36E-02	(g-soil/cm^3-wat)
$VF_{s,amb}$	NA	NA	(g-soil/cm^3-air)
$VF_{gw,amb}$	NA	NA	(cm^3-wat/cm^3-air)

transport and thermodynamic parameters

			[references]
MW	78.96	(g/mole)	USEPA(1996)
D_{air}	NA	(cm^2/sec)	
D_{wat}	NA	(cm^2/sec)	
Kd	0.3424227	log10(L-water/kg-so	USEPA(1996); pH=8.0
H	0.00E+00	(atm-m^3/mol)	(nonvolatile)
H	0.00E+00	(L-water/L-air)	
P_v	0.00E+00	(mm Hg)	(nonvolatile)
S	NA	(mg/L)	(no limit imposed)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	5.00E-03	(mg/kg-day)	IRIS (1994)
RfC_i	1.75E-02	(mg/m^3)	Route-to-Route
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E	D		IRIS (1994)
MCL	5.00E-02	(mg/L-wat)	56 FR 3526 (30 Jan 91)
RAF_o	1.00E+00		
RAF_d	0.00E+00		

derived parameters dependent on:
chemical properties and soil parameters

UF	1.00E+00	(unitless)
H_{eff}	0.00E+00	(L-wat/L-air)
$C_{sat,vap}$	0.00E+00	($\mu g/m^3$-air)
K_{sw}	2.27E+00	(L-wat/kg-soil)
$C_{sat,soil}$	NA	(mg/kg-soil)
$D_{eff,vad}$	NA	(cm^2/sec)
$D_{eff,cap}$	NA	(cm^2/sec)
$D_{eff,ws}$	NA	(cm^2/sec)
$D_{eff,crk}$	NA	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

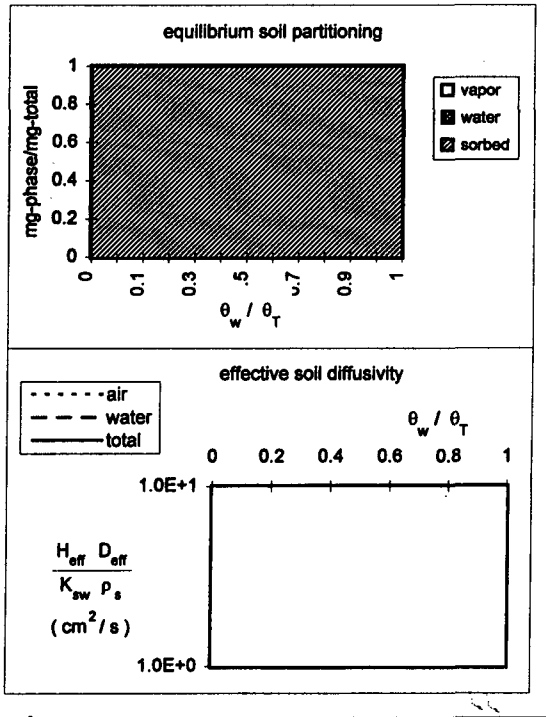
CASRN 7440-43-9
name cadmium

Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	NA	NA
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	NA	NA
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	1.83E-02	5.11E-02
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	5.00E-03	5.00E-03
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	3.69E+02	1.03E+03
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	1.01E+02	1.01E+02
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	3.65E+02	1.02E+03
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	3.91E+01	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	1.37E+02	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	#VALUE!	#VALUE!
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	#VALUE!	
	TR_U		
	TR_L		
(age-adj.)	THQ	#VALUE!	
	TR_U		
	TR_L		
derived parameters:			
$VF_{s,esp}$		NA	NA (g-soil/cm^3-air)
$VF_{gw,esp}$		NA	NA (cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$		0.00E+00	0.00E+00 (g-soil/cm^3-air)
$VF_{ss,amb,2}$		1.80E-08	2.16E-08 (g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$		0.00E+00	0.00E+00 (g-soil/cm^3-air)
LF_{sw}		4.94E-05	4.94E-05 (g-soil/cm^3-wat)
$VF_{s,amb}$		NA	NA (g-soil/cm^3-air)
$VF_{gw,amb}$		NA	NA (cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	112.41	(g/mole)	USEPA(1996)
D_{air}	NA	(cm^2/sec)	
D_{wat}	NA	(cm^2/sec)	
Kd	3.6334685	log10(L-water/kg-so	USEPA(1996); pH=8.0
H	0.00E+00	(atm-m^3/mol)	(nonvolatile)
H	0.00E+00	(L-water/L-air)	
P_v	0.00E+00	(mm Hg)	(nonvolatile)
S	NA	(mg/L)	(no limit imposed)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	5.00E-04	(mg/kg-day)	IRIS (1994)
RfC_i	NA	(mg/m^3)	Route-to-Route inappropriate
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E	B1		IRIS (1994)
MCL	5.00E-03	(mg/L-wat)	56 FR 3526 (30 Jan 91)
RAF_o	1.00E+00		
RAF_d	0.00E+00		

derived parameters dependent on:		
chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	0.00E+00	(L-wat/L-air)
$C_{sat,vap}$	0.00E+00	($\mu g/m^3$-air)
K_{sw}	4.30E+03	(L-wat/kg-soil)
$C_{sat,soil}$	NA	(mg/kg-soil)
$D_{eff,vad}$	NA	(cm^2/sec)
$D_{eff,cap}$	NA	(cm^2/sec)
$D_{eff,ws}$	NA	(cm^2/sec)
$D_{eff,crk}$	NA	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Ra), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN	7440-39-3
name	barium

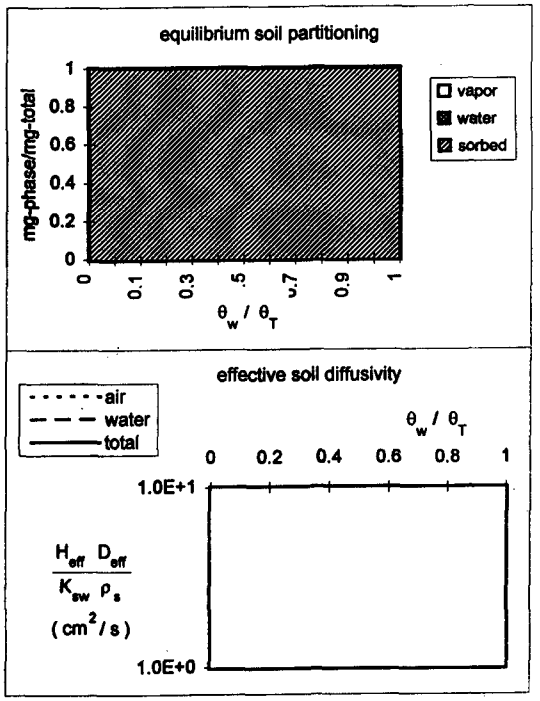
Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

		criteria:	residential	industrial
ambient vapor inhalation				
$RBSL_{air}$		THQ = 1	P< (5.21E-01)	P< (7.30E-01)
($\mu g/m^3$)		$TR_U = 10^{-4}$	NA	NA
		$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation				
$RBSL_{air}$		THQ = 1	P< (6.95E-01)	P< (7.30E-01)
($\mu g/m^3$)		$TR_U = 10^{-4}$	NA	NA
		$TR_L = 10^{-6}$	NA	NA
groundwater ingestion				
$RBSL_{gw}$		THQ = 1	2.56E+00	7.15E+00
(mg/L)		$TR_U = 10^{-4}$	NA	NA
		$TR_L = 10^{-6}$	NA	NA
		MCL	2.00E+00	2.00E+00
soil leaching to groundwater ingestion				
$RBSL_s$		THQ = 1	6.26E+02	1.75E+03
(mg/kg)		$TR_U = 10^{-4}$	NA	NA
		$TR_L = 10^{-6}$	NA	NA
		MCL	4.90E+02	4.90E+02
groundwater to ambient vapor inhalation				
$RBSL_{gw}$		THQ = 1	NA	NA
(mg/L)		$TR_U = 10^{-4}$	NA	NA
		$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation				
$RBSL_{gw}$		THQ = 1	NA	NA
(mg/L)		$TR_U = 10^{-4}$	NA	NA
		$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air				
$RBSL_s$		THQ = 1	NA	NA
(mg/kg)		$TR_U = 10^{-4}$	NA	NA
		$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space				
$RBSL_s$		THQ = 1	NA	NA
(mg/kg)		$TR_U = 10^{-4}$	NA	NA
		$TR_L = 10^{-6}$	NA	NA
surficial soil exposure				
$RBSL_{ss}$		THQ = 1	5.11E+04	1.43E+05
(mg/kg)		$TR_U = 10^{-4}$	NA	NA
		$TR_L = 10^{-6}$	NA	NA
(child)		THQ	5.47E+03	
		TR_U	NA	
		TR_L	NA	
(age-adj.)		THQ	1.92E+04	
		TR_U	NA	
		TR_L	NA	
surficial soil exposure apportionment [2]				
(%)		THQ = 1	99-00-00-00	99-00-00-00
(i-d-v-p)		$TR_U = 10^{-4}$		
		$TR_L = 10^{-6}$		
(child)		THQ	99-00-00-00	
		TR_U		
		TR_L		
(age-adj.)		THQ	99-00-00-00	
		TR_U		
		TR_L		

derived parameters:			
$VF_{s,esp}$	NA	NA	(g-soil/cm^3-air)
$VF_{gw,esp}$	NA	NA	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	0.00E+00	0.00E+00	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	0.00E+00	0.00E+00	(g-soil/cm^3-air)
LF_{sw}	4.08E-03	4.08E-03	(g-soil/cm^3-wat)
$VF_{s,amb}$	NA	NA	(g-soil/cm^3-air)
$VF_{gw,amb}$	NA	NA	(cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	137.33	(g/mole)	USEPA(1996)
D_{air}	NA	(cm^2/sec)	
D_{wat}	NA	(cm^2/sec)	
Kd	1.7160033	log10(L-water/kg-so	USEPA(1996); pH=8.0
H	0.00E+00	(atm-m^3/mol)	(nonvolatile)
H	0.00E+00	(L-water/L-air)	
P_v	0.00E+00	(mm Hg)	(nonvolatile)
S	NA	(mg/L)	(no limit imposed)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	7.00E-02	(mg/kg-day)	IRIS (1994)
RfC_i	5.00E-04	(mg/m^3)	HEAST (07/93)
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL	2.00E+00	(mg/L-wat)	56 FR 30266 (01 Jul 91)
RAF_o	1.00E+00		
RAF_d	0.00E+00		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	0.00E+00	(L-wat/L-air)
$C_{sat,vap}$	0.00E+00	($\mu g/m^3$-air)
K_{sw}	5.21E+01	(L-wat/kg-soil)
$C_{sat,soil}$	NA	(mg/kg-soil)
$D_{eff,vad}$	NA	(cm^2/sec)
$D_{eff,cap}$	NA	(cm^2/sec)
$D_{eff,ws}$	NA	(cm^2/sec)
$D_{eff,crk}$	NA	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN	7440-02-0
name	nickel

Risk-Based Screening-Level Concentrations [1]

risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	P< (7.30E+01)	P< (1.02E+02)
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	P< (9.73E+01)	P< (1.02E+02)
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	7.30E-01	2.04E+00
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	1.00E-01	1.00E-01
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	6.52E+03	1.83E+04
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	8.94E+02	8.94E+02
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	1.46E+04	4.09E+04
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	1.56E+03	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	5.49E+03	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	99-00-00-00	99-00-00-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	99-00-00-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	99-00-00-00	
	TR_U		
	TR_L		

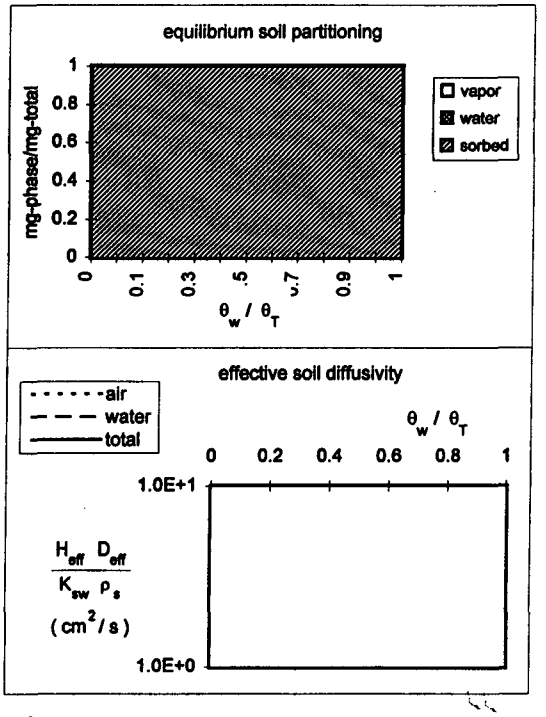
derived parameters:

$VF_{s,esp}$	NA	NA	(g-soil/cm^3-air)
$VF_{gw,esp}$	NA	NA	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	0.00E+00	0.00E+00	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	0.00E+00	0.00E+00	(g-soil/cm^3-air)
LF_{sw}	1.12E-04	1.12E-04	(g-soil/cm^3-wat)
$VF_{s,amb}$	NA	NA	(g-soil/cm^3-air)
$VF_{gw,amb}$	NA	NA	(cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	58.71	(g/mole)	USEPA(1996)
D_{air}	NA	(cm^2/sec)	
D_{wat}	NA	(cm^2/sec)	
Kd	3.2787536	log10(L-water/kg-so	USEPA(1996); pH=8.0
H	0.00E+00	(atm-m^3/mol)	(nonvolatile)
H	0.00E+00	(L-water/L-air)	
P_v	0.00E+00	(mm Hg)	(nonvolatile)
S	NA	(mg/L)	(no limit imposed)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	2.00E-02	(mg/kg-day)	IRIS (1994)
RfC_i	7.00E-02	(mg/m^3)	Route-to-Route
SF_o		(1/(mg/kg-day))	IRIS (03/01/94) under review
SF_i		(1/(mg/kg-day))	IRIS (03/01/94) under review
W of E			
MCL	1.00E-01	(mg/L-wat)	57 FR 31776 (17 Jul 92) Effecti
RAF_o	1.00E+00		
RAF_d	0.00E+00		

derived parameters dependent on:

chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	0.00E+00	(L-wat/L-air)
$C_{sat,vap}$	0.00E+00	($\mu g/m^3$-air)
K_{sw}	1.90E+03	(L-wat/kg-soil)
$C_{sat,soil}$	NA	(mg/kg-soil)
$D_{eff,vad}$	NA	(cm^2/sec)
$D_{eff,cap}$	NA	(cm^2/sec)
$D_{eff,ws}$	NA	(cm^2/sec)
$D_{eff,crk}$	NA	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN 7440-66-6
name zinc

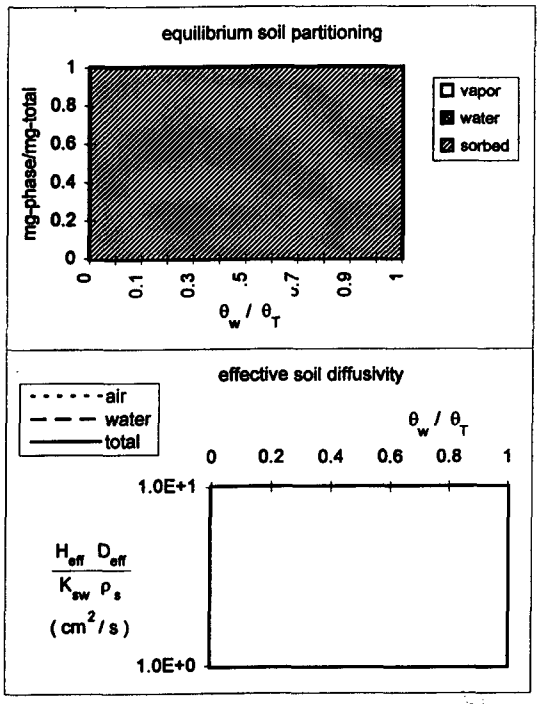
Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	P< (1.10E+03)	P< (1.53E+03)
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	P< (1.46E+03)	P< (1.53E+03)
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	1.10E+01	3.07E+01
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	2.73E+04	7.65E+04
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	2.19E+05	6.13E+05
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	2.35E+04	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	8.23E+04	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	99-00-00-00	99-00-00-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	99-00-00-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	99-00-00-00	
	TR_U		
	TR_L		
derived parameters:			
$VF_{s,esp}$		NA	NA (g-soil/cm^3-air)
$VF_{gw,esp}$		NA	NA (cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$		0.00E+00	0.00E+00 (g-soil/cm^3-air)
$VF_{ss,amb,2}$		1.80E-08	2.16E-08 (g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$		0.00E+00	0.00E+00 (g-soil/cm^3-air)
LF_{sw}		4.01E-04	4.01E-04 (g-soil/cm^3-wat)
$VF_{s,amb}$		NA	NA (g-soil/cm^3-air)
$VF_{gw,amb}$		NA	NA (cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	65.38	(g/mole)	USEPA(1996)
D_{air}	NA	(cm^2/sec)	
D_{wat}	NA	(cm^2/sec)	
Kd	2.7242759	log10(L-water/kg-so	USEPA(1996); pH=8.0
H	0.00E+00	(atm-m^3/mol)	(nonvolatile)
H	0.00E+00	(L-water/L-air)	
P_v	0.00E+00	(mm Hg)	(nonvolatile)
S	NA	(mg/L)	(no limit imposed)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	3.00E-01	(mg/kg-day)	IRIS (1994)
RfC_i	1.05E+00	(mg/m^3)	Route-to-Route
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E	D		IRIS (1994)
MCL		(mg/L-wat)	
RAF_o	1.00E+00		
RAF_d	0.00E+00		

derived parameters dependent on:
chemical properties and soil parameters

UF	1.00E+00	(unitless)
H_{eff}	0.00E+00	(L-wat/L-air)
$C_{sat,vap}$	0.00E+00	($\mu g/m^3$-air)
K_{sw}	5.30E+02	(L-wat/kg-soil)
$C_{sat,soil}$	NA	(mg/kg-soil)
$D_{eff,vad}$	NA	(cm^2/sec)
$D_{eff,cap}$	NA	(cm^2/sec)
$D_{eff,ws}$	NA	(cm^2/sec)
$D_{eff,crk}$	NA	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVault, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN 7440-50-8
name copper

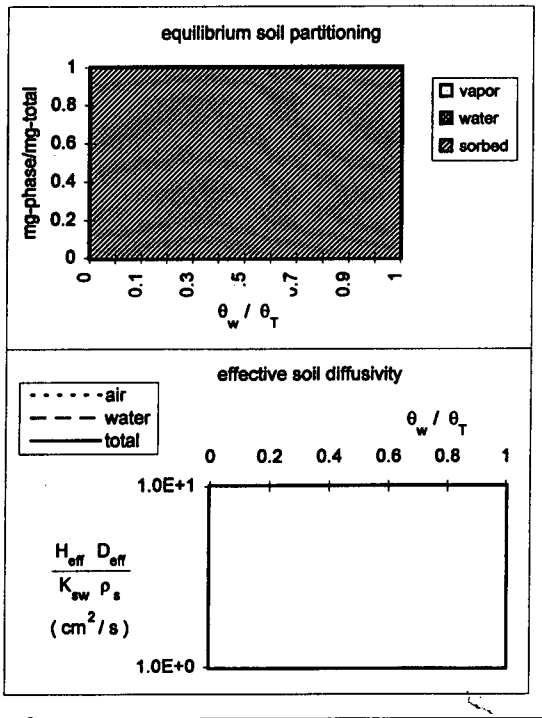
Risk-Based Screening-Level Concentrations [1]

risk or hazard scenario:	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	P< (1.35E+02)	P< (1.89E+02)
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	P< (1.80E+02)	P< (1.89E+02)
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	1.35E+00	3.78E+00
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	1.30E+00	1.30E+00
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	3.19E+02	8.92E+02
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	3.07E+02	3.07E+02
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	2.70E+04	7.56E+04
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	2.89E+03	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	1.02E+04	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	99-00-00-00	99-00-00-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	99-00-00-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	99-00-00-00	
	TR_U		
	TR_L		

derived parameters:			
$VF_{s,esp}$	NA	NA	(g-soil/cm^3-air)
$VF_{gw,esp}$	NA	NA	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	0.00E+00	0.00E+00	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	0.00E+00	0.00E+00	(g-soil/cm^3-air)
LF_{sw}	4.24E-03	4.24E-03	(g-soil/cm^3-wat)
$VF_{s,amb}$	NA	NA	(g-soil/cm^3-air)
$VF_{gw,amb}$	NA	NA	(cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	63.546	(g/mole)	USEPA(1979)
D_{air}	NA	(cm^2/sec)	
D_{wat}	NA	(cm^2/sec)	
Koc	3.6998377	log10(L-water/kg-oc	USEPA(1979)
H	0.00E+00	(atm-m^3/mol)	(nonvolatile)
H	0.00E+00	(L-water/L-air)	
P_v	0.00E+00	(mm Hg)	(nonvolatile)
S	NA	(mg/L)	(no limit imposed)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	3.70E-02	(mg/kg-day)	HEAST (07/93)
RfC_i	1.30E-01	(mg/m^3)	Route-to-Route
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E	D		IRIS (1994)
MCL	1.30E+00	(mg/L-wat)	56 FR 26460 (07 Jun 91) see L
RAF_o	1.00E+00		
RAF_d	0.00E+00		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	0.00E+00	(L-wat/L-air)
$C_{sat,vap}$	0.00E+00	($\mu g/m^3$-air)
K_{sw}	5.02E+01	(L-wat/kg-soil)
$C_{sat,soil}$	NA	(mg/kg-soil)
$D_{eff,vad}$	NA	(cm^2/sec)
$D_{eff,cap}$	NA	(cm^2/sec)
$D_{eff,we}$	NA	(cm^2/sec)
$D_{eff,crk}$	NA	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVault, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN	71-43-2
name	benzene

Risk-Based Screening-Level Concentrations [1]

risk or hazard scenario:		criteria:	residential	industrial
ambient vapor inhalation				
$RBSL_{air}$	THQ = 1		NA	NA
($\mu g/m^3$)	$TR_U = 10^{-4}$		2.94E+01	4.93E+01
	$TR_L = 10^{-6}$		2.94E-01	4.93E-01
enclosed space vapor inhalation				
$RBSL_{air}$	THQ = 1		NA	NA
($\mu g/m^3$)	$TR_U = 10^{-4}$		3.92E+01	4.93E+01
	$TR_L = 10^{-6}$		3.92E-01	4.93E-01
groundwater ingestion				
$RBSL_{gw}$	THQ = 1		NA	NA
(mg/L)	$TR_U = 10^{-4}$		2.94E-01	9.87E-01
	$TR_L = 10^{-6}$		2.94E-03	9.87E-03
	MCL		5.00E-03	5.00E-03
soil leaching to groundwater ingestion				
$RBSL_s$	THQ = 1		NA	NA
(mg/kg)	$TR_U = 10^{-4}$		9.60E-01	3.22E+00
	$TR_L = 10^{-6}$		9.60E-03	3.22E-02
	MCL		1.63E-02	1.63E-02
groundwater to ambient vapor inhalation				
$RBSL_{gw}$	THQ = 1		NA	NA
(mg/L)	$TR_U = 10^{-4}$		3.79E+02	6.37E+02
	$TR_L = 10^{-6}$		3.79E+00	6.37E+00
groundwater to enclosed space vapor inhalation				
$RBSL_{gw}$	THQ = 1		NA	NA
(mg/L)	$TR_U = 10^{-4}$		2.43E+00	7.66E+00
	$TR_L = 10^{-6}$		2.43E-02	7.66E-02
subsurface soil volatilization to ambient air				
$RBSL_s$	THQ = 1		NA	NA
(mg/kg)	$TR_U = 10^{-4}$		1.29E+01	2.16E+01
	$TR_L = 10^{-6}$		1.29E-01	2.16E-01
subsurface soil volatilization to enclosed space				
$RBSL_s$	THQ = 1		NA	NA
(mg/kg)	$TR_U = 10^{-4}$		7.63E-01	2.40E+00
	$TR_L = 10^{-6}$		7.63E-03	2.40E-02
surficial soil exposure				
$RBSL_{ss}$	THQ = 1		NA	NA
(mg/kg)	$TR_U = 10^{-4}$		4.70E+02	7.76E+02
	$TR_L = 10^{-6}$		4.70E+00	7.76E+00
(child)	THQ		NA	
	TR_U		5.91E+02	
	TR_L		5.91E+00	
(age-adj.)	THQ		NA	
	TR_U		3.82E+02	
	TR_L		3.82E+00	
surficial soil exposure apportionment [2]				
(%)	THQ = 1			
(i-d-v-p)	$TR_U = 10^{-4}$		08-63-28-00	03-62-33-00
	$TR_L = 10^{-6}$		08-63-28-00	03-62-33-00
(child)	THQ			
	TR_U		18-47-33-00	
	TR_L		18-47-33-00	
(age-adj.)	THQ			
	TR_U		17-59-23-00	
	TR_L		17-59-23-00	

derived parameters:

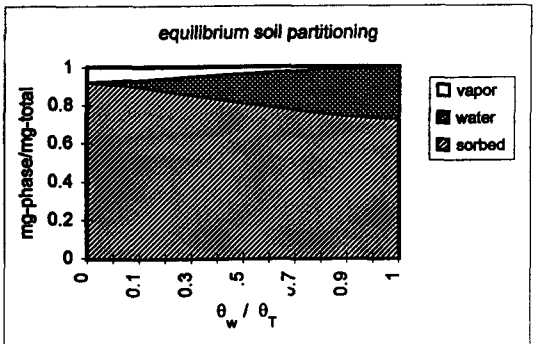
$VF_{s,esp}$	5.13E-05	2.05E-05	(g-soil/cm^3-air)
$VF_{gw,esp}$	1.61E-05	6.44E-06	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	2.28E-07	2.50E-07	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	3.06E-01	3.06E-01	(g-soil/cm^3-wat)
$VF_{s,amb}$	2.28E-06	2.28E-06	(g-soil/cm^3-air)
$VF_{gw,amb}$	7.75E-08	7.75E-08	(cm^3-wat/cm^3-air)

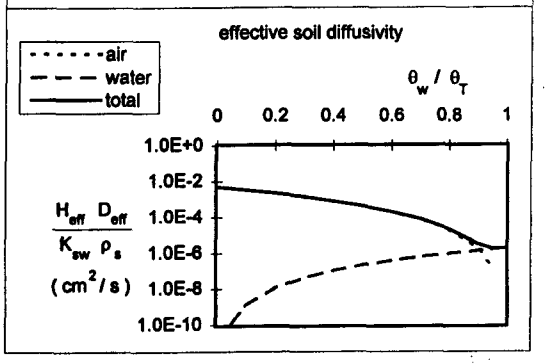
transport and thermodynamic parameters

			[references]
MW	78.11364	(g/mole)	USEPA(1996)
D_{air}	8.80E-02	(cm^2/sec)	USEPA(1996)
D_{wat}	9.80E-06	(cm^2/sec)	USEPA(1996)
Koc	1.77	log10(L-water/kg-oc	USEPA(1996)
H	5.55E-03	(atm-m^3/mol)	USEPA(1996)
H	2.31E-01	(L-water/L-air)	
P_v	9.52E+01	(mm Hg)	USEPA(1994)
S	1.75E+03	(mg/L)	USEPA(1996)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o		(mg/kg-day)	
RfC_i		(mg/m^3)	
SF_o	2.90E-02	(1/(mg/kg-day))	IRIS (1994)
SF_i	2.90E-02	(1/(mg/kg-day))	HEAST (07/93)
W of E	A		IRIS (1994)
MCL	5.00E-03	(mg/L-wat)	52 FR 25690
RAF_o	1.00E+00		
RAF_d	5.00E-01		

derived parameters dependent on:
chemical properties and soil parameters

UF	1.00E+00	(unitless)
H_{eff}	2.31E-01	(L-wat/L-air)
$C_{sat,vap}$	4.07E+08	($\mu g/m^3$-air)
K_{sw}	6.95E-01	(L-wat/kg-soil)
$C_{sat,soil}$	1.22E+03	(mg/kg-soil)
$D_{eff,vad}$	6.87E-03	(cm^2/sec)
$D_{eff,cap}$	1.96E-05	(cm^2/sec)
$D_{eff,ws}$	1.01E-03	(cm^2/sec)
$D_{eff,crk}$	6.87E-03	(cm^2/sec)





Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN 108-88-3
name toluene

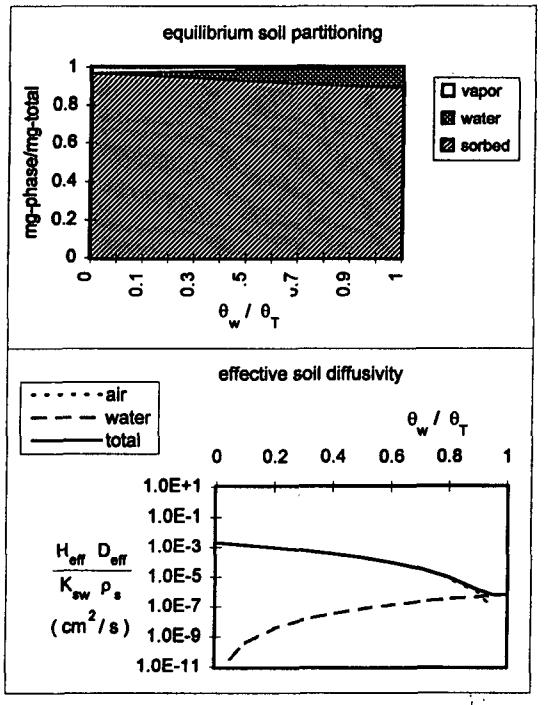
Risk-Based Screening-Level Concentrations [1]

risk or hazard scenario:	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$ ($\mu g/m^3$)	THQ = 1	4.17E+02	5.84E+02
	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$ ($\mu g/m^3$)	THQ = 1	5.56E+02	5.84E+02
	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$ (mg/L)	THQ = 1	7.30E+00	2.04E+01
	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	1.00E+00	1.00E+00
soil leaching to groundwater ingestion			
$RBSL_s$ (mg/kg)	THQ = 1	6.64E+01	1.86E+02
	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	9.09E+00	9.09E+00
groundwater to ambient vapor inhalation			
$RBSL_{gw}$ (mg/L)	THQ = 1	S< (5.02E+03)	S< (7.03E+03)
	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$ (mg/L)	THQ = 1	3.10E+01	8.13E+01
	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$ (mg/kg)	THQ = 1	4.30E+02	6.02E+02
	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$ (mg/kg)	THQ = 1	2.55E+01	6.69E+01
	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$ (mg/kg)	THQ = 1	9.61E+03	1.28E+04
	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	2.34E+03	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	8.07E+03	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	06-52-41-00	03-49-47-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	14-37-47-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	14-50-34-00	
	TR_U		
	TR_L		

derived parameters:			
$VF_{s,esp}$	2.18E-05	8.73E-06	(g-soil/cm^3-air)
$VF_{gw,esp}$	1.80E-05	7.18E-06	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	1.49E-07	1.63E-07	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	1.10E-01	1.10E-01	(g-soil/cm^3-wat)
$VF_{s,amb}$	9.70E-07	9.70E-07	(g-soil/cm^3-air)
$VF_{gw,amb}$	8.30E-08	8.30E-08	(cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	92.14052	(g/mole)	USEPA(1996)
D_{air}	8.70E-02	(cm^2/sec)	USEPA(1996)
D_{wat}	8.60E-06	(cm^2/sec)	USEPA(1996)
Koc	2.26	log10(L-water/kg-oc	USEPA(1996)
H	6.64E-03	(atm-m^3/mol)	USEPA(1996)
H	2.76E-01	(L-water/L-air)	
P_v	2.85E+01	(mm Hg)	DIPPR (AUG. 1995)
S	5.26E+02	(mg/L)	USEPA(1996)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	2.00E-01	(mg/kg-day)	IRIS (1994)
RfC_i	4.00E-01	(mg/m^3)	IRIS (1994)
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E	D		IRIS (1994)
MCL	1.00E+00	(mg/L-wat)	56 FR 3526 (30 Jan 91)
RAF_o	1.00E+00		
RAF_d	5.00E-01		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	2.76E-01	(L-wat/L-air)
$C_{sat,vap}$	1.44E+08	($\mu g/m^3$-air)
K_{sw}	1.93E+00	(L-wat/kg-soil)
$C_{sat,soil}$	1.02E+03	(mg/kg-soil)
$D_{eff,vad}$	6.79E-03	(cm^2/sec)
$D_{eff,cap}$	1.73E-05	(cm^2/sec)
$D_{eff,ws}$	9.02E-04	(cm^2/sec)
$D_{eff,crk}$	6.79E-03	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN	100-41-4
name	ethylbenzene

Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	1.04E+03	1.46E+03
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	1.39E+03	1.46E+03
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	3.65E+00	1.02E+01
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	7.00E-01	7.00E-01
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	6.44E+01	1.80E+02
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	1.24E+01	1.24E+01
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (1.27E+04)	S< (1.78E+04)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	7.73E+01	S< (2.03E+02)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	Rs (2.04E+03)	Rs (2.86E+03)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	1.21E+02	3.17E+02
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	7.19E+03	1.03E+04
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	1.88E+03	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	5.59E+03	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	09-77-12-00	05-79-15-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	24-60-15-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	20-69-09-00	
	TR_U		
	TR_L		

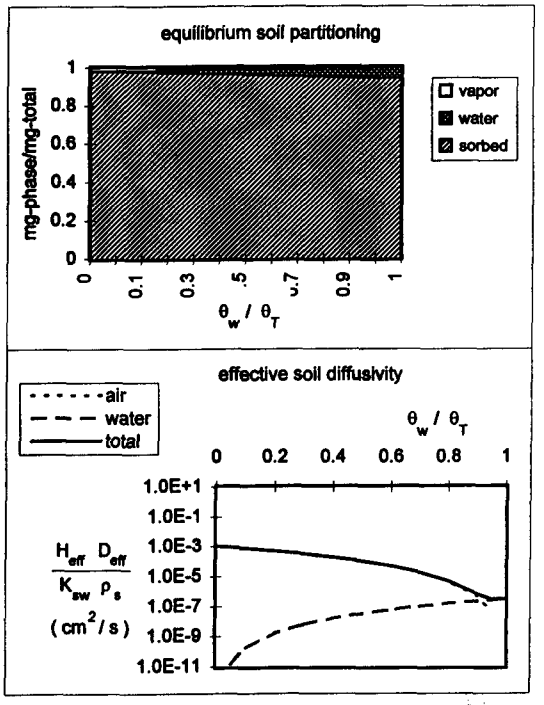
derived parameters:

$VF_{s,esp}$	1.15E-05	4.60E-06	(g-soil/cm^3-air)
$VF_{gw,esp}$	1.80E-05	7.19E-06	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	1.08E-07	1.18E-07	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	5.67E-02	5.67E-02	(g-soil/cm^3-wat)
$VF_{s,amb}$	5.11E-07	5.11E-07	(g-soil/cm^3-air)
$VF_{gw,amb}$	8.20E-08	8.20E-08	(cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	106.1674	(g/mole)	USEPA(1996)
D_{air}	7.50E-02	(cm^2/sec)	USEPA(1996)
D_{wat}	7.80E-06	(cm^2/sec)	USEPA(1996)
Koc	2.56	log10(L-water/kg-oc	USEPA(1996)
H	7.88E-03	(atm-m^3/mol)	USEPA(1996)
H	3.28E-01	(L-water/L-air)	
P_v	9.53E+00	(mm Hg)	Mackay(1992a)
S	1.69E+02	(mg/L)	USEPA(1996)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	1.00E-01	(mg/kg-day)	IRIS (1994)
RfC_i	1.00E+00	(mg/m^3)	IRIS (1994)
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E	D		IRIS (1994)
MCL	7.00E-01	(mg/L-wat)	56 FR 3526 (30 Jan 91)
RAF_o	1.00E+00		
RAF_d	5.00E-01		

derived parameters dependent on:
chemical properties and soil parameters

UF	1.00E+00	(unitless)
H_{eff}	3.28E-01	(L-wat/L-air)
$C_{sat,vap}$	5.53E+07	($\mu g/m^3$-air)
K_{sw}	3.75E+00	(L-wat/kg-soil)
$C_{sat,soil}$	6.34E+02	(mg/kg-soil)
$D_{eff,vad}$	5.85E-03	(cm^2/sec)
$D_{eff,cap}$	1.43E-05	(cm^2/sec)
$D_{eff,ws}$	7.51E-04	(cm^2/sec)
$D_{eff,crk}$	5.85E-03	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

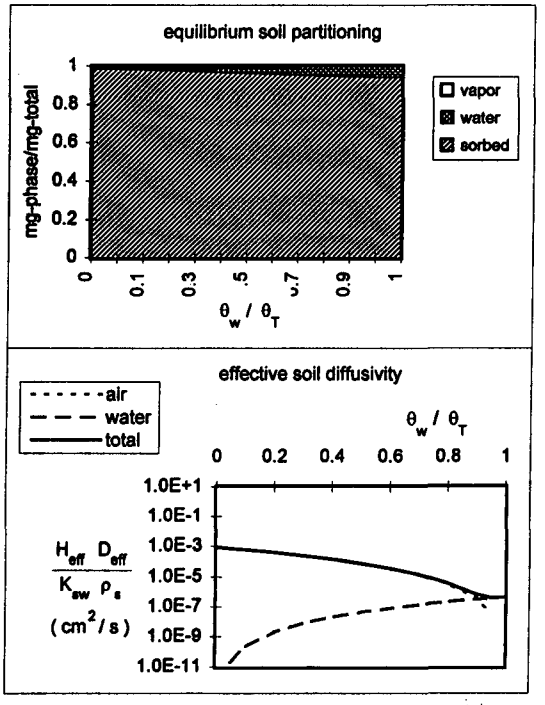
CASRN	95-47-6
name	xylene, o-

Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	7.30E+03	1.02E+04
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	9.73E+03	1.02E+04
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	7.30E+01	S< (2.04E+02)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	1.00E+01	1.00E+01
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	Rs (1.28E+03)	S<
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	1.76E+02	1.76E+02
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (9.82E+04)	S< (1.38E+05)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (6.41E+02)	S< (1.68E+03)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	Rs (1.86E+04)	Rs (2.60E+04)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	Rs (1.10E+03)	Rs (2.89E+03)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	1.17E+05	1.61E+05
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	2.94E+04	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	9.48E+04	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	08-63-28-00	03-62-33-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	18-47-33-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	17-59-23-00	
	TR_U		
	TR_L		

transport and thermodynamic parameters			[references]
MW	106.1674	(g/mole)	USEPA(1996)
D_{air}	8.70E-02	(cm^2/sec)	USEPA(1996)
D_{wat}	1.00E-05	(cm^2/sec)	USEPA(1996)
Koc	2.56	log10(L-water/kg-oc	USEPA(1996)
H	5.19E-03	(atm-m^3/mol)	USEPA(1996)
H	2.16E-01	(L-water/L-air)	
P_v	6.65E+00	(mm Hg)	DIPPR (AUG. 1995)
S	1.78E+02	(mg/L)	USEPA(1996)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	2.00E+00	(mg/kg-day)	HEAST (07/93)
RfC_i	7.00E+00	(mg/m^3)	Route-to-Route
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL	1.00E+01	(mg/L-wat)	56 FR 3526 (30 Jan 91) MCL f
RAF_o	1.00E+00		
RAF_d	5.00E-01		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	2.16E-01	(L-wat/L-air)
$C_{sat,vap}$	3.86E+07	($\mu g/m^3$-air)
K_{sw}	3.73E+00	(L-wat/kg-soil)
$C_{sat,soil}$	6.65E+02	(mg/kg-soil)
$D_{eff,vad}$	6.79E-03	(cm^2/sec)
$D_{eff,cap}$	2.02E-05	(cm^2/sec)
$D_{eff,we}$	1.03E-03	(cm^2/sec)
$D_{eff,crk}$	6.79E-03	(cm^2/sec)



derived parameters:

$VF_{s,esp}$	8.83E-06	3.53E-06	(g-soil/cm^3-air)
$VF_{gw,esp}$	1.52E-05	6.08E-06	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	9.48E-08	1.04E-07	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	5.69E-02	5.69E-02	(g-soil/cm^3-wat)
$VF_{s,amb}$	3.92E-07	3.92E-07	(g-soil/cm^3-air)
$VF_{gw,amb}$	7.43E-08	7.43E-08	(cm^3-wat/cm^3-air)

Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN	108-38-3
name	xylene, m-

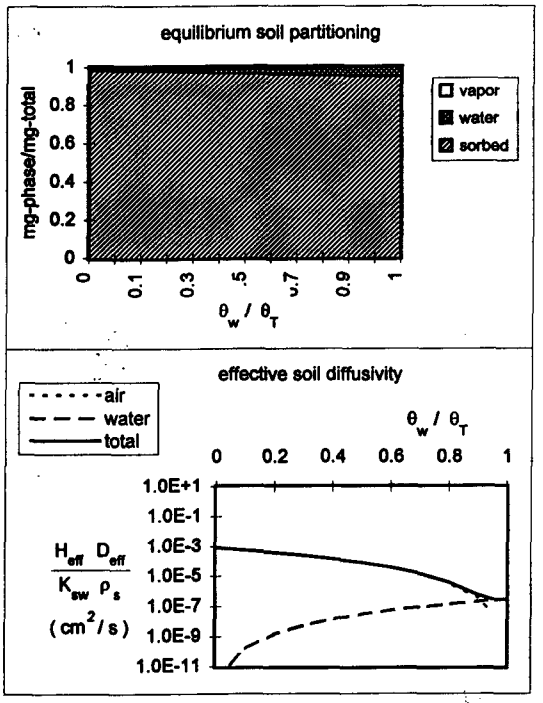
Risk-Based Screening-Level Concentrations [1]

risk or hazard scenario:			
	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	NA	NA
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	NA	NA
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	NA	NA
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	NA	NA
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	NA	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	NA	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1		
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ		
	TR_U		
	TR_L		
(age-adj.)	THQ		
	TR_U		
	TR_L		

transport and thermodynamic parameters			[references]
MW	106.1674	(g/mole)	USEPA(1996)
D_{air}	7.00E-02	(cm^2/sec)	USEPA(1996)
D_{wat}	7.80E-06	(cm^2/sec)	USEPA(1996)
Koc	2.61	log10(L-water/kg-oc	USEPA(1996)
H	7.34E-03	(atm-m^3/mol)	USEPA(1996)
H	3.05E-01	(L-water/L-air)	
P_v	8.40E+00	(mm Hg)	DIPPR (AUG. 1995)
S	1.61E+02	(mg/L)	USEPA(1996)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	NA	(mg/kg-day)	NA
RfC_i	NA	(mg/m^3)	NA
SF_o	NA	(1/(mg/kg-day))	NA
SF_i	NA	(1/(mg/kg-day))	NA
W of E	NA		NA
MCL	NA	(mg/L-wat)	NA
RAF_o	1.00E+00		
RAF_d	5.00E-01		

derived parameters dependent on:
chemical properties and soil parameters

UF	1.00E+00	(unitless)
H_{eff}	3.05E-01	(L-wat/L-air)
$C_{sat,vap}$	4.88E+07	($\mu g/m^3$-air)
K_{sw}	4.19E+00	(L-wat/kg-soil)
$C_{sat,soil}$	6.75E+02	(mg/kg-soil)
$D_{eff,vad}$	5.46E-03	(cm^2/sec)
$D_{eff,cap}$	1.40E-05	(cm^2/sec)
$D_{eff,ws}$	7.30E-04	(cm^2/sec)
$D_{eff,crk}$	5.46E-03	(cm^2/sec)



derived parameters:

$VF_{s,esp}$	8.95E-06	3.58E-06	(g-soil/cm^3-air)
$VF_{gw,esp}$	1.60E-05	6.41E-06	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	9.54E-08	1.05E-07	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	5.07E-02	5.07E-02	(g-soil/cm^3-wat)
$VF_{s,amb}$	3.98E-07	3.98E-07	(g-soil/cm^3-air)
$VF_{gw,amb}$	7.43E-08	7.43E-08	(cm^3-wat/cm^3-air)

Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) *Percent of surficial soil exposure due to* contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

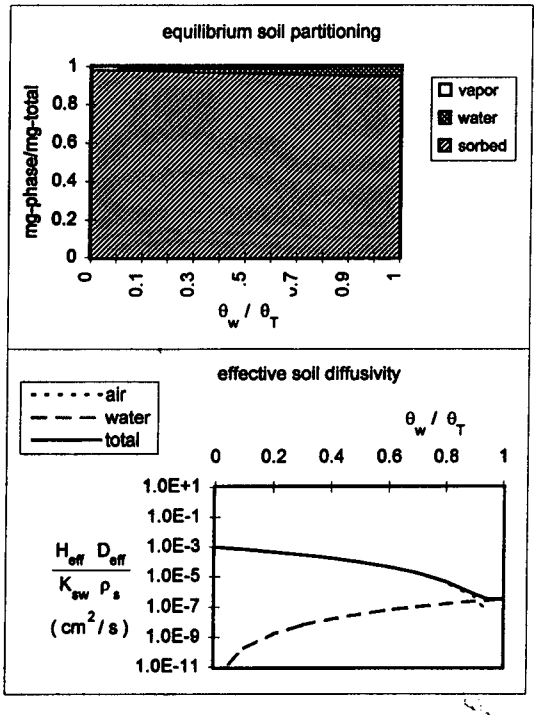
CASRN	106-42-3
name	xylene, p-

Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	NA	NA
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	NA	NA
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	1.00E+01	1.00E+01
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	1.89E+02	1.89E+02
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	NA	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	NA	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1		
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ		
	TR_U		
	TR_L		
(age-adj.)	THQ		
	TR_U		
	TR_L		

transport and thermodynamic parameters			[references]
MW	106.1674	(g/mole)	USEPA(1996)
D_{air}	7.69E-02	(cm^2/sec)	USEPA(1996)
D_{wat}	8.44E-06	(cm^2/sec)	USEPA(1996)
Koc	2.59	log10(L-water/kg-oc	USEPA(1996)
H	7.66E-03	(atm-m^3/mol)	USEPA(1996)
H	3.19E-01	(L-water/L-air)	
P_v	8.78E+00	(mm Hg)	DIPPR (AUG. 1995)
S	1.85E+02	(mg/L)	USEPA(1996)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o		(mg/kg-day)	
RfC_i		(mg/m^3)	HEAST (12/11/91) Not Verifiab
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL	1.00E+01	(mg/L-wat)	56 FR 3526 (30 Jan 91) MCL f
RAF_o	1.00E+00		
RAF_d	5.00E-01		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	3.19E-01	(L-wat/L-air)
$C_{sat,vap}$	5.10E+07	($\mu g/m^3$-air)
K_{sw}	4.01E+00	(L-wat/kg-soil)
$C_{sat,soil}$	7.42E+02	(mg/kg-soil)
$D_{eff,vad}$	6.00E-03	(cm^2/sec)
$D_{eff,cap}$	1.51E-05	(cm^2/sec)
$D_{eff,ws}$	7.88E-04	(cm^2/sec)
$D_{eff,crk}$	6.00E-03	(cm^2/sec)



derived parameters:			
$VF_{s,esp}$	1.07E-05	4.29E-06	(g-soil/cm^3-air)
$VF_{gw,esp}$	1.82E-05	7.27E-06	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	1.04E-07	1.14E-07	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	5.30E-02	5.30E-02	(g-soil/cm^3-wat)
$VF_{s,amb}$	4.77E-07	4.77E-07	(g-soil/cm^3-air)
$VF_{gw,amb}$	8.37E-08	8.37E-08	(cm^3-wat/cm^3-air)

Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Re), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

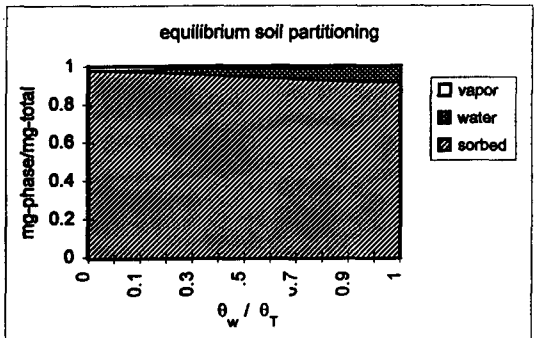
CASRN	1330-20-7
name	xylenes (mixed isomers)

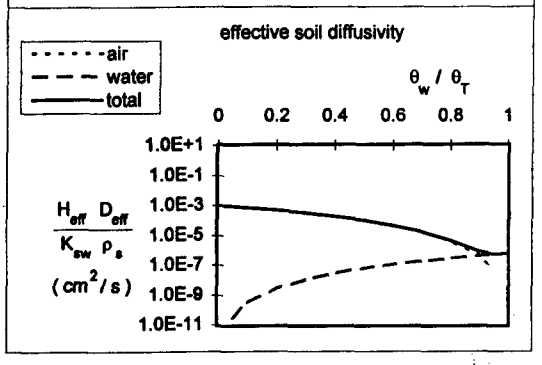
Risk-Based Screening-Level Concentrations [1]

risk or hazard scenario:	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	7.30E+03	1.02E+04
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	9.73E+03	1.02E+04
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	7.30E+01	S< (2.04E+02)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	1.00E+01	1.00E+01
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	Rs (8.59E+02)	S<
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL	1.18E+02	1.18E+02
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (1.13E+05)	S< (1.58E+05)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (7.52E+02)	S< (1.97E+03)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	Rs (1.50E+04)	Rs (2.10E+04)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	Rs (8.90E+02)	Rs (2.34E+03)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	1.17E+05	1.61E+05
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	2.94E+04	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	9.48E+04	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	08-63-28-00	03-62-33-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	18-47-33-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	17-59-23-00	
	TR_U		
	TR_L		

transport and thermodynamic parameters			[references]
MW	106.1674	(g/mole)	USEPA(1994)
D_{air}	7.14E-02	(cm^2/sec)	USEPA(1994)
D_{wat}	9.34E-06	(cm^2/sec)	USEPA(1994)
Koc	2.38	log10(L-water/kg-oc	TPHCWG (1997)
H	5.25E-03	(atm-m^3/mol)	USEPA(1994)
H	2.18E-01	(L-water/L-air)	
P_v	8.50E+00	(mm Hg)	USEPA(1994)
S	1.80E+02	(mg/L)	Versch.(1983)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	2.00E+00	(mg/kg-day)	IRIS (1994)
RfC_i	7.00E+00	(mg/m^3)	Route-to-Route
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E	D		IRIS (1994)
MCL	1.00E+01	(mg/L-wat)	56 FR 3526 (30 Jan 91) MCL f
RAF_o	1.00E+00		
RAF_d	5.00E-01		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	2.18E-01	(L-wat/L-air)
$C_{sat,vap}$	4.94E+07	($\mu g/m^3$-air)
K_{sw}	2.50E+00	(L-wat/kg-soil)
$C_{sat,soil}$	4.51E+02	(mg/kg-soil)
$D_{eff,vad}$	5.57E-03	(cm^2/sec)
$D_{eff,cap}$	1.75E-05	(cm^2/sec)
$D_{eff,ws}$	8.87E-04	(cm^2/sec)
$D_{eff,crk}$	5.57E-03	(cm^2/sec)





derived parameters:

$VF_{s,esp}$	1.09E-05	4.37E-06	(g-soil/cm^3-air)
$VF_{gw,esp}$	1.29E-05	5.18E-06	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	1.05E-07	1.16E-07	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	8.49E-02	8.49E-02	(g-soil/cm^3-wat)
$VF_{s,amb}$	4.86E-07	4.86E-07	(g-soil/cm^3-air)
$VF_{gw,amb}$	6.46E-08	6.46E-08	(cm^3-wat/cm^3-air)

Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

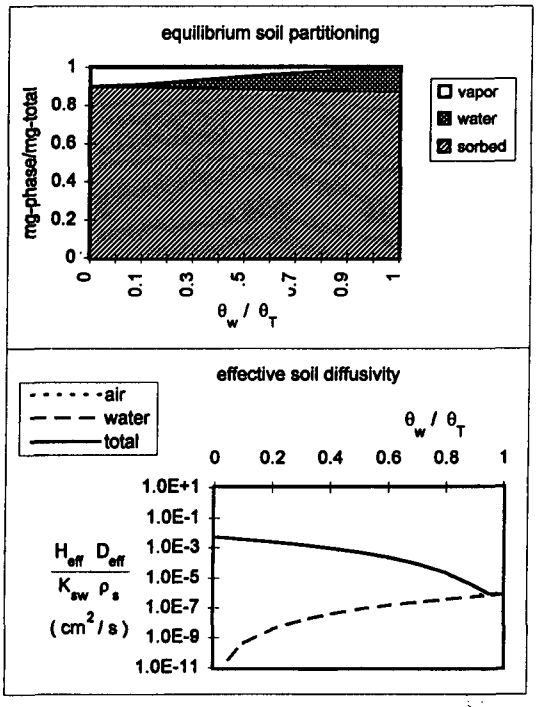
CASRN 127-18-4
name tetrachloroethylene

Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	3.65E+01	5.11E+01
($\mu g/m^3$)	$TR_U = 10^{-4}$	4.26E+02	7.15E+02
	$TR_L = 10^{-6}$	4.26E+00	7.15E+00
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	4.87E+01	5.11E+01
($\mu g/m^3$)	$TR_U = 10^{-4}$	5.68E+02	7.15E+02
	$TR_L = 10^{-6}$	5.68E+00	7.15E+00
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	3.65E-01	1.02E+00
(mg/L)	$TR_U = 10^{-4}$	1.64E-01	5.50E-01
	$TR_L = 10^{-6}$	1.64E-03	5.50E-03
	MCL	5.00E-03	5.00E-03
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	2.98E+00	8.35E+00
(mg/kg)	$TR_U = 10^{-4}$	1.34E+00	4.50E+00
	$TR_L = 10^{-6}$	1.34E-02	4.50E-02
	MCL	4.08E-02	4.08E-02
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (2.35E+02)	S< (3.28E+02)
(mg/L)	$TR_U = 10^{-4}$	S< (2.74E+03)	S< (4.60E+03)
	$TR_L = 10^{-6}$	2.74E+01	4.60E+01
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	1.34E+00	3.52E+00
(mg/L)	$TR_U = 10^{-4}$	1.56E+01	4.93E+01
	$TR_L = 10^{-6}$	1.56E-01	4.93E-01
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	1.47E+01	2.06E+01
(mg/kg)	$TR_U = 10^{-4}$	1.72E+02	2.89E+02
	$TR_L = 10^{-6}$	1.72E+00	2.89E+00
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	8.74E-01	2.29E+00
(mg/kg)	$TR_U = 10^{-4}$	1.02E+01	3.21E+01
	$TR_L = 10^{-6}$	1.02E-01	3.21E-01
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	5.84E+02	8.04E+02
(mg/kg)	$TR_U = 10^{-4}$	3.62E+02	6.42E+02
	$TR_L = 10^{-6}$	3.62E+00	6.42E+00
(child)	THQ	1.47E+02	
	TR_U	4.88E+02	
	TR_L	4.88E+00	
(age-adj.)	THQ	4.74E+02	
	TR_U	2.74E+02	
	TR_L	2.74E+00	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	08-63-28-00	03-62-33-00
(i-d-v-p)	$TR_U = 10^{-4}$	11-87-01-00	05-92-01-00
	$TR_L = 10^{-6}$	11-87-01-00	05-92-01-00
(child)	THQ	18-47-33-00	
	TR_U	27-70-01-00	
	TR_L	27-70-01-00	
(age-adj.)	THQ	17-59-23-00	
	TR_U	22-76-01-00	
	TR_L	22-76-01-00	

transport and thermodynamic parameters			[references]
MW	165.83	(g/mole)	USEPA(1996)
D_{air}	7.20E-02	(cm^2/sec)	USEPA(1996)
D_{wat}	8.20E-06	(cm^2/sec)	USEPA(1996)
Koc	2.19	log10(L-water/kg-oc	USEPA(1996)
H	1.84E-02	(atm-m^3/mol)	USEPA(1996)
H	7.65E-01	(L-water/L-air)	
P_v	1.85E+01	(mm Hg)	DIPPR (AUG. 1996)
S	2.00E+02	(mg/L)	DIPPR (AUG. 1996)
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	1.00E-02	(mg/kg-day)	IRIS (1994)
RfC_i	3.50E-02	(mg/m^3)	Route-to-Route
SF_o	5.20E-02	(1/(mg/kg-day))	ECAO (1992)
SF_i	2.00E-03	(1/(mg/kg-day))	ECAO (1992)
W of E	C-B2		ECAO (1992)
MCL	5.00E-03	(mg/L-wat)	56 FR 3526 (30 Jan 91)
RAF_o	1.00E+00		
RAF_d	5.00E-01		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	7.65E-01	(L-wat/L-air)
$C_{sat,vap}$	1.68E+08	($\mu g/m^3$-air)
K_{sw}	1.74E+00	(L-wat/kg-soil)
$C_{sat,soil}$	3.47E+02	(mg/kg-soil)
$D_{eff,vad}$	5.62E-03	(cm^2/sec)
$D_{eff,cap}$	1.14E-05	(cm^2/sec)
$D_{eff,ws}$	6.10E-04	(cm^2/sec)
$D_{eff,crk}$	5.62E-03	(cm^2/sec)



derived parameters:

$VF_{s,esp}$	5.57E-05	2.23E-05	(g-soil/cm^3-air)
$VF_{gw,esp}$	3.63E-05	1.45E-05	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	2.38E-07	2.61E-07	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	1.22E-01	1.22E-01	(g-soil/cm^3-wat)
$VF_{s,amb}$	2.48E-06	2.48E-06	(g-soil/cm^3-air)
$VF_{gw,amb}$	1.56E-07	1.56E-07	(cm^3-wat/cm^3-air)

Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN 0-00-1
name EC 5 to 6 aliphatic

Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	1.92E+04	2.69E+04
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	2.56E+04	2.69E+04
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	S< (1.83E+02)	S< (5.11E+02)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	S< (1.12E+04)	S<
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (2.46E+03)	S< (3.44E+03)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	1.33E+01	3.48E+01
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	Rs (9.73E+02)	Rs (1.36E+03)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	5.77E+01	1.51E+02
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	7.01E+05	9.48E+05
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	1.32E+05	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	5.22E+05	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	19-15-65-00	09-14-76-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	33-08-57-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	38-13-48-00	
	TR_U		
	TR_L		

derived parameters:

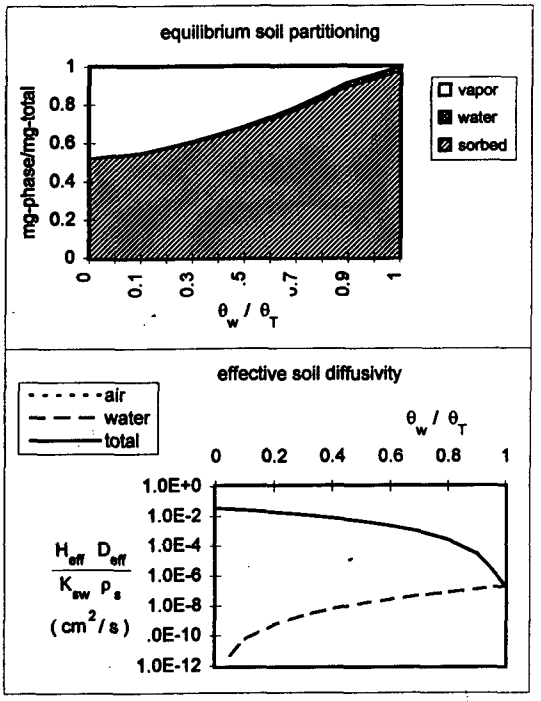
$VF_{s,esp}$	4.44E-04	1.77E-04	(g-soil/cm^3-air)
$VF_{gw,esp}$	1.93E-03	7.72E-04	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	6.72E-07	7.36E-07	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	1.63E-02	1.63E-02	(g-soil/cm^3-wat)
$VF_{s,amb}$	1.97E-05	1.97E-05	(g-soil/cm^3-air)
$VF_{gw,amb}$	7.80E-06	7.80E-06	(cm^3-wat/cm^3-air)

transport and thermodynamic parameters [references]

MW	81	(g/mole)	TPHCWG(1997) v.3
D_{air}	1.00E-01	(cm^2/sec)	TPHCWG(1997) v.3
D_{wat}	1.00E-05	(cm^2/sec)	TPHCWG(1997) v.3
Koc	2.9	log10(L-water/kg-oc	TPHCWG(1997) v.3
H	7.93E-01	(atm-m^3/mol)	TPHCWG(1997) v.3
H	3.30E+01	(L-water/L-air)	
P_v	2.66E+02	(mm Hg)	TPHCWG(1997) v.3
S	3.60E+01	(mg/L)	TPHCWG(1997) v.3
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	5.00E+00	(mg/kg-day)	TPHCWG(1997) v.4
RfC_i	1.84E+01	(mg/m^3)	TPHCWG(1997) v.4
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL		(mg/L-wat)	
RAF_o	1.00E+00		
RAF_d	5.00E-02		

derived parameters dependent on:
chemical properties and soil parameters

UF	1.00E+00	(unitless)
H_{eff}	3.30E+01	(L-wat/L-air)
$C_{sat,vap}$	1.18E+09	($\mu g/m^3$-air)
K_{sw}	1.31E+01	(L-wat/kg-soil)
$C_{sat,soil}$	4.70E+02	(mg/kg-soil)
$D_{eff,vad}$	7.80E-03	(cm^2/sec)
$D_{eff,cap}$	1.30E-05	(cm^2/sec)
$D_{eff,ws}$	7.09E-04	(cm^2/sec)
$D_{eff,crk}$	7.80E-03	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

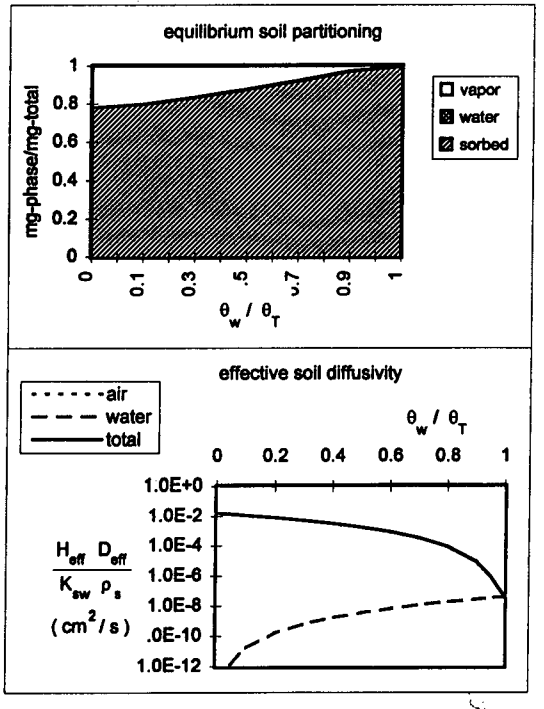
CASRN	0-00-2
name	EC >6 to 8 aliphatic

Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	1.92E+04	2.69E+04
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	2.56E+04	2.69E+04
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	S< (1.83E+02)	S< (5.11E+02)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	S< (4.08E+04)	S<
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (1.63E+03)	S< (2.28E+03)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (8.76E+00)	S< (2.30E+01)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	Rs (2.34E+03)	Rs (3.27E+03)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	1.39E+02	Rs (3.64E+02)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	7.01E+05	9.48E+05
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	1.32E+05	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	5.22E+05	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	19-15-65-00	09-14-76-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	33-08-57-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	38-13-48-00	
	TR_U		
	TR_L		

transport and thermodynamic parameters			[references]
MW	100	(g/mole)	TPHCWG(1997) v.3
D_{air}	1.00E-01	(cm^2/sec)	TPHCWG(1997) v.3
D_{wat}	1.00E-05	(cm^2/sec)	TPHCWG(1997) v.3
Koc	3.6	log10(L-water/kg-oc	TPHCWG(1997) v.3
H	1.20E+00	(atm-m^3/mol)	TPHCWG(1997) v.3
H	5.00E+01	(L-water/L-air)	
P_v	4.79E+01	(mm Hg)	TPHCWG(1997) v.3
S	5.40E+00	(mg/L)	TPHCWG(1997) v.3
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	5.00E+00	(mg/kg-day)	TPHCWG(1997) v.4
RfC_i	1.84E+01	(mg/m^3)	TPHCWG(1997) v.4
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL		(mg/L-wat)	
RAF_o	1.00E+00		
RAF_d	5.00E-02		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	5.00E+01	(L-wat/L-air)
$C_{sat,vap}$	2.62E+08	($\mu g/m^3$-air)
K_{sw}	4.75E+01	(L-wat/kg-soil)
$C_{sat,soil}$	2.57E+02	(mg/kg-soil)
$D_{eff,vad}$	7.80E-03	(cm^2/sec)
$D_{eff,cap}$	1.30E-05	(cm^2/sec)
$D_{eff,ws}$	7.08E-04	(cm^2/sec)
$D_{eff,crk}$	7.80E-03	(cm^2/sec)



derived parameters:			
$VF_{s,esp}$	1.85E-04	7.39E-05	(g-soil/cm^3-air)
$VF_{gw,esp}$	2.92E-03	1.17E-03	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	4.33E-07	4.75E-07	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	4.47E-03	4.47E-03	(g-soil/cm^3-wat)
$VF_{s,amb}$	8.21E-06	8.21E-06	(g-soil/cm^3-air)
$VF_{gw,amb}$	1.18E-05	1.18E-05	(cm^3-wat/cm^3-air)

Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN	*0-00-3*
name	EC >8 to 10 aliphatic

Risk-Based Screening-Level Concentrations [1]

risk or hazard scenario:	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	1.04E+03	1.46E+03
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	1.39E+03	1.46E+03
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	S< (3.65E+00)	S< (1.02E+01)
(*mg/L*)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	S< (5.64E+03)	S<
(*mg/kg*)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (5.53E+01)	S< (7.74E+01)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	2.98E-01	S< (7.81E-01)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	Rs (5.49E+02)	Rs (7.68E+02)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	3.25E+01	8.54E+01
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	2.40E+04	3.65E+04
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	4.16E+03	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	1.51E+04	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	32-25-41-00	17-28-53-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	53-13-33-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	55-18-26-00	
	TR_U		
	TR_L		

derived parameters:

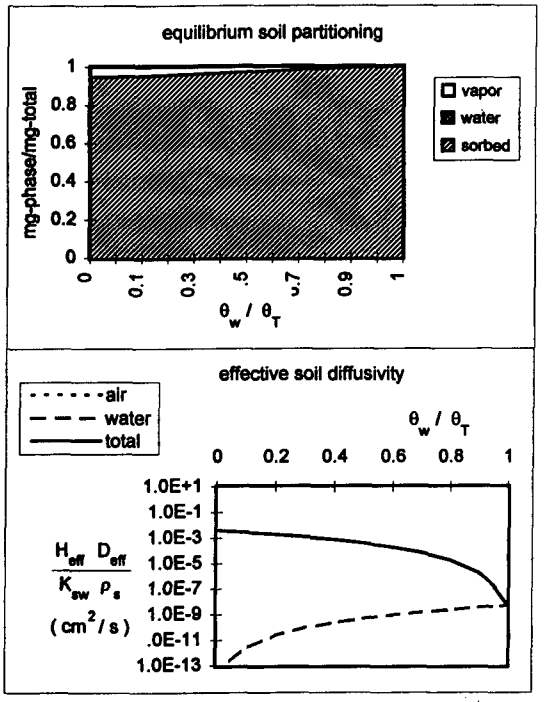
$VF_{s,esp}$	4.27E-05	1.71E-05	(g-soil/cm^3-air)
$VF_{gw,esp}$	4.67E-03	1.87E-03	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	2.09E-07	2.28E-07	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	6.47E-04	6.47E-04	(g-soil/cm^3-wat)
$VF_{s,amb}$	1.90E-06	1.90E-06	(g-soil/cm^3-air)
$VF_{gw,amb}$	1.89E-05	1.89E-05	(cm^3-wat/cm^3-air)

transport and thermodynamic parameters [references]

MW	130	(g/mole)	TPHCWG(1997) v.3
D_{air}	1.00E-01	(cm^2/sec)	TPHCWG(1997) v.3
D_{wat}	1.00E-05	(cm^2/sec)	TPHCWG(1997) v.3
Koc	4.5	log10(L-water/kg-oc	TPHCWG(1997) v.3
H	1.92E+00	(atm-m^3/mol)	TPHCWG(1997) v.3
H	8.00E+01	(L-water/L-air)	
P_v	4.79E+00	(mm Hg)	TPHCWG(1997) v.3
S	4.30E-01	(mg/L)	TPHCWG(1997) v.3
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	1.00E-01	(mg/kg-day)	TPHCWG(1997) v.4
RfC_i	1.00E+00	(mg/m^3)	TPHCWG(1997) v.4
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL		(*mg/L-wat*)	
RAF_o	1.00E+00		
RAF_d	5.00E-02		

derived parameters dependent on:
chemical properties and soil parameters

UF	1.00E+00	(unitless)
H_{eff}	8.00E+01	(L-wat/L-air)
$C_{sat,vap}$	3.41E+07	($\mu g/m^3$-air)
K_{sw}	3.29E+02	(L-wat/kg-soil)
$C_{sat,soil}$	1.41E+02	(*mg/kg-soil*)
$D_{eff,ved}$	7.80E-03	(cm^2/sec)
$D_{eff,cap}$	1.29E-05	(cm^2/sec)
$D_{eff,ws}$	7.07E-04	(cm^2/sec)
$D_{eff,crk}$	7.80E-03	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN 0-00-4
name EC >10 to 12 aliphatic

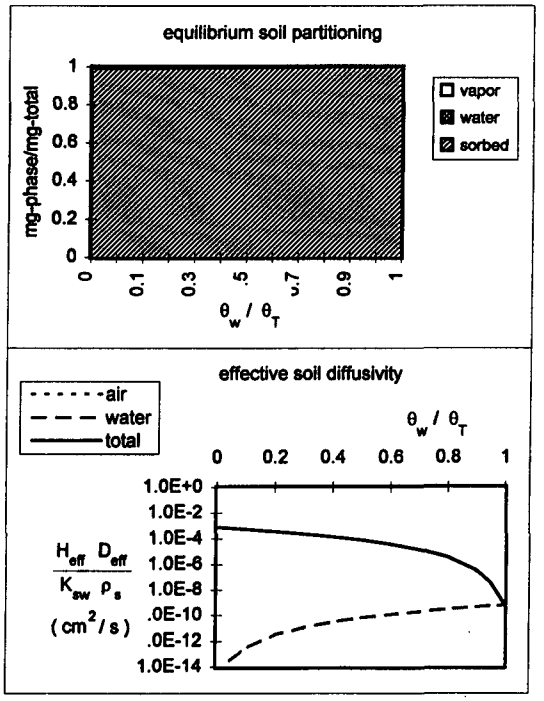
Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	1.04E+03	1.46E+03
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	1.39E+03	1.46E+03
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	S< (3.65E+00)	S< (1.02E+01)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	S< (4.34E+04)	S<
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (3.69E+01)	S< (5.16E+01)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (1.98E-01)	S< (5.21E-01)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	Rs (2.82E+03)	Rs (3.95E+03)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	Rs (1.67E+02)	Rs (4.38E+02)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	2.40E+04	3.65E+04
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	4.16E+03	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	1.51E+04	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	32-25-41-00	17-28-53-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	53-13-33-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	55-18-26-00	
	TR_U		
	TR_L		

derived parameters:			
$VF_{s,esp}$	8.33E-06	3.33E-06	(g-soil/cm^3-air)
$VF_{gw,esp}$	7.00E-03	2.80E-03	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	9.20E-08	1.01E-07	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	8.40E-05	8.40E-05	(g-soil/cm^3-wat)
$VF_{s,amb}$	3.70E-07	3.70E-07	(g-soil/cm^3-air)
$VF_{gw,amb}$	2.83E-05	2.83E-05	(cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	160	(g/mole)	TPHCWG(1997) v.3
D_{air}	1.00E-01	(cm^2/sec)	TPHCWG(1997) v.3
D_{wat}	1.00E-05	(cm^2/sec)	TPHCWG(1997) v.3
Koc	5.4	log10(L-water/kg-oc	TPHCWG(1997) v.3
H	2.89E+00	(atm-m^3/mol)	TPHCWG(1997) v.3
H	1.20E+02	(L-water/L-air)	
P_v	4.79E-01	(mm Hg)	TPHCWG(1997) v.3
S	3.40E-02	(mg/L)	TPHCWG(1997) v.3
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	1.00E-01	(mg/kg-day)	TPHCWG(1997) v.4
RfC_i	1.00E+00	(mg/m^3)	TPHCWG(1997) v.4
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL		(mg/L-wat)	
RAF_o	1.00E+00		
RAF_d	5.00E-02		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	1.20E+02	(L-wat/L-air)
$C_{sat,vap}$	4.19E+06	($\mu g/m^3$-air)
K_{sw}	2.53E+03	(L-wat/kg-soil)
$C_{sat,soil}$	8.60E+01	(mg/kg-soil)
$D_{eff,vad}$	7.80E-03	(cm^2/sec)
$D_{eff,cap}$	1.29E-05	(cm^2/sec)
$D_{eff,ws}$	7.07E-04	(cm^2/sec)
$D_{eff,crk}$	7.80E-03	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN	0-00-5
name	EC >12 to 16 aliphatic

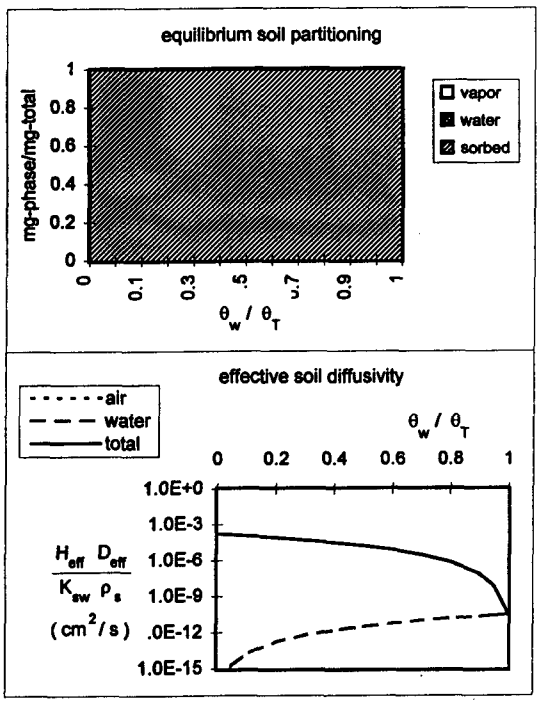
Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	1.04E+03	1.46E+03
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	1.39E+03	1.46E+03
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	S< (3.65E+00)	S< (1.02E+01)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	S< (8.62E+05)	S<
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (8.52E+00)	S< (1.19E+01)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (4.58E-02)	S< (1.20E-01)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	Rs (1.29E+04)	Rs (1.81E+04)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	Rs (7.65E+02)	Rs (2.01E+03)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	2.40E+04	3.65E+04
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	4.16E+03	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	1.51E+04	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	32-25-41-00	17-28-53-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	53-13-33-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	55-18-26-00	
	TR_U		
	TR_L		

derived parameters:			
$VF_{s,esp}$	1.82E-06	7.27E-07	(g-soil/cm^3-air)
$VF_{gw,esp}$	3.03E-02	1.21E-02	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	4.30E-08	4.71E-08	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	4.23E-06	4.23E-06	(g-soil/cm^3-wat)
$VF_{s,amb}$	8.08E-08	8.08E-08	(g-soil/cm^3-air)
$VF_{gw,amb}$	1.22E-04	1.22E-04	(cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	200	(g/mole)	TPHCWG(1997) v.3
D_{air}	1.00E-01	(cm^2/sec)	TPHCWG(1997) v.3
D_{wat}	1.00E-05	(cm^2/sec)	TPHCWG(1997) v.3
Koc	6.7	log10(L-water/kg-oc	TPHCWG(1997) v.3
H	1.25E+01	(atm-m^3/mol)	TPHCWG(1997) v.3
H	5.20E+02	(L-water/L-air)	
P_v	3.65E-02	(mm Hg)	TPHCWG(1997) v.3
S	7.60E-04	(mg/L)	TPHCWG(1997) v.3
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	1.00E-01	(mg/kg-day)	TPHCWG(1997) v.4
RfC_i	1.00E+00	(mg/m^3)	TPHCWG(1997) v.4
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL		(mg/L-wat)	
RAF_o	1.00E+00		
RAF_d	5.00E-02		

derived parameters dependent on:		
chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	5.20E+02	(L-wat/L-air)
$C_{sat,vap}$	3.99E+05	($\mu g/m^3$-air)
K_{sw}	5.02E+04	(L-wat/kg-soil)
$C_{sat,soil}$	3.82E+01	(mg/kg-soil)
$D_{eff,vad}$	7.80E-03	(cm^2/sec)
$D_{eff,cap}$	1.29E-05	(cm^2/sec)
$D_{eff,ws}$	7.06E-04	(cm^2/sec)
$D_{eff,crk}$	7.80E-03	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

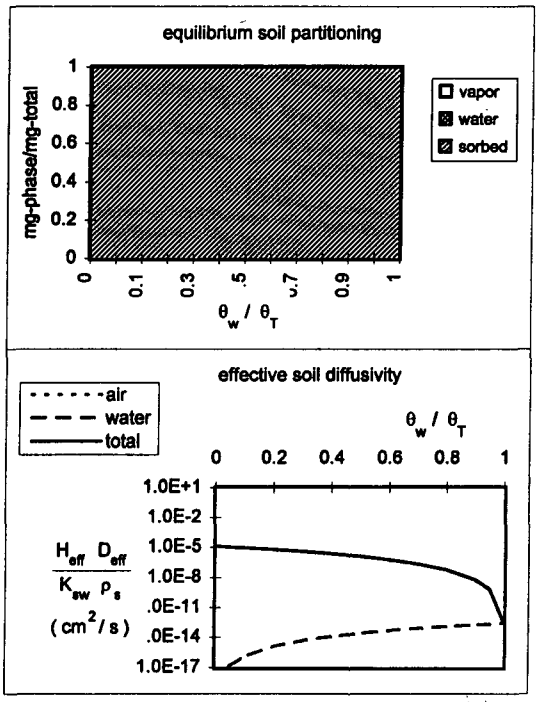
CASRN	0-00-6	
name	EC >16 to 21 aliphatic	

Risk-Based Screening-Level Concentrations [1]

risk or hazard scenario:	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	NA	NA
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	NA	NA
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	S< (7.30E+01)	S< (2.04E+02)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	S< (2.17E+09)	S<
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	8.16E+05	1.58E+06
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	1.25E+05	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	4.08E+05	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	#VALUE!	#VALUE!
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	#VALUE!	
	TR_U		
	TR_L		
(age-adj.)	THQ	#VALUE!	
	TR_U		
	TR_L		

transport and thermodynamic parameters			[references]
MW	270	(g/mole)	TPHCWG(1997) v.3
D_{air}	1.00E-01	(cm^2/sec)	TPHCWG(1997) v.3
D_{wat}	1.00E-05	(cm^2/sec)	TPHCWG(1997) v.3
Koc	8.8	log10(L-water/kg-oc	TPHCWG(1997) v.3
H	1.18E+02	(atm-m^3/mol)	TPHCWG(1997) v.3
H	4.90E+03	(L-water/L-air)	
P_v	8.36E-04	(mm Hg)	TPHCWG(1997) v.3
S	2.60E-06	(mg/L)	TPHCWG(1997) v.3
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	2.00E+00	(mg/kg-day)	TPHCWG(1997) v.4
RfC_i		(mg/m^3)	TPHCWG(1997) v.4
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL		(mg/L-wat)	
RAF_o	1.00E+00		
RAF_d	5.00E-02		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	4.90E+03	(L-wat/L-air)
$C_{sat,vap}$	1.24E+04	($\mu g/m^3$-air)
K_{sw}	6.31E+06	(L-wat/kg-soil)
$C_{sat,soil}$	1.64E+01	(mg/kg-soil)
$D_{eff,vad}$	7.80E-03	(cm^2/sec)
$D_{eff,cap}$	1.29E-05	(cm^2/sec)
$D_{eff,ws}$	7.06E-04	(cm^2/sec)
$D_{eff,crk}$	7.80E-03	(cm^2/sec)



derived parameters:			
$VF_{s,esp}$	1.36E-07	5.45E-08	(cm^3-soil/cm^3-air)
$VF_{gw,esp}$	2.86E-01	1.14E-01	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	1.18E-08	1.29E-08	(cm^3-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(cm^3-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.18E-08	1.29E-08	(cm^3-soil/cm^3-air)
LF_{sw}	3.37E-08	3.37E-08	(cm^3-soil/cm^3-wat)
$VF_{s,amb}$	6.06E-09	6.06E-09	(cm^3-soil/cm^3-air)
$VF_{gw,amb}$	1.15E-03	1.15E-03	(cm^3-wat/cm^3-air)

Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN	0-00-7
name	Benzene (EC 5 to 7) aromatic

Risk-Based Screening-Level Concentrations [1]

risk or hazard scenario:	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	4.17E+02	5.84E+02
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	5.56E+02	5.84E+02
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	7.30E+00	2.04E+01
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	3.09E+01	8.65E+01
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (4.93E+03)	S< (6.90E+03)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	3.12E+01	8.18E+01
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	2.09E+02	2.93E+02
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	1.24E+01	3.25E+01
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	9.61E+03	1.28E+04
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	2.34E+03	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	8.07E+03	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	06-52-41-00	03-49-47-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	14-37-47-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	14-50-34-00	
	TR_U		
	TR_L		

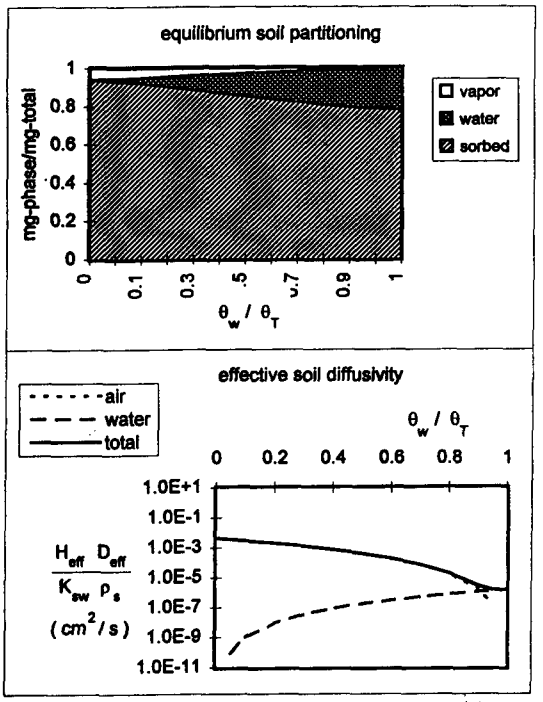
derived parameters:

$VF_{s,esp}$	4.49E-05	1.79E-05	(g-soil/cm^3-air)
$VF_{gw,esp}$	1.76E-05	7.14E-06	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	2.14E-07	2.34E-07	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	2.36E-01	2.36E-01	(g-soil/cm^3-wat)
$VF_{s,amb}$	1.99E-06	1.99E-06	(g-soil/cm^3-air)
$VF_{gw,amb}$	8.46E-08	8.46E-08	(cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	78	(g/mole)	TPHCWG(1997) v.3
D_{air}	1.00E-01	(cm^2/sec)	TPHCWG(1997) v.3
D_{wat}	1.00E-05	(cm^2/sec)	TPHCWG(1997) v.3
Koc	1.9	log10(L-water/kg-oc	TPHCWG(1997) v.3
H	5.53E-03	(atm-m^3/mol)	TPHCWG(1997) v.3
H	2.30E-01	(L-water/L-air)	
P_v	9.88E+01	(mm Hg)	TPHCWG(1997) v.3
S	1.80E+03	(mg/L)	TPHCWG(1997) v.3
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	2.00E-01	(mg/kg-day)	TPHCWG(1997) v.4
RfC_i	4.00E-01	(mg/m^3)	TPHCWG(1997) v.4
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL		(mg/L-wat)	
RAF_o	1.00E+00		
RAF_d	5.00E-01		

derived parameters dependent on:
chemical properties and soil parameters

UF	1.00E+00	(unitless)
H_{eff}	2.30E-01	(L-wat/L-air)
$C_{sat,vap}$	4.22E+08	($\mu g/m^3$-air)
K_{sw}	9.00E-01	(L-wat/kg-soil)
$C_{sat,soil}$	1.62E+03	(mg/kg-soil)
$D_{eff,vad}$	7.80E-03	(cm^2/sec)
$D_{eff,cap}$	2.14E-05	(cm^2/sec)
$D_{eff,ws}$	1.10E-03	(cm^2/sec)
$D_{eff,crk}$	7.80E-03	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of *aqueous solubility* (S<), *saturated vapor pressure* (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the *calculated values are given in parentheses.*
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN 0-00-8
name Toluene (EC >8 to 10) aromatic

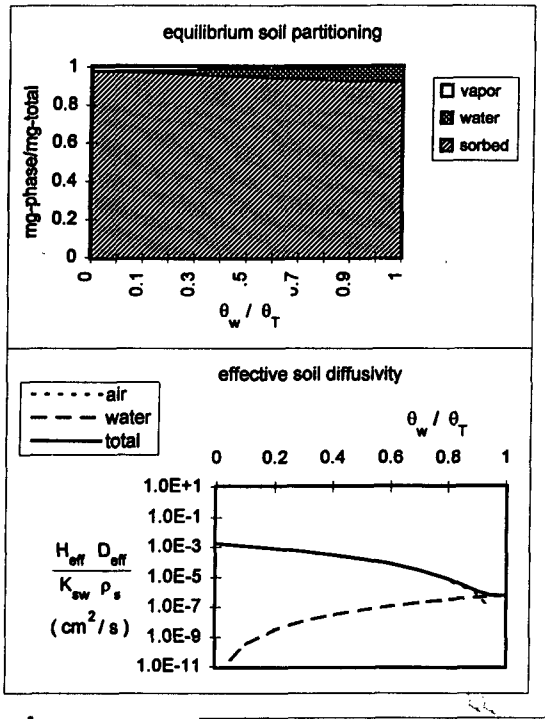
Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	4.17E+02	5.84E+02
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	5.56E+02	5.84E+02
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	1.46E+00	4.09E+00
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	1.80E+01	5.05E+01
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (4.42E+03)	S< (6.19E+03)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	2.74E+01	7.19E+01
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	5.19E+02	7.27E+02
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	3.08E+01	8.08E+01
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	2.87E+03	4.13E+03
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	7.52E+02	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	2.24E+03	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	09-77-12-00	05-79-15-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	24-60-15-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	20-69-09-00	
	TR_U		
	TR_L		

derived parameters:			
$VF_{s,esp}$	1.81E-05	7.23E-06	(g-soil/cm^3-air)
$VF_{gw,esp}$	2.03E-05	8.12E-06	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	1.36E-07	1.48E-07	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	8.10E-02	8.10E-02	(g-soil/cm^3-wat)
$VF_{s,amb}$	8.03E-07	8.03E-07	(g-soil/cm^3-air)
$VF_{gw,amb}$	9.43E-08	9.43E-08	(cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	92	(g/mole)	TPHCWG(1997) v.3
D_{air}	1.00E-01	(cm^2/sec)	TPHCWG(1997) v.3
D_{wat}	1.00E-05	(cm^2/sec)	TPHCWG(1997) v.3
Koc	2.4	log10(L-water/kg-oc	TPHCWG(1997) v.3
H	6.49E-03	(atm-m^3/mol)	TPHCWG(1997) v.3
H	2.70E-01	(L-water/L-air)	
P_v	2.89E+01	(mm Hg)	TPHCWG(1997) v.3
S	5.20E+02	(mg/L)	TPHCWG(1997) v.3
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	4.00E-02	(mg/kg-day)	TPHCWG(1997) v.4
RfC_i	4.00E-01	(mg/m^3)	TPHCWG(1997) v.4
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL		(mg/L-wat)	
RAF_o	1.00E+00		
RAF_d	5.00E-01		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	2.70E-01	(L-wat/L-air)
$C_{sat,vap}$	1.45E+08	($\mu g/m^3$-air)
K_{sw}	2.62E+00	(L-wat/kg-soil)
$C_{sat,soil}$	1.36E+03	(mg/kg-soil)
$D_{eff,vad}$	7.80E-03	(cm^2/sec)
$D_{eff,cap}$	2.01E-05	(cm^2/sec)
$D_{eff,ws}$	1.05E-03	(cm^2/sec)
$D_{eff,crk}$	7.80E-03	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN 0-00-9
name EC > 8 to 10 aromatic

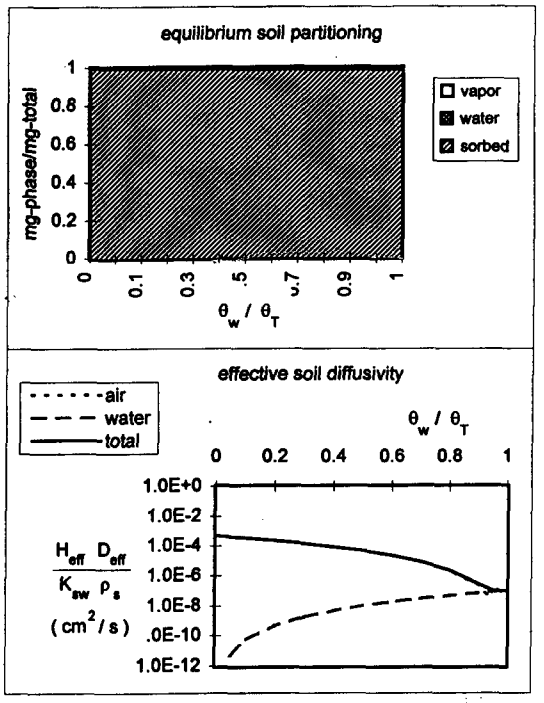
Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	2.09E+02	2.92E+02
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	2.78E+02	2.92E+02
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	1.46E+00	4.09E+00
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	1.10E+02	3.08E+02
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (1.44E+03)	S< (2.02E+03)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	8.45E+00	2.22E+01
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	8.91E+02	Rs (1.25E+03)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	5.28E+01	1.39E+02
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	6.78E+03	9.49E+03
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	1.25E+03	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	4.79E+03	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	23-18-58-00	11-18-70-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	39-10-50-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	43-15-41-00	
	TR_U		
	TR_L		

derived parameters:			
$VF_{s,esp}$	5.27E-06	2.11E-06	(g-soil/cm^3-air)
$VF_{gw,esp}$	3.29E-05	1.32E-05	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	7.32E-08	8.02E-08	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
LF_{sw}	1.33E-02	1.33E-02	(g-soil/cm^3-wat)
$VF_{s,amb}$	2.34E-07	2.34E-07	(g-soil/cm^3-air)
$VF_{gw,amb}$	1.44E-07	1.44E-07	(cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	120	(g/mole)	TPHCWG(1997) v.3
D_{air}	1.00E-01	(cm^2/sec)	TPHCWG(1997) v.3
D_{wat}	1.00E-05	(cm^2/sec)	TPHCWG(1997) v.3
Koc	3.2	log10(L-water/kg-oc	TPHCWG(1997) v.3
H	1.15E-02	(atm-m^3/mol)	TPHCWG(1997) v.3
H	4.80E-01	(L-water/L-air)	
P_v	4.79E+00	(mm Hg)	TPHCWG(1997) v.3
S	6.50E+01	(mg/L)	TPHCWG(1997) v.3
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	4.00E-02	(mg/kg-day)	TPHCWG(1997) v.4
RfC_i	2.00E-01	(mg/m^3)	TPHCWG(1997) v.4
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL		(mg/L-wat)	
RAF_o	1.00E+00		
RAF_d	5.00E-02		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	4.80E-01	(L-wat/L-air)
$C_{sat,vap}$	3.14E+07	($\mu g/m^3$-air)
K_{sw}	1.60E+01	(L-wat/kg-soil)
$C_{sat,soil}$	1.04E+03	(mg/kg-soil)
$D_{eff,vad}$	7.80E-03	(cm^2/sec)
$D_{eff,cap}$	1.70E-05	(cm^2/sec)
$D_{eff,ws}$	9.02E-04	(cm^2/sec)
$D_{eff,crk}$	7.80E-03	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of *aqueous solubility (S<), saturated vapor pressure (<P),* or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) *Percent of surficial soil exposure due to* contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

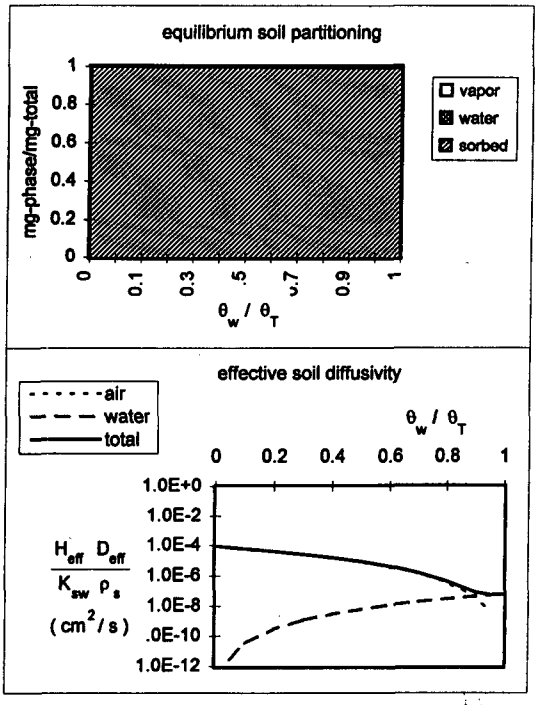
CASRN 0-01-0
name EC > 10 to 12 aromatic

Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	2.09E+02	2.92E+02
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	2.78E+02	2.92E+02
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	1.46E+00	4.09E+00
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	1.73E+02	4.85E+02
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (3.34E+03)	S< (4.68E+03)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	2.30E+01	S< (6.03E+01)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	Rs (4.81E+03)	Rs (6.74E+03)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	2.85E+02	Rs (7.49E+02)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	6.78E+03	9.49E+03
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	1.25E+03	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	4.79E+03	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	23-18-58-00	11-18-70-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	39-10-50-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	43-15-41-00	
	TR_U		
	TR_L		
derived parameters:			
$VF_{s,esp}$		9.75E-07	3.90E-07 (g-soil/cm^3-air)
$VF_{gw,esp}$		1.21E-05	4.84E-06 (cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$		3.15E-08	3.45E-08 (g-soil/cm^3-air)
$VF_{ss,amb,2}$		1.80E-08	2.16E-08 (g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$		1.80E-08	2.16E-08 (g-soil/cm^3-air)
LF_{sw}		8.43E-03	8.43E-03 (g-soil/cm^3-wat)
$VF_{s,amb}$		4.33E-08	4.33E-08 (g-soil/cm^3-air)
$VF_{gw,amb}$		6.24E-08	6.24E-08 (cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	130	(g/mole)	TPHCWG(1997) v.3
D_{air}	1.00E-01	(cm^2/sec)	TPHCWG(1997) v.3
D_{wat}	1.00E-05	(cm^2/sec)	TPHCWG(1997) v.3
Koc	3.4	log10(L-water/kg-oc	TPHCWG(1997) v.3
H	3.37E-03	(atm-m^3/mol)	TPHCWG(1997) v.3
H	1.40E-01	(L-water/L-air)	
P_v	4.79E-01	(mm Hg)	TPHCWG(1997) v.3
S	2.50E+01	(mg/L)	TPHCWG(1997) v.3
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	4.00E-02	(mg/kg-day)	TPHCWG(1997) v.4
RfC_i	2.00E-01	(mg/m^3)	TPHCWG(1997) v.4
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL		(mg/L-wat)	
RAF_o	1.00E+00		
RAF_d	5.00E-02		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	1.40E-01	(L-wat/L-air)
$C_{sat,vap}$	3.41E+06	($\mu g/m^3$-air)
K_{sw}	2.52E+01	(L-wat/kg-soil)
$C_{sat,soil}$	6.30E+02	(mg/kg-soil)
$D_{eff,vad}$	7.80E-03	(cm^2/sec)
$D_{eff,cap}$	2.68E-05	(cm^2/sec)
$D_{eff,ws}$	1.34E-03	(cm^2/sec)
$D_{eff,crk}$	7.80E-03	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

CASRN 0-01-1
name EC >12 to 16 aromatic

Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	2.09E+02	2.92E+02
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	2.78E+02	2.92E+02
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	1.46E+00	4.09E+00
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	Rs (3.45E+02)	Rs (9.65E+02)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (5.45E+03)	S< (7.64E+03)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	S< (4.82E+01)	S< (1.27E+02)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	Rs (2.53E+04)	Rs (3.54E+04)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	Rs (1.50E+03)	Rs (3.94E+03)
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	7.87E+03	1.20E+04
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	1.41E+03	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	5.31E+03	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	26-21-51-00	14-23-62-00
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	45-11-43-00	
	TR_U		
	TR_L		
(age-adj.)	THQ	48-16-34-00	
	TR_U		
	TR_L		

derived parameters:

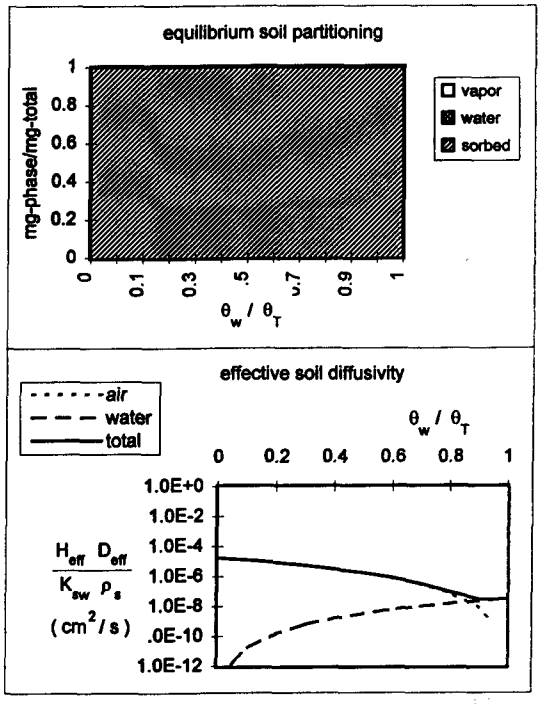
$VF_{s,esp}$	1.85E-07	7.42E-08	(g-soil/cm^3-air)
$VF_{gw,esp}$	5.77E-06	2.31E-06	(cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$	1.37E-08	1.50E-08	(g-soil/cm^3-air)
$VF_{ss,amb,2}$	1.80E-08	2.16E-08	(g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$	1.37E-08	1.50E-08	(g-soil/cm^3-air)
LF_{sw}	4.23E-03	4.23E-03	(g-soil/cm^3-wat)
$VF_{s,amb}$	8.24E-09	8.24E-09	(g-soil/cm^3-air)
$VF_{gw,amb}$	3.82E-08	3.82E-08	(cm^3-wat/cm^3-air)

transport and thermodynamic parameters [references]

MW	150	(g/mole)	TPHCWG(1997) v.3
D_{air}	1.00E-01	(cm^2/sec)	TPHCWG(1997) v.3
D_{wat}	1.00E-05	(cm^2/sec)	TPHCWG(1997) v.3
Koc	3.7	log10(L-water/kg-oc	TPHCWG(1997) v.3
H	1.27E-03	(atm-m^3/mol)	TPHCWG(1997) v.3
H	5.30E-02	(L-water/L-air)	
P_v	3.65E-02	(mm Hg)	TPHCWG(1997) v.3
S	5.80E+00	(mg/L)	TPHCWG(1997) v.3
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	4.00E-02	(mg/kg-day)	TPHCWG(1997) v.4
RfC_i	2.00E-01	(mg/m^3)	TPHCWG(1997) v.4
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL		(mg/L-wat)	
RAF_o	1.00E+00		
RAF_d	5.00E-02		

derived parameters dependent on:
chemical properties and soil parameters

UF	1.00E+00	(unitless)
H_{eff}	5.30E-02	(L-wat/L-air)
$C_{sat,vap}$	2.99E+05	($\mu g/m^3$-air)
K_{sw}	5.02E+01	(L-wat/kg-soil)
$C_{sat,soil}$	2.91E+02	(mg/kg-soil)
$D_{eff,vad}$	7.80E-03	(cm^2/sec)
$D_{eff,cap}$	4.96E-05	(cm^2/sec)
$D_{eff,ws}$	2.16E-03	(cm^2/sec)
$D_{eff,crk}$	7.80E-03	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

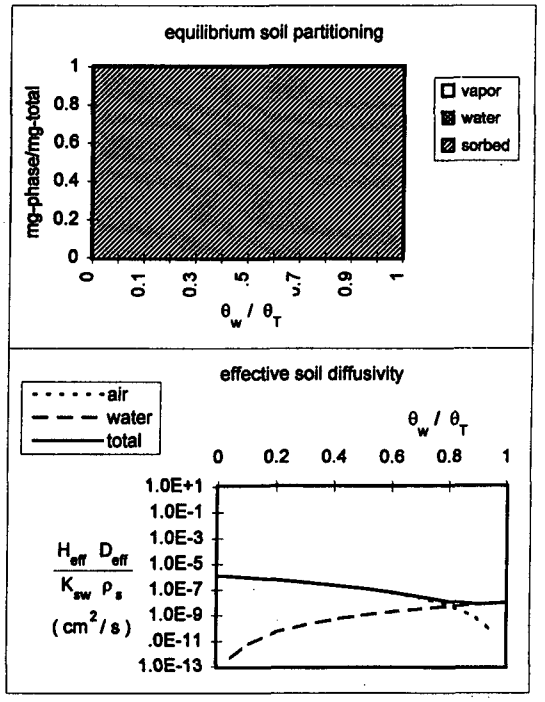
CASRN 0-01-2
name EC >16 to 21 aromatic

Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	NA	NA
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	NA	NA
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	S< (1.10E+00)	S< (3.07E+00)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	S< (8.17E+02)	S<
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	1.22E+04	2.38E+04
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	1.87E+03	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	6.13E+03	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	#VALUE!	#VALUE!
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	#VALUE!	
	TR_U		
	TR_L		
(age-adj.)	THQ	#VALUE!	
	TR_U		
	TR_L		
derived parameters:			
$VF_{s,esp}$		1.44E-08	5.76E-09 (g-soil/cm^3-air)
$VF_{gw,esp}$		1.80E-06	7.18E-07 (cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$		3.83E-09	4.19E-09 (g-soil/cm^3-air)
$VF_{ss,amb,2}$		1.80E-08	2.16E-08 (g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$		3.83E-09	4.19E-09 (g-soil/cm^3-air)
LF_{sw}		1.34E-03	1.34E-03 (g-soil/cm^3-wat)
$VF_{s,amb}$		6.40E-10	6.40E-10 (g-soil/cm^3-air)
$VF_{gw,amb}$		1.90E-08	1.90E-08 (cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	190	(g/mole)	TPHCWG(1997) v.3
D_{air}	1.00E-01	(cm^2/sec)	TPHCWG(1997) v.3
D_{wat}	1.00E-05	(cm^2/sec)	TPHCWG(1997) v.3
Koc	4.2	log10(L-water/kg-oc	TPHCWG(1997) v.3
H	3.13E-04	(atm-m^3/mol)	TPHCWG(1997) v.3
H	1.30E-02	(L-water/L-air)	
P_v	8.36E-04	(mm Hg)	TPHCWG(1997) v.3
S	6.50E-01	(mg/L)	TPHCWG(1997) v.3
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	3.00E-02	(mg/kg-day)	TPHCWG(1997) v.4
RfC_i		(mg/m^3)	TPHCWG(1997) v.4
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL		(mg/L-wat)	
RAF_o	1.00E+00		
RAF_d	5.00E-02		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	1.30E-02	(L-wat/L-air)
$C_{sat,vap}$	8.69E+03	($\mu g/m^3$-air)
K_{sw}	1.59E+02	(L-wat/kg-soil)
$C_{sat,soil}$	1.03E+02	(mg/kg-soil)
$D_{eff,vad}$	7.81E-03	(cm^2/sec)
$D_{eff,cap}$	1.62E-04	(cm^2/sec)
$D_{eff,ws}$	4.38E-03	(cm^2/sec)
$D_{eff,crk}$	7.81E-03	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

Chemical-Specific Parameters and Risk-Based Screening Level Concentrations

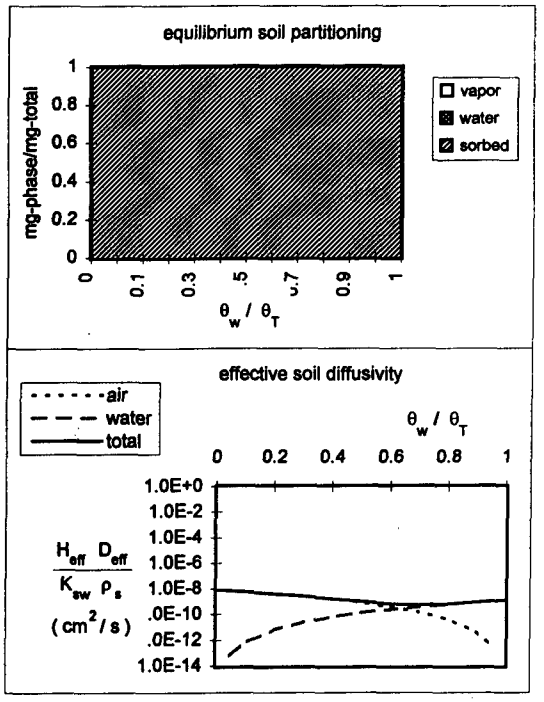
CASRN 0-01-3
name EC >21 to 35 aromatic

Risk-Based Screening-Level Concentrations [1]
risk or hazard scenario:

	criteria:	residential	industrial
ambient vapor inhalation			
$RBSL_{air}$	THQ = 1	NA	NA
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
enclosed space vapor inhalation			
$RBSL_{air}$	THQ = 1	NA	NA
($\mu g/m^3$)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater ingestion			
$RBSL_{gw}$	THQ = 1	S< (1.10E+00)	S< (3.07E+00)
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
soil leaching to groundwater ingestion			
$RBSL_s$	THQ = 1	S< (6.49E+03)	S<
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
	MCL		
groundwater to ambient vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
groundwater to enclosed space vapor inhalation			
$RBSL_{gw}$	THQ = 1	NA	NA
(mg/L)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to ambient air			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
subsurface soil volatilization to enclosed space			
$RBSL_s$	THQ = 1	NA	NA
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
surficial soil exposure			
$RBSL_{ss}$	THQ = 1	1.22E+04	2.38E+04
(mg/kg)	$TR_U = 10^{-4}$	NA	NA
	$TR_L = 10^{-6}$	NA	NA
(child)	THQ	1.87E+03	
	TR_U	NA	
	TR_L	NA	
(age-adj.)	THQ	6.13E+03	
	TR_U	NA	
	TR_L	NA	
surficial soil exposure apportionment [2]			
(%)	THQ = 1	#VALUE!	#VALUE!
(i-d-v-p)	$TR_U = 10^{-4}$		
	$TR_L = 10^{-6}$		
(child)	THQ	#VALUE!	
	TR_U		
	TR_L		
(age-adj.)	THQ	#VALUE!	
	TR_U		
	TR_L		
derived parameters:			
$VF_{s,esp}$		9.45E-11	3.78E-11 (g-soil/cm^3-air)
$VF_{gw,esp}$		1.05E-07	4.21E-08 (cm^3-wat/cm^3-air)
$VF_{ss,amb,1}$		3.10E-10	3.40E-10 (g-soil/cm^3-air)
$VF_{ss,amb,2}$		1.80E-08	2.16E-08 (g-soil/cm^3-air)
$VF_{ss,amb,min(1,2)}$		3.10E-10	3.40E-10 (g-soil/cm^3-air)
LF_{sw}		1.69E-04	1.69E-04 (g-soil/cm^3-wat)
$VF_{s,amb}$		4.20E-12	4.20E-12 (g-soil/cm^3-air)
$VF_{gw,amb}$		1.71E-09	1.71E-09 (cm^3-wat/cm^3-air)

transport and thermodynamic parameters			[references]
MW	240	(g/mole)	TPHCWG(1997) v.3
D_{air}	1.00E-01	(cm^2/sec)	TPHCWG(1997) v.3
D_{wat}	1.00E-05	(cm^2/sec)	TPHCWG(1997) v.3
Koc	5.1	log10(L-water/kg-oc	TPHCWG(1997) v.3
H	1.61E-05	(atm-m^3/mol)	TPHCWG(1997) v.3
H	6.70E-04	(L-water/L-air)	
P_v	3.34E-07	(mm Hg)	TPHCWG(1997) v.3
S	6.60E-03	(mg/L)	TPHCWG(1997) v.3
pK_a		(log10(mol/mol))	
pK_b		(log10(mol/mol))	
toxicity parameters			
RfD_o	3.00E-02	(mg/kg-day)	TPHCWG(1997) v.4
RfC_i		(mg/m^3)	TPHCWG(1997) v.4
SF_o		(1/(mg/kg-day))	
SF_i		(1/(mg/kg-day))	
W of E			
MCL		(mg/L-wat)	
RAF_o	1.00E+00		
RAF_d	5.00E-02		

derived parameters dependent on: chemical properties and soil parameters		
UF	1.00E+00	(unitless)
H_{eff}	6.70E-04	(L-wat/L-air)
$C_{sat,vap}$	4.39E+00	($\mu g/m^3$-air)
K_{sw}	1.26E+03	(L-wat/kg-soil)
$C_{sat,soil}$	8.31E+00	(mg/kg-soil)
$D_{eff,vad}$	7.89E-03	(cm^2/sec)
$D_{eff,cap}$	2.91E-03	(cm^2/sec)
$D_{eff,ws}$	7.67E-03	(cm^2/sec)
$D_{eff,crk}$	7.89E-03	(cm^2/sec)



Notes:
(1) RBSL values are compared to physical limits of aqueous solubility (S<), saturated vapor pressure (<P), or either (Rs), and flagged if the calculated value is physically unrealistic. For cases where this occurs, the calculated values are given in parentheses.
(2) Percent of surficial soil exposure due to contributions of ingestion, dermal contact, vapor inhalation, and particulate inhalation (i-d-v-p).
(3) NA - not applicable.

G. E. DeVaull, 3/9/98

3/12/98 Shell/OCD meeting handout #2

Risk-Based Assessment of Soils

Tasker Road Site
Hobbs, New Mexico

George DeVaull
George Deeley
Illeana Rhodes

Shell Oil Company
Houston, Texas

12 March 1998

Risk-Based Assessment includes information from:

Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites, ASTM E 1739-95

Total Petroleum Hydrocarbons Working Group Methodology

Tier 1 Risk-Based Corrective Action (RBCA) Tools for Application at Exploration and Production Facilities (GRI/API project *in progress*)

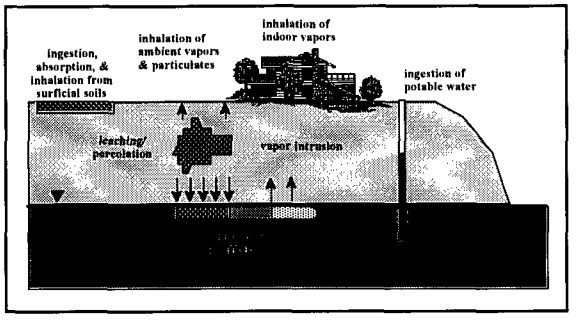
ASTM

E1739

RBCA

Risk-Based Assessment

- Initial data requirements from a risk perspective
- Identify possible sources
- Identify potential "receptors"
- Identify potential migration pathways



ASTM

E1739

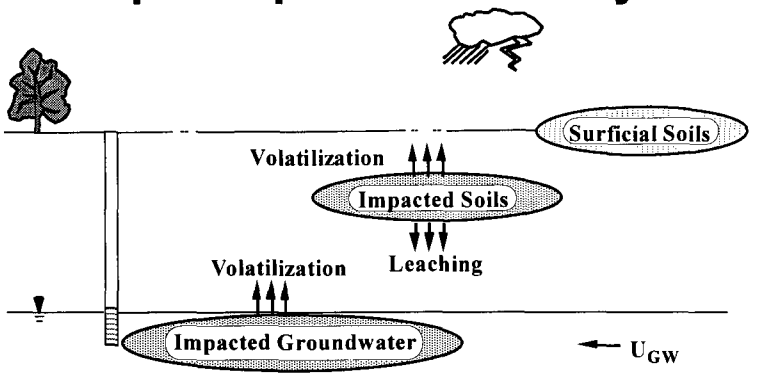
RBCA

Tiered Assessment Process

- Tier 1 *generic*
- ASTM generic conceptual model (exposure pathways)
- EPA upper-bound exposure factors
- Conservative site parameters
- Look-up tables
- No degradation or attenuation
- Tier 2 *simple, site-specific*
- Site-specific parameters
- Algebraic modeling
- Include degradation or attenuation
- Tier 3 *detailed*
- More detailed site data
- Computer models

decisions are made at each tier

Sample Exposure Pathways

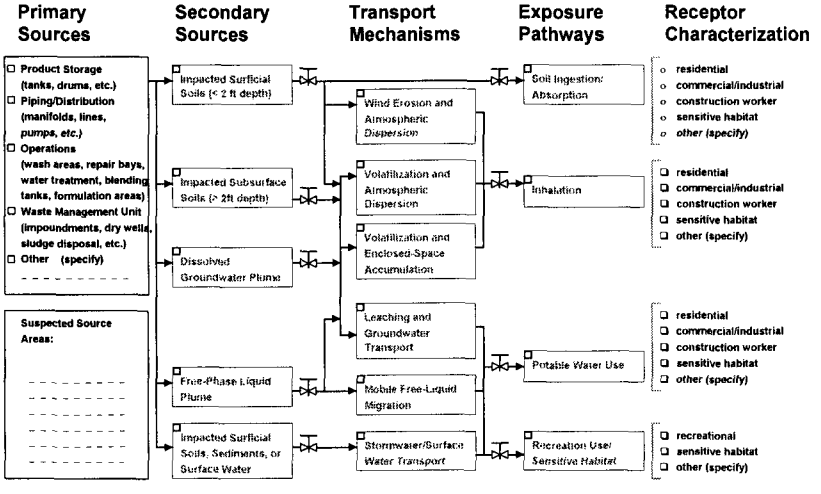


Example Pathways:

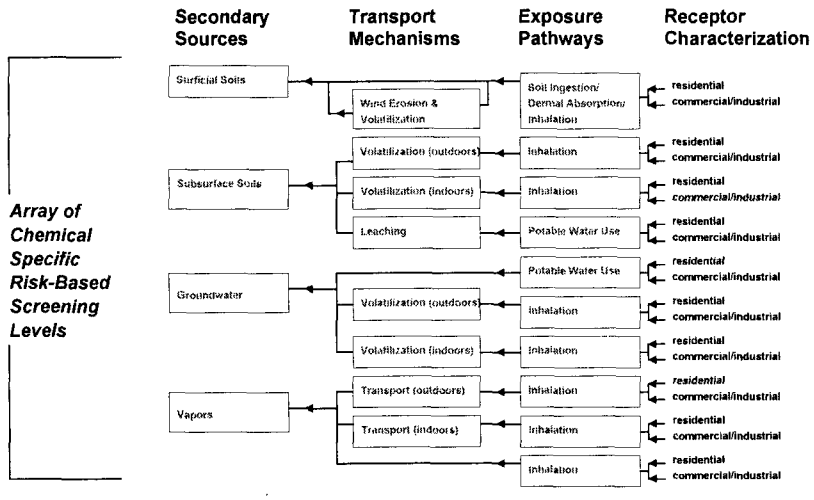
- **Vapor Inhalation**
- **Groundwater Ingestion**
- **Surficial Soil Ingestion, Dermal Contact, and Inhalation**
- **Ambient Air Inhalation from Soil or Groundwater Source**
- **Indoor Air Inhalation from Soil or Groundwater Source**
- **Soil Leaching to Groundwater and Ingestion or Potable Usage**

Risk-Based Corrective Action

site conceptual model



RBSL Development



Tier 1 Lookup Tables - Basis

- **USEPA recommended:**
  - risk/exposure assessment practices
  - reasonable maximum exposure assumptions
- **RBSL tables for soil, groundwater & air are based on:**
  - estimated impacts to human health and environmental resources
  - ambient background
- **Values are given for:**
  - Risk Range 10^{-6} to 10^{-4} carcinogens
  - Hazard Quotient = 1 non-carcinogens
- **Pathways include:**
  - direct exposure *(example: drinking water ingestion)*
  - indirect exposure *(example: vapors from contaminated soils)*

Risk Based Screening Levels [RBSL]

Exposure Point Concentrations - *direct exposure calculation*

carcinogen:

$$RBSL = \frac{\text{Risk Level x Body Weight x Lifetime}}{\text{Slope Factor x Daily Intake Rate x Exposure Time}}$$

Risk Level = 10^{-4} to 10^{-6}

Slope Factor = (kg_{BW}-day/mg_{chem}) chemical specific measure of carcinogen potency

response is proportional to lifetime dose

non-carcinogen:

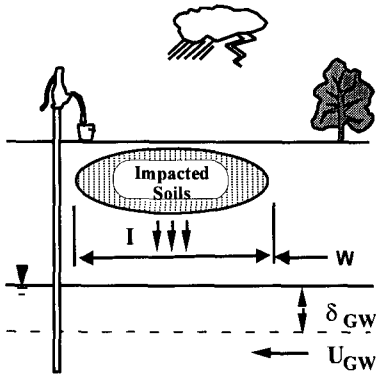
$$RBSL = \frac{\text{Hazard Index x Reference Dose x Body Weight}}{\text{Daily Intake Rate}}$$

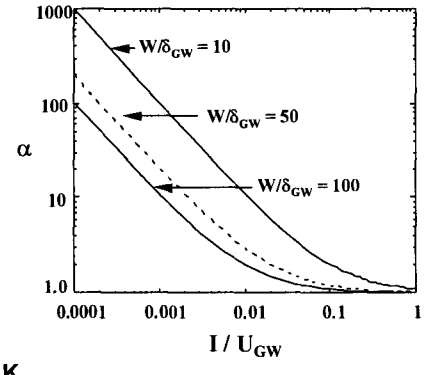
Hazard Index = 1

Reference Dose = (mg_{chem}/kg_{BW}-day) chemical specific measure of chronic toxicity

there is a theshold dose, below which no observed adverse effects are found

Cross Media Transport: Soil Leachate to Groundwater





$RBSL(mg/kg) = RBSLGW(mg/l) \cdot \alpha \cdot K_{SW}$

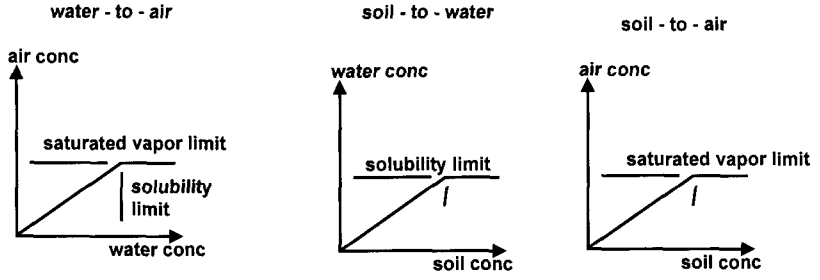
K_{SW} = Soil to leachate equilibrium coefficient

Note: Groundwater attenuation is not included.

Risk Based Screening Levels [RBSL]

Partitioning Limitations -

theoretical upper bound on achievable exposure point concentrations



limits are marked by the presence of a free phase or precipitate

Tasker Road Site

individual chemicals - Tier 1 Risk-Based screening

- VOCs
  - ethylbenzene and xylenes
    - below screening levels for all exposure pathways
  - tetrachloroethene
    - 1 in 10 detect, low levels, not of concern
- metals
    - below screening levels for all exposure pathways
    - at natural background levels
    - some refinement (Tier 1 ~ 2)
- Total Petroleum Hydrocarbons
  - use TPHCWG methodology
    - Total Petroleum Hydrocarbon Working Group
      - **Open, ad-hoc group, how to use TPH for risk-based assessment?**
      - **Wade Weisman, MSPH, Captain, U.S.A.F**

Risk-Based Assessment of Petroleum Hydrocarbons

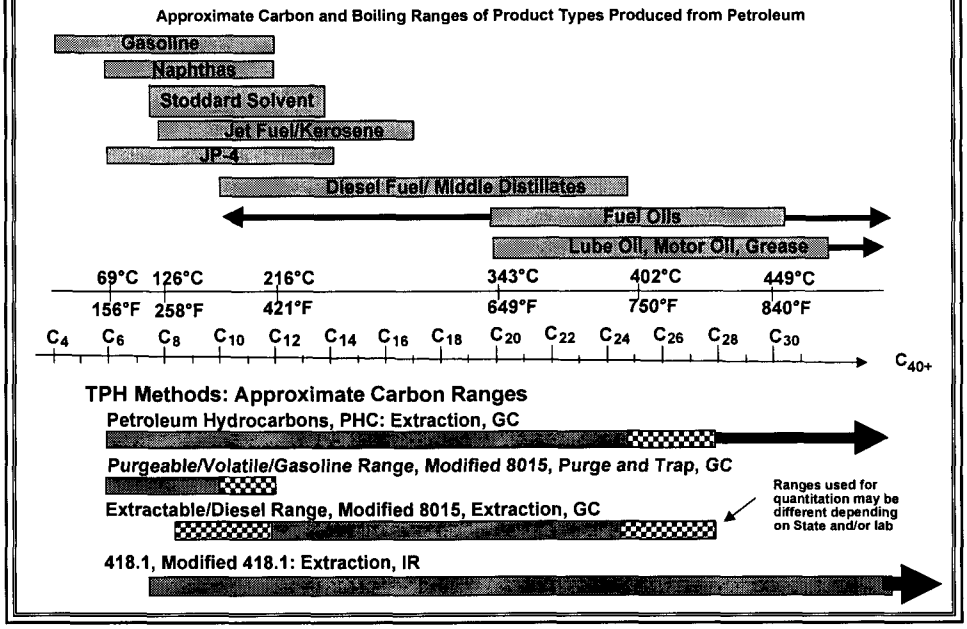
Total Petroleum Hydrocarbons Working Group (TPHCWG)

- Include Indicator Chemicals (BTEX, PAHs)
- Petroleum Mixtures
  - Analyze by carbon number or boiling-point distribution
  - Use surrogate fractions in RBCA analysis
    - assigned fate and transport
    - assigned non-carcinogen surrogate toxicity

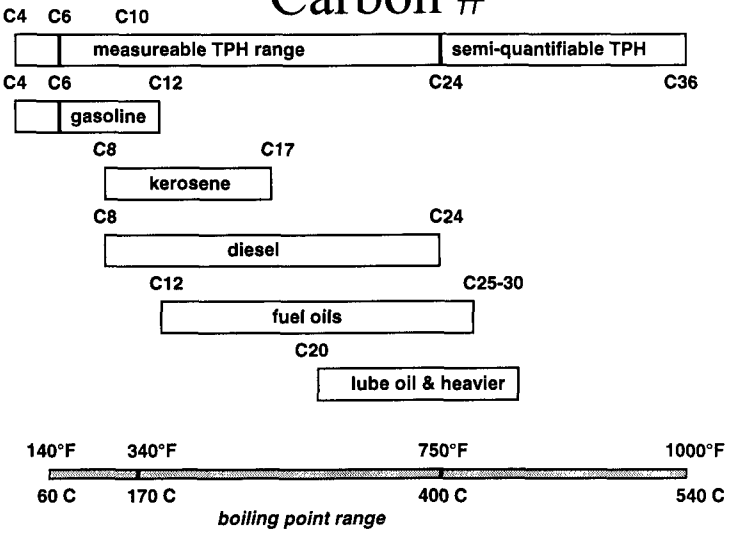
What is a Surrogate?

- **In our case, a compound (single or mixture) that is used to represent the toxicity of a group of compounds.**
- **In contrast to an indicator - a compound that if it is present there is toxicity if not present there is no toxicity**

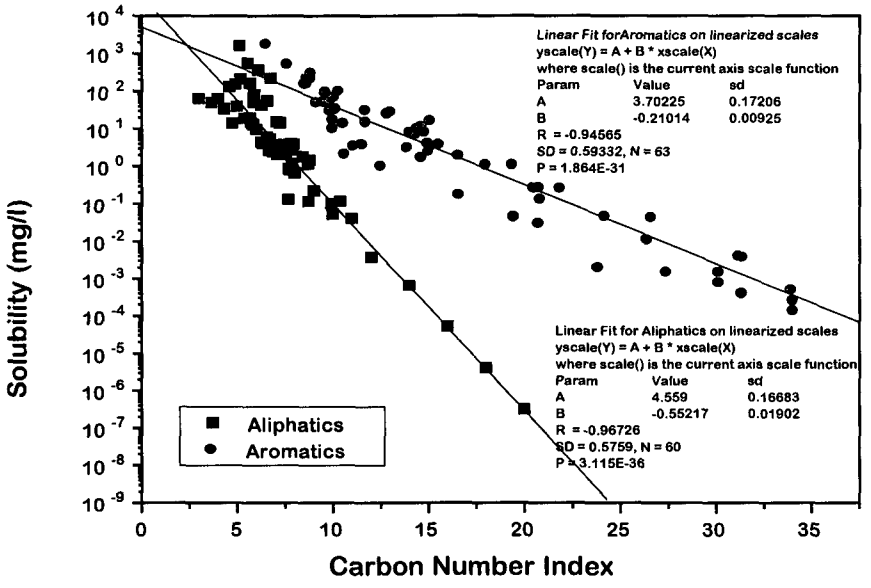
Summary of Petroleum Product Types and TPH Analytical Methods with Respect to Carbon and Boiling Ranges



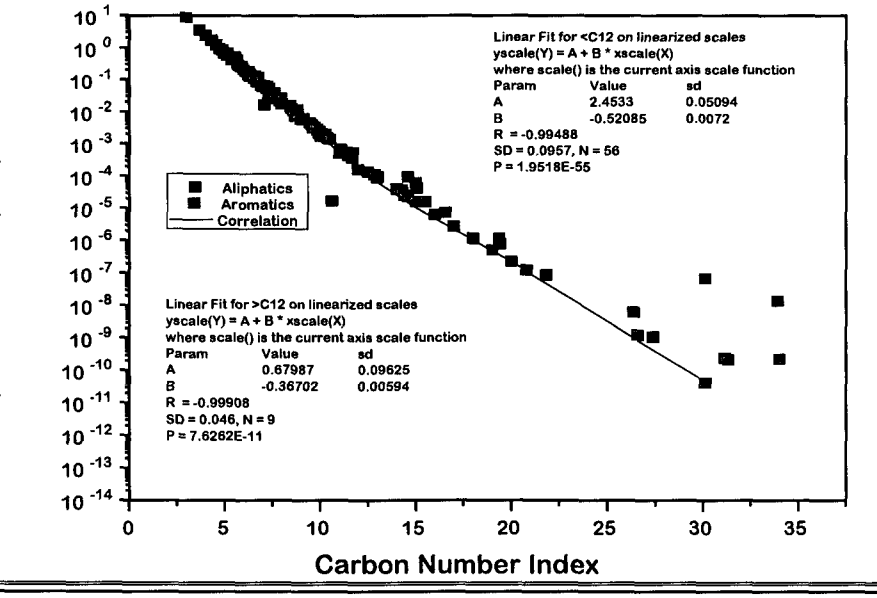
TPH measurements by GC and Carbon



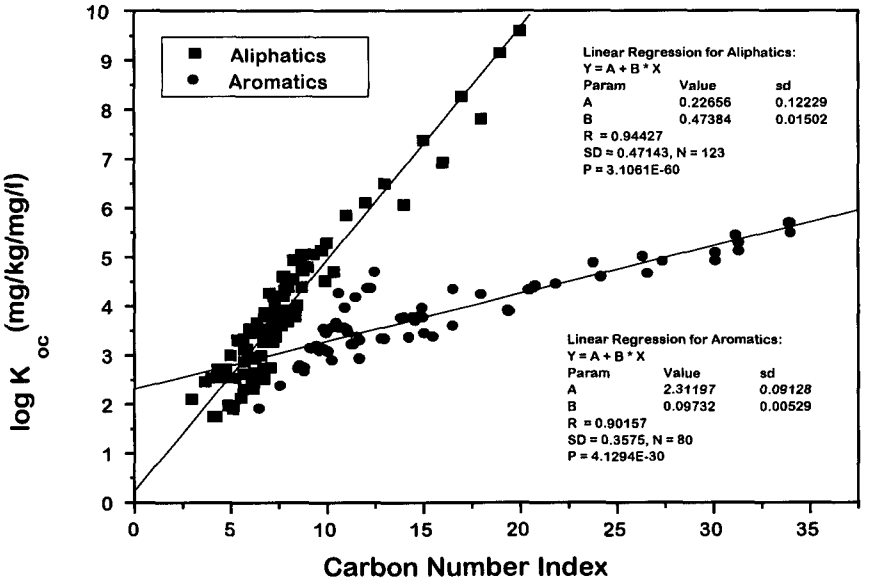
Solubility Aromatics > Aliphatics



Vapor Pressure Correlation
Relative Carbon Number Index



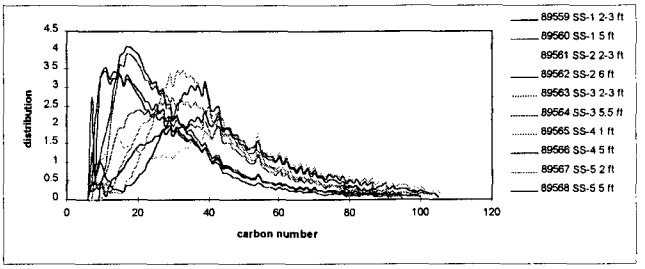
Sorption of Aliphatics > Aromatics

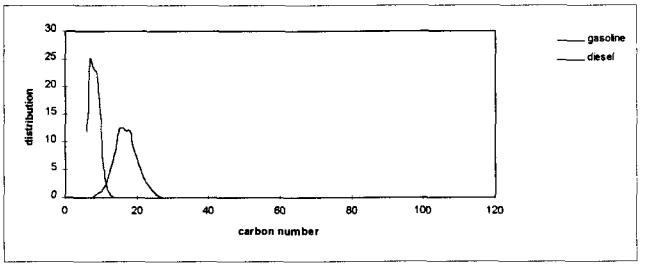


Representative Fractions

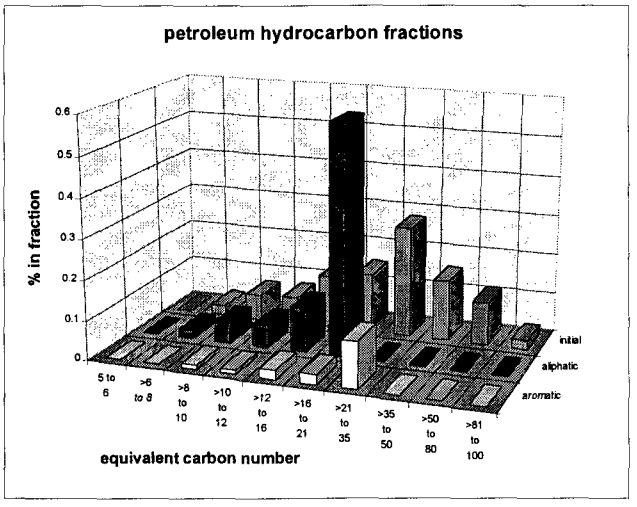
- Significantly Different Mobility
  - Leaching of Aromatics >> Leaching of Aliphatics
  - Volatilization of Aliphatics >= Volatilization of Aromatics
- Behavior spans orders of magnitude
  - Characterize by order of magnitude changes in behavior
- Defined Fractions Based on Behavior
  - Separate Aromatics from Aliphatics
  - Order of magnitude difference in behavior
  - 12 Fractions (6 aromatics and 6 alkanes/alkenes)
- Consistent with available analytical methods and uncertainty of toxicity data
  - Pseudo boiling point column GC
  - Order of magnitude uncertainty factors

Petroleum Hydrocarbon Analysis for Tasker Road Site





Petroleum Fractions for Tasker Road Site



Sample 89562 SS-2 6 ft

Petroleum Fractions for Tasker Road Site

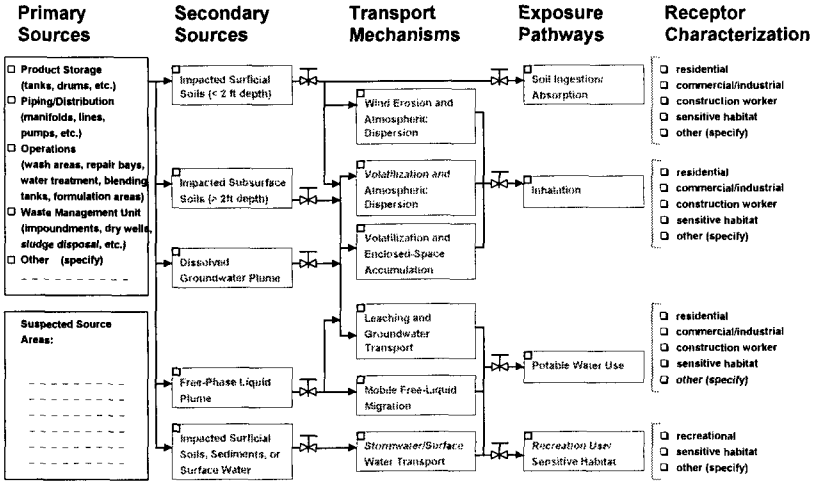
Fractional distribution in soil matrix

name	Soil Pore Water	Soil Pore Air	Soil-Sorbed	Residual Oil-phase	Total
EC 5 to 6 aliphatic	0.0E+0	0.0E+0	0.0E+0	0	0
EC >6 to 8 aliphatic	1.7E-2	1.4E+0	9.5E+0	547	558
EC >8 to 10 aliphatic	2.7E-3	3.7E-1	1.2E+1	1434	1447
EC >10 to 12 aliphatic	1.8E-4	3.8E-2	6.6E+0	1517	1524
EC >12 to 16 aliphatic	6.5E-6	5.7E-3	4.6E+0	2981	2986
EC >16 to 21 aliphatic	8.5E-8	7.1E-4	7.6E+0	15475	15483
Benzene (EC 5 to 7) aromatic	0.0E+0	0.0E+0	0.0E+0	0	0
Toluene (EC >8 to 10) aromatic	0.0E+0	0.0E+0	0.0E+0	0	0
EC > 8 to 10 aromatic	8.5E-2	6.9E-2	1.9E+1	273	292
EC > 10 to 12 aromatic	3.3E-2	7.7E-3	1.2E+1	296	308
EC >12 to 16 aromatic	1.3E-2	1.2E-3	9.3E+0	594	603
EC >16 to 21 aromatic	1.3E-3	2.9E-5	2.9E+0	671	673
EC >21 to 35 aromatic	4.9E-5	5.6E-8	8.8E-1	3125	3126
Total:	0.15	1.93	84	26914	27000

all units in mg/kg soil Sample 89562 SS-2 6 ft

Risk-Based Corrective Action

site conceptual model



For each TPH analysis result

- Calculate transport along each pathway for each fraction; estimate potential exposure point concentrations
- calculate hazard quotient for each fraction
- $HQ_i = C_i / RBSL_i$
- Calculate hazard index for summed fractions
- $HI = \Sigma HQ_i$
- $HI > 1$, potential exceedence of criteria

Tasker Road Site - TPH

- Set HI = 1
- Back calculate soil concentration
- range 7400 to 9900 mg/kg, approx.
  - Controlled by direct exposure estimate (ingestion, contact)
  - Leaching to groundwater & vapor evlution calculations show no concern