6.0 BASELINE RISK ASSESSMENT

The Baseline Risk Assessment was completed as part of the PVLF RI/FS by the Sanitation Districts' consultant, Dames & Moore. Both a human health and an environmental evaluation were performed.

Site Description and General History

Topographically, the PVLF is located in the north-facing foothills of the Palos Verdes Peninsula in the south central portion of Los Angeles County, California (Figure 1.3-1). The PVLF consists of 291 acres physically divided into three portions by Hawthorne Boulevard in the northwest and by Crenshaw Boulevard in the southeast (see Exhibit 1.3-1). There are six parcels within the PVLF that became operational at different times throughout the history of the facility. The three site areas are described below, and more detailed discussions can be found in Section 1.0.

South Coast Botanic Garden Area. The southern most portion of the site (83 acres) contains Parcel 1 and is the current location of the South Coast Botanic Garden. Approximately fifteen acres of this area was operated as a landfill by BKK Corporation from 1952 until 1957, at which time the PVLF came under the control of the Sanitation Districts. By 1965, Parcel 1 had reached capacity and landfill activities ceased. Subsequently, the County of Los Angeles established the South Coast Botanic Garden at this area.

Main Site Area. The central landfill area is called the main site (173 acres), and includes parcels 2, 3, 5 and 6. Landfilling operations began at the main site in 1961. The area contains an engineered Class 1 facility at Parcel 6. Parcel 6 and portions of Parcels 2, 3, and 5 were permitted to accept hazardous wastes. Landfilling operations ceased at the main site when it reached capacity in December of 1980. The area was covered predominantly with imported soil and currently has a partial cover of dry, grassy vegetation.

Ernie Howlett Park Area. The northern part of the PVLF encompasses Parcel 4, and is the current location of Ernie Howlett Park, a multipurpose recreational area. Landfill operations began at Parcel 4 in 1970 and continued until 1979, when the parcel was closed and developed into

the park. The majority of materials accepted at Parcel 4 were inert construction and demolition wastes.

Prior to establishment of the landfill, the site and surrounding areas were utilized for quarrying and mining of sand, gravel and diatomaceous earth. Diatomite mining operations at the site occurred from the early 1900s until 1957 when the ore reserves were depleted. The tailings generated by diatomite mining were utilized to backfill excavation pits, and were also discarded in canyons to the northeast and southwest of the PVLF.

Sand and gravel were mined in areas northeast of the site from the 1920s until the early 1960s. In the 1960s through the early 1970s, large scale mining occurred on portions of land northeast of the property line adjacent to Parcel 6 of the main site.

Post-closure maintenance activities, other than general maintenance, are directed by the Sanitation Districts for all areas of the PVLF. The Sanitation Districts maintain several environmental control systems at the PVLF, including:

- A landfill gas collection/energy recovery system. The energy recovery facility is located in the northern corner of the main site;
- A system of landfill gas probes installed around the perimeter of the entire PVLF in order to monitor the effectiveness of the gas collection system; and
- An underdrain and collection sump (Sump 7) installed at the main site and at Ernie Howlett Park (Parcel 4 Sump) for the purposes of limiting the migration of chemicals through ground water; additionally, a subsurface barrier and extraction well system was built along Hawthorne Boulevard. Chemical contamination of ground water downgradient of the site is monitored via a network of ground water monitoring wells.

Scope and Purpose

The Baseline Risk Assessment was conducted in accordance with current EPA guidance on risk assessment (EPA, 1989a; 1989b; and 1991a), which is also recommended and endorsed by

DTSC. As part of the human health evaluation process for the PVLF, the purpose of the Baseline Risk Assessment was to develop information to "determine what actions are necessary to reduce risks, and not to fully characterize site risks or eliminate all uncertainty from the analysis" (EPA, 1989a).

The general tasks undertaken in the risk assessment were as follows:

- The site analytical data were evaluated and a set of chemicals of potential concern (COCs) was defined for the site;
- Potentially complete human exposure pathways were identified for the purposes of quantitative risk calculations;
- Exposures to receptor populations were calculated utilizing monitoring data or estimates based on air or ground water modeling. All complete or potentially complete exposure pathways were addressed and quantified unless otherwise noted. Reasonable Maximum Exposures (RME) and Average Case exposures were computed for each complete pathway;
- Carcinogenic and non-carcinogenic risks were calculated based upon the estimated exposures, and utilizing toxicity constants defined by the EPA and DTSC, or in certain cases, derived from the available toxicological data; and
- Potential exposures and risks to ecological receptors at or near the PVLF site were evaluated qualitatively.

6.1 HUMAN HEALTH EVALUATION

The human health evaluation consists of four parts: the identification of COCs, an exposure assessment, a toxicity assessment, and risk characterization. The following sections discuss these items.

6.1.1 Identification of Chemicals of Potential Concern

This section evaluates the available analytical data as well as the historical information on chemicals placed at the PVLF in order to define the COCs. The COCs potentially represent landfill-associated chemicals that could pose health risks to potentially exposed populations.

Reasonable maximum estimates for COCs in surface soil and landfill gas were calculated as part of the data evaluation. The history of chemical disposal at the PVLF is discussed in Section 6.1.1.1. The analytical data for the PVLF are discussed in Sections 6.1.1.2 and 6.1.1.3. Section 6.1.1.4 presents the rationale for selection of the COCs.

6.1.1.1 History of Chemical Disposal at the Site

The PVLF accepted approximately 23.6 million tons of solid and liquid wastes while operating under the authority of the Sanitation Districts. Of this, approximately 18.3 million tons (78 percent) were disposed of at the main site, 3.5 million tons (fifteen percent) at the South Coast Botanic Garden, and 1.8 million tons (eight percent) at Ernie Howlett Park. Approximately three to four percent of the total wastes were hazardous; all hazardous wastes were disposed of in permitted sections of the main site.

Parcels 1 (the South Coast Botanic Garden) and 4 (Ernie Howlett Park) accepted only non-hazardous wastes, whereas the main site accepted both non-hazardous and hazardous wastes (the hazardous wastes were disposed of between 1964 and 1980). Liquid wastes accounted for approximately twelve percent the total waste materials placed at the main site. Approximately 55,260 tons of liquid acid and alkaline wastes were disposed of in eleven injection wells drilled into the refuse in the central region of the main site. Liquid wastes disposed of at the PVLF include the following, also shown on Table 1.3-2:

- Mud, water, and drilling mud;
- Cannery waste;
- Acid and alkaline wastes;
- Tetraethyl lead sludge;
- Chemical toilet wastes;
- Hazardous tank bottoms;
- Oily wastes;
- Contaminated sand and soil;
- Brine;
- Pesticides;

- Refinery wastes; and
- Paint sludge.

6.1.1.2 Discussion of the Available Data

The chemical monitoring programs conducted by the Sanitation Districts, as part of the RI, are described in Sections 2.0 and 3.0 which presents monitoring program designs and results as well as qualitative and statistical comparisons of the data to background concentrations. The monitoring programs are described briefly below.

6.1.1.2.1 Hydrogeologic Characterization

The hydrogeologic characterization studies conducted by the Sanitation Districts defined hydrogeologic conditions and the nature and extent of ground water contamination at the PVLF in sufficient detail to proceed with the development of a contaminant transport model and then a risk assessment. The field investigations included exploratory borings, soil and water sampling, and ground water monitoring at locations both upgradient and downgradient from the PVLF. Data summaries for ground water samples collected from 1986 through 1994 are presented in Section 3.6, as are complete well histories for wells sampled. The chemical data for ground water samples collected over the monitoring period January 1, 1986, through June 30, 1994, were used in the Baseline Risk Assessment and are summarized in Section 6.1.1.3.

6.1.1.2.2 Air and Landfill Gas Characterizations

The air and landfill gas characterizations performed for the RI and discussed in Section 3.1 presented the results of methane and VOC monitoring programs which have been used to evaluate the effectiveness of the landfill gas collection and control system. The original ambient air, surface gas, boundary probe, and landfill gas sampling program speciated TACs, which include the 17 VOCs on the AB 2588 list. Monitoring data from this program were collected at the PVLF for at least one year from September 1990 to August 1991. An additional ambient air and landfill gas sampling program was conducted during June and July of 1994; EPA Method TO-14 was used to speciate 43 VOCs in the samples collected.

The monitoring programs include:

- Ambient air monitoring at locations upwind and downwind from the PVLF for TACs over a one year period from September 1990 through August 1991;
- Ambient air monitoring at locations upwind and downwind from the PVLF for priority pollutant VOCs by EPA Method TO-14 over a two month period of June and July 1994;
- Integrated surface gas monitoring from the landfill surface for methane and TACs over a one year period from September 1990 through August 1991 for the whole landfill, and continuing at the main site and South Coast Botanic Garden through June 1994;
- Boundary probe monitoring for methane and TACs from September 1990 through June 1994;
- Neighborhood monitoring of ambient air from water meter boxes for methane beginning prior to the initiation of the RI studies and reported through June 1994;
- Surface emissions testing for eight VOCs using a surface flux chamber at off site locations (northeast of the PVLF);
- Landfill gas testing for methane, TACs, and hydrogen sulfide over a one year period from September 1990 through August 1991;
- Landfill gas testing for priority pollutant VOCs by EPA Method TO-14 over a two month period of June and July 1994; and
- Flare emissions testing for TACs.

The results of all of the monitoring programs are presented in Section 3.0.

6.1.1.2.3 Surface Water and Sediment Characterization

The surface water and sediment characterization documented in Section 3.2 presents work conducted by the Sanitation Districts to investigate surface water runoff and water-transported sediment at the PVLF. The work included sampling and analysis of surface water and sediment in

runoff collected from eighteen locations on and around the PVLF, including five background locations. In addition, 56 surface soil samples from the landfill cover were collected and analyzed.

The soil characterization included in Section 3.5 presents the results of various drilling programs conducted by the Sanitation Districts to determine soil conditions in the vicinity of the PVLF. The programs included drilling seventeen borings upgradient of the landfill as well as 29 borings down-canyon of the site. A total of 156 soil samples were collected.

6.1.1.3 Data Evaluation

Measurable chemical concentrations that are potentially associated with the PVLF were detected in the monitoring data for ground water and landfill gas (including soil vapor from boundary probes). In addition, several chemicals were detected at concentrations which may exceed background in surface soil samples from the landfill cover. These data were used to characterize risks associated with the landfill and are evaluated in further detail below. The reader is referred to Sections 2.0 and 3.0 for details of the remaining monitoring programs and background comparisons.

6.1.1.3.1 Chemicals in Ground Water

The ground water quality at the PVLF has been extensively monitored since the mid 1980s. The current monitoring system consists of 66 ground water monitoring wells, including fourteen monitoring wells from upgradient locations. The locations of the monitoring wells are shown on Exhibit 2.1-10. The chemical data for ground water samples collected over the monitoring period January 1, 1986, through June 30, 1994, were reviewed to identify chemicals which could be associated with the site. These data are summarized for all on site and downgradient wells in Tables 6.1-1 through 6.1-3. Table 6.1-4 is a data summary for upgradient wells over the monitoring period January 1, 1986 through December 31, 1992, which was used for background comparisons.

Fourteen metals were detected in the PVLF ground water program. In order to evaluate the source of these metals, a soil equilibrium study was performed by the Sanitation Districts in 1984. Samples of three members of the Monterey Formation (Malaga Mudstone, Valmonte Diatomite, and Altamira Shale) were mixed with deionized water and allowed to equilibrate (as was

TABLE 6.1-1

SUMMARY OF CHEMICALS DETECTED IN ON SITE AND DOWNGRADIENT GROUND WATER MONITORING WELLS NEAR HAWTHORNE BOULEVARD (1986 - 1992)

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Summary of Chemicals Detected (a)			
	Times Detected	Times Tested	Minimum Detected	Maximum Detected
ORGANIC COMPOUNDS (mg/L)				
Acetone	63	356	1.9	1200
Benzene	274	677	0.1	990
Benzo(g,h,i)Perylene	2	185	0.7	1.9
Bis(2-Chloroethyl)Ether	1	185	0.5	0.5
Bromodichloromethane	8	677	0.2	9.4
Bromoform	2	679	0.6	2.1
Bromomethane	1	665	2.1	2.1
Butanone, 2-	2	383	21	38
Butylbenzyl Phthalate	2	185	1.8	18
Carbon Tetrachloride	1	675	0.5	0.5
Chlorobenzene	455	679	0.3	1400
Chloroethane	2	665	1.1	1.8
Chloroform	49	674	0.1	9
Chloromethane	10	665	7	150
Chlorophenol, 2-	15	185	0.6	13
Chrysene	1	185	0.8	0.8
DDD	2	84	0.01	0.01
DDE	3	84	0.01	0.01
Di-n-butylphthalate	45	185	0.2	21
Di-n-octylphthalate	38	185	0.4	24
Dibromochloromethane	8	677	0.7	11
Dichlorobenzene, 1,2-	22	818	0.8	6
Dichlorobenzene, 1,4-	66	726	0.5	30
Dichloroethane, 1,1-	537	678	0.2	230
Dichloroethane, 1,2-	525	662	0.2	590
Dichloroethene, 1,1-	115	676	0.1	46
Dichloroethene, cis-1,2-	63	101	0.5	510
Dichloroethene, trans-1,2-	338	664	0.1	130
Dichloropropane, 1,2-	227	666	0.3	46
Dichloropropene, 1,3-	1	666	9.9	9.9
Diethylhexylphthalate	106	185	1	180
Diethylphthalate	16	185	1	30
Dimethylphenol, 2,4-	2	185	1	1
Dinitrophenol, 2,4-	1	185	1	1
Ethylbenzene	27	667	0.1	5
Fluoranthene	1	185	0.8	0.8
Isophorone	61	185	0.5	72
Methylene Chloride	109	670	0.5	580
Naphthalene	7	185	0.4	1.6
Nitrophenol, 2-	1	185	1	1
Nitrophenol, 4-	1	185	1	1

TABLE 6.1-1 (CONTINUED)
SUMMARY OF CHEMICALS DETECTED IN ON SITE AND DOWNGRADIENT GROUND WATER MONITORING WELLS NEAR HAWTHORNE BOULEVARD (1986 - 1992)
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Summary of Chemicals Detected (a)			
	Times Detected	Times Tested	Minimum Detected	Maximum Detected
Pentachlorophenol	1	185	3.5	3.5
Phenanthrene	5	185	0.6	1.3
Phenol	40	185	0.3	24
Pyrene	2	185	0.2	0.9
Tetrachloroethene	257	679	0.1	27
Tetrahydrofuran	24	62	77	7600
Toluene	84	679	0.3	21
Trichlorobenzene, 1,2,4-	2	185	0.3	1
Trichloroethane, 1,1,1-	16	679	0.3	25
Trichloroethane, 1,1,2-	28	666	0.5	4
Trichloroethene	483	677	0.1	100
Vinyl Chloride	424	678	0.7	6600
Xylenes	1	66	1.5	1.5
INORGANICS (mg/L)				
Arsenic	619	628	0.0006	1.1
Barium	418	419	0.02	7.35
Boron	417	417	0.09	5.48
Cadmium	489	596	0.001	0.5
Chromium, Hexavalent	14	553	0.01	0.57
Chromium, Total	596	631	0.01	19.2
Copper	515	564	0.01	6.13
Lead	131	633	0.005	1.96
Manganese	564	567	0.02	17.8
Mercury	339	632	0.0001	0.0705
Nickel	558	565	0.04	8.55
Selenium	552	621	0.0005	1.5
Silver	284	378	0.004	0.62
Zinc	553	571	0.02	25.4
Ammonia Nitrogen	251	554	0.09	16.9
Nitrate Nitrogen	600	636	0.01	48
Cyanide	3	7	0.01	0.03

(a) Samples collected 1/1/86 through 12/31/92 from 31 onsite and downgradient wells along Hawthorne Boulevard (wells MO1A&B through MO7A&B, M23A through M26A, M30B, M46A, M49A, M50B, M51B, PV3, P4-6, P4-7, P4-8, P4-9, P4-10, P4-11, and P4-12).

TABLE 6.1-2

SUMMARY OF CHEMICALS DETECTED IN ON SITE AND DOWNGRADIENT GROUND WATER MONITORING WELLS NEAR CRENSHAW BOULEVARD (1986 - 1992)

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Summary of Chemicals Detected (a)			
	Times Detected	Times Tested	Minimum Detected	Maximum Detected
ORGANIC COMPOUNDS (mg/L)				
Acenaphthene	6	105	0.5	2
Acetone	19	182	7.4	240
Anthracene	1	105	0.1	0.1
Benzene	75	262	0.1	89
Bromodichloromethane	4	265	0.1	7.4
Butanone, 2-	1	183	2	2
Butylbenzylphthalate	2	105	0.3	0.5
Chlordane	3	49	0.02	0.4
Chlorobenzene	58	265	0.3	23
Chloroethane	1	265	1.7	1.7
Chloroform	17	265	0.1	4.3
DDD	3	60	0.01	0.33
DDE	4	60	0.01	0.19
DDT	1	60	0.01	0.01
Di-n-butylphthalate	9	105	0.2	1
Di-n-octylphthalate	22	105	0.3	35
Dibromochloromethane	1	263	3	3
Dichlorobenzene, 1,2-	27	349	0.5	1.6
Dichlorobenzene, 1,4-	63	327	0.6	15
Dichloroethane, 1,1-	69	265	0.1	27
Dichloroethane, 1,2-	48	264	0.2	1000
Dichloroethene, 1,1-	24	265	0.2	2.9
Dichloroethene, cis-1,2-	42	88	0.7	140
Dichloroethene, trans-1,2-	51	265	0.3	37
Dichloropropane, 1,2-	25	265	0.6	5.3
Dieldrin	1	60	0.06	0.06
Diethylhexylphthalate	59	105	0.5	170
Diethylphthalate	6	105	0.4	3
Ethylbenzene	16	263	0.1	18
Freon 11 (CCL3F)	1	43	1.9	1.9
Isophorone	16	105	0.7	4.1
Methylene Chloride	65	264	0.5	190
Naphthalene	4	105	0.6	1.9
Nonachlor, trans-	2	49	0.01	0.12
Phenanthrene	2	105	0.1	15.6
Phenol	18	105	0.4	8
Tetrachloroethene	100	265	0.3	43
Tetrahydrofuran	2	44	26	130
Toluene	40	263	0.3	310
Trichloroethane, 1,1,1-	3	264	0.2	0.7
Trichloroethane, 1,1,2-	12	265	6.6	72

TABLE 6.1-2 (CONTINUED)
SUMMARY OF CHEMICALS DETECTED IN ON SITE AND DOWNGRADIENT GROUND WATER MONITORING WELLS NEAR CRENSHAW BOULEVARD (1986 - 1992)
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Summary of Chemicals Detected (a)			
	Times Detected	Times Tested	Minimum Detected	Maximum Detected
Trichloroethene	101	265	0.2	110
Vinyl Chloride	66	264	1	180
Xylenes	4	59	21	40
INORGANICS (mg/L)				
Arsenic	247	262	0.0006	0.25
Barium	154	165	0.014	9.23
Boron	99	99	0.3	35.6
Cadmium	192	265	0.001	1
Chromium, Hexavalent	1	202	0.015	0.015
Chromium, Total	221	264	0.008	9.2
Copper	156	200	0.02	1.46
Lead	69	265	0.003	1.4
Manganese	200	200	0.05	73.3
Mercury	112	262	0.0001	0.0176
Nickel	197	202	0.03	24.2
Selenium	212	264	0.0006	1.75
Silver	90	167	0.005	0.15
Zinc	192	204	0.02	24.2
Ammonia Nitrogen	157	219	0.1	266
Nitrate Nitrogen	244	261	0.006	90.9

(a) Samples collected 1/1/86 through 12/31/92 from thirteen onsite and downgradient wells along Crenshaw Boulevard (wells M32B through M35B, M36A through M40A, M43A, M44A, M52B, and M53B).

TABLE 6.1-3

SUMMARY OF CHEMICALS IN ON SITE AND DOWNGRADIENT GROUND WATER FOR 1986 - 1994 AND 1992 - 1994

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

COMPOUND	DETECTED RANGE			
	HAWTHORNE BOULEVARD		CRENSHAW BOULEVARD	
	1/1/86 - 6/30/94	7/01/92 - 6/30/94	1/1/86 - 6/30/94	7/01/92 - 6/30/94
VOCs (UG/L)				
Acetone	1.9 - 1200 (144)	510 - 510 (510)	7.4 - 240 (39)	ND<250
Benzene	0.1 - 520 (39)	0.3 - 78 (16)	0.1 - 16 (3)	0.5 - 16 (3)
Bromodichloromethane	0.2 - 9.4 (2.7)	ND <10	0.1 - 7.4 (3)	ND<2.5
Bromoform	0.6 - 2.1 (1)	ND <10	ND<0.5	ND<2.5
Bromomethane	2.1 - 2.1 (2.1)	ND<50	ND<2.5	ND<15
Butanone, 2-	ND<1000	ND<1000	2 - 2 (2)	ND<250
Carbon Disulfide	NT	NT	NT	NT
Carbon Tetrachloride	0.5 - 0.5 (0.5)	ND <5	ND<0.5	ND<1.5
Chlorobenzene	0.3 - 1400 (159)	0.8 - 1300 (274)	0.3 - 24 (12)	5.4 - 24 (17)
Chloroethane	1.1 - 1.8 (1)	ND<50	1.7 - 1.7 (1.7)	ND<15
Chloroform	0.1 - 19 (2)	0.6 - 19 (6)	0.1 - 4.3 (0.9)	0.6 - 1.2 (0.9)
Chloromethane	7 - 150 (56)	ND<50	ND<2.5	ND<15
Dibromochloromethane	0.7 - 11 (4)	ND <10	3 - 4.8 (3.9)	4.8 - 4.8 (4.8)
Dibromoethane, 1,2-	NT	NT	NT	NT
Dichlorobenzene, 1,2-	1 - 4.4 (2)	ND <10	0.5 - 1.9 (0.9)	0.5 - 1.9 (1)
Dichlorobenzene, 1,3-	ND < 1	ND <10	ND<0.5	ND<2.5
Dichlorobenzene, 1,4-	0.6 - 38 (11)	7 - 38 (16)	0.6 - 21 (10)	2.7 - 21 (11)
Dichloroethane, 1,1-	0.2 - 230 (39)	0.6 - 190 (40)	0.1 - 27 (7)	0.5 - 19 (7)
Dichloroethane, 1,2-	0.2 - 590 (101)	0.4 - 350 (92)	0.2 - 1000 (179)	0.5 - 380 (73)
Dichloroethene, 1,1-	0.1 - 46 (2)	0.7 - 1 (0.85)	0.2 - 2.9 (0.9)	0.4 - 2.6 (0.9)
Dichloroethene, cis-1,2-	0.5 - 560 (104)	0.5 - 560 (126)	0.5 - 140 (29)	0.5 - 140 (26)
Dichloroethene, trans-1,2-	0.1 - 130 (11)	0.6 - 54 (15)	0.3 - 37 (5)	0.3 - 12 (3)
Dichloropropane, 1,2-	0.3 - 46 (7)	1.1 - 30 (9)	0.6 - 5.3 (1.7)	0.6 - 3 (1.8)
Dichloropropene, cis-1,3-	0.5 - 0.5 (0.5)	ND<10	ND<0.5	ND<2.5
Dichloropropene, trans-1,3-	9.4 - 9.4 (9.4)	ND<10	ND<0.5	ND<2.5
Ethylbenzene	0.1 - 5 (2)	ND <5	0.1 - 23 (10)	2.6 - 23 (14)
Hexanone, 2-	NT	NT	NT	NT
Methyl tert-butyl Ether	NT	NT	NT	NT
Methylene Chloride	0.5 - 580 (25)	1.5 - 81 (16)	0.5 - 190 (30)	1.6 - 110 (38)
Pentanone, 4-Methyl-2-	ND <100	ND <100	ND<25	ND<25
Styrene	ND <50	ND <50	ND<12.5	ND<12.5
Tetrachloroethane, 1,1,2,2-	ND < 1	ND<10	ND<0.5	ND<2.5
Tetrachloroethene	0.1 - 27 (5)	1 - 14 (5)	0.3 - 56 (11)	1.1 - 56 (10)
Toluene	0.3 - 54 (6)	0.4 - 54 (11)	0.3 - 310 (24)	0.4 - 82 (26)
Trichloroethane, 1,1,1-	0.3 - 25 (5)	1.2 - 20 (8)	0.2 - 0.7 (0.5)	0.5 - 0.5 (0.5)
Trichloroethane, 1,1,2-	0.5 - 4 (1)	0.6 - 0.6	1.2 - 72 (28)	1.2 - 2.2 (1.7)
Trichloroethene	0.1 - 100 (20)	0.4 - 80 (21)	0.2 - 110 (24)	0.8 - 100 (21)
Trichlorofluoromethane	ND <100	ND <100	0.8 - 1.9 (1.2)	0.8 -1 (0.9)
Trichlorotrifluoroethane	NT	NT	NT	NT
Vinyl Acetate	ND <1,000	ND <1,000	ND<250	ND<250
Vinyl Chloride	0.7 - 6600 (366)	1.7 - 2000 (342)	0.9 - 180 (12)	0.9 - 33 (7)
Xylene, o	0.5 - 10 (5)	10 - 10 (10)	6.1 - 15 (10)	9.1 - 15 (12)
Xylenes, m- & p-	1 - 10 (4)	1.5 - 10 (6)	0.6 - 32 (21)	0.6 - 32 (22)

TABLE 6.1-3 (CONTINUED)

SUMMARY OF CHEMICALS IN ON SITE AND DOWNGRADIENT GROUND WATER FOR 1986 - 1994 AND 1992 - 1994

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

COMPOUND	DETECTED RANGE			
	HAWTHORNE BOULEVARD		CRENSHAW BOULEVARD	
	1/1/86 - 6/30/94	7/01/92 - 6/30/94	1/1/86 - 6/30/94	7/01/92 - 6/30/94
INORGANICS (mg/L)				
Nitrate	0.01 - 37 (3)	0.01 - 28.1 (4)	0.006 - 90.9 (8)	0.01 - 61.6 (12)
Cyanide	0.01 - 0.03 (0.02)	0.01 - 0.01 (0.01)	0.01 - 0.01 (0.01)	0.01 - 0.01 (0.01)
Arsenic, Unfiltered	0.0009 - 1.1 (0.08)	0.0009 - 0.31 (0.04)	0.0006 - 2.13	0.0009 - 2.13
Arsenic, Filtered	0.001 - 0.266 (0.04)	0.001 - 0.266 (0.04)	0.0001 - 0.32 (0.03)	0.0001 - 0.32 (0.03)
SVOCs (ug/L)				
Bis-(2-chloroethyl)ether	0.5 - 0.5 (0.5)	ND<50	ND<5	ND<5
Chlorophenol, 2-	0.6 - 13 (4)	ND<80	ND<8	ND<8
Isophorone	0.5 - 72 (4)	1 - 4 (2.6)	0.7 - 4.1 (2)	1 - 1 (1)
Pentachlorophenol	3.5 - 3.5 (3.5)	ND<160	ND<16	ND<16
Phenol	0.3 - 20 (4)	3 - 3 (3)	0.4 - 7 (2)	6 - 6 (6)
Tetrahydrofuran	52 - 7600 (1453)	52 -7600 (1630)	26 - 210 (120)	81 - 210 (140)
Anthracene	ND<1	ND<10	0.1 - 0.1 (0.1)	ND<1
Acenaphthene	ND<2	ND<20	0.5 - 2 (1.6)	1 - 2 (1.5)
Benzo(g,h,i)perylene	0.7 - 1.9 (1.3)	ND<60	ND<6	ND<6
Chrysene	0.8 - 0.8 (0.8)	ND<20	ND<2	ND<2
Fluoranthene	0.8 - 0.8 (0.8)	ND<20	ND<2	ND<2
Naphthalene	0.4 - 1.6 (0.6)	ND<20	0.6 - 1.9 (1)	ND<2
N-nitrosodi-n-propylamine	ND<2	ND<20	2 - 2 (2)	2 - 2 (2)
Phenanthrene	0.6 - 1.3 (0.84)	ND<10	0.1 - 15.6 (8)	ND<1
Pyrene	0.2 - 0.9 (0.55)	ND<20	ND<2	ND<2
Trichlorobenzene, 1,2,4-	0.3 - 0.3 (0.3)	ND<30	ND<3	ND<3
N-nitrosodiphenylamine	2.1 - 5.2 (3.7)	ND<20	2 - 2 (2)	ND<2
Di-n-butylphthalate	0.2 - 21 (2)	ND<40	0.2 - 0.8 (0.5)	ND<4
Diethylphthalate	1.6 - 30 (8)	ND<20	0.4 - 3 (1.5)	1 - 3 (2)
PESTICIDES (mg/L)				
DDE	0.01 - 0.02 (0.01)	0.01 - 0.02 (0.01)	0.01 - 1.9 (0.05)	0.01 - 0.04 (0.02)
DDD	0.01 - 0.03 (0.02)	0.01 - 0.03 (0.02)	0.01 - 0.33 (0.09)	0.01 - 0.06 (0.03)
DDT	0.11 - 0.11 (0.11)	0.11 - 0.11 (0.11)	0.01 - 0.01 (0.01)	ND<0.01
Gamma-BHC (Lindane)	ND<0.05	ND<0.01	0.04 - 0.04 (0.04)	0.04 - 0.04 (0.04)
Dieldrin	ND<0.05	ND<0.01	0.01 - 0.06 (0.04)	0.01 - 0.01 (0.01)
Chlordane	0.05 - 0.05 (0.05)	0.05 - 0.05 (0.05)	0.01 - 0.52 (0.14)	0.03 - 0.10 (0.06)

Notes:

1) "ND<" indicates compound was not detected in any well (below the stated detection limit). The stated detection limit was achieved for each well at least once during the monitoring period.

2) Values in parentheses are the average of detected values.

3) "NT" indicates the compound was not analysed for in ground water.

4) Data are shown for all priority pollutant VOCs, for comparison with the TO-14 landfill gas data, whether or not the chemical was analysed for or detected in ground water.

5) Data are shown for phthalate esters which were detected in at least five percent of samples from either the Hawthorne or Crenshaw Boulevard area. Data are not shown for less frequently detected phthalates, or for di-n-octylphthalate and diethylhexylphthalate which were detected at similar concentrations and frequencies in upgradient well.

6) Hawthorne Boulevard area wells include M01A&B, M23A through M26A, M30B, M46A, M49A, M50B, M51B, M63B, M64B, P4-6 through P412, and PV3. Crenshaw Boulevard area wells include M32B through M35B, M36A through M40A, M43A, M44A, M52B, M53B, M69B, and M70B.

TABLE 6.1-4

SUMMARY OF CHEMICALS DETECTED IN BACKGROUND GROUND WATER MONITORING WELLS (1986-1992)

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Summary of Chemicals Detected (a)			
	Times Detected	Times Tested	Minimum Detected	Maximum Detected
ORGANIC COMPOUNDS (mg/L)				
Acetone	7	111	5.2	41
Benzene	2	194	0.6	1.3
Benzo(a)Anthracene	1	84	1.8	1.8
Benzo(a)Pyrene	1	84	1.6	1.6
Benzo(b)Fluoranthene	1	84	1.6	1.6
Benzo(g,h,i)Perylene	1	84	2.2	2.2
Benzo(k)Fluoranthene	1	84	1.6	1.6
Chlordane	1	59	0.02	0.02
Chloroform	17	198	0.1	2.8
Chrysene	1	84	2.1	2.1
DDE	1	63	0.01	0.01
Di-n-butylphthalate	3	84	0.2	0.6
Di-n-octylphthalate	10	84	0.4	13.2
Dichloroethane, 1,1-	5	197	0.3	0.5
Dichloroethane, 1,2-	2	197	0.6	1.5
Dichloroethene, 1,1-	1	198	0.1	0.1
Dichloroethene, cis-1,2-	3	62	0.3	1.2
Diethylhexylphthalate	51	84	0.8	31.4
Diethylphthalate	4	84	0.2	1
Ethylbenzene	1	194	2.8	2.8
Fluoranthene	1	84	1.6	1.6
Freon 11 (CCL3F)	1	46	1.1	1.1
Methylene Chloride	15	198	0.6	8.3
Naphthalene	2	84	0.4	0.5
Nonachlor, trans-	1	59	0.01	0.01
Phenol	15	84	0.4	4
Pyrene	1	84	1.4	1.4
Tetrachloroethene	24	197	0.2	13
Toluene	4	194	0.3	6.4
Trichloroethane, 1,1,1-	1	198	0.6	0.6
Trichloroethene	22	198	0.4	2.2
Vinyl Chloride	3	198	0.8	1.4

TABLE 6.1-4 (CONTINED)
SUMMARY OF CHEMICALS DETECTED IN BACKGROUND GROUND WATER MONITORING WELLS (1986-1992)
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Summary of Chemicals Detected (a)			
	Times Detected	Times Tested	Minimum Detected	Maximum Detected
INORGANICS (mg/L)				
Arsenic	189	199	0.01	0.178
Barium	146	154	0.02	4.43
Boron	45	45	0.02	1.29
Cadmium	115	199	0.004	0.16
Chromium, Hexavalent	2	129	0.03	0.08
Chromium, Total	161	198	0.02	81.2
Copper	101	139	0.02	0.98
Lead	28	200	0.011	0.48
Manganese	128	128	0.01	6.84
Mercury	76	199	0.0001	0.0014
Nickel	115	128	0.04	7.9
Selenium	179	198	0.0008	1.5
Silver	111	155	0.005	0.11
Zinc	122	129	0.02	1.6
Ammonia Nitrogen	50	177	0.04	1.26
Nitrate Nitrogen	187	196	0.01	36

(a) Samples collected 1/1/86 through 12/31/92 from fourteen background wells upgradient or crossgradient of the PVLF (wells M41A, M42, M45A, M47B, M48A, M54B through M62B).

measured by constant conductivity values). The water was then extracted and analyzed for general water quality parameters and metals. An additional study called the mineral leaching study, involving many more samples from the Monterey Formation, was conducted in 1990 through 1993. Results of both the soil equilibrium and mineral leaching studies are presented in Section 3.6. These results indicate similar metals concentrations from the soil equilibrium and mineral leaching studies of the various members of the Monterey Formation, and in the ground water near the PVLF that is in contact with these members. Therefore, based on the results of these studies, the metals concentrations in ground water were considered to be naturally occurring. Statistical comparisons with up-canyon concentrations were not used to evaluate metals in ground water because the down-canyon concentrations are likely to be higher under natural conditions, due to the additional leaching time during ground water flow from the up-canyon to the down-canyon locations.

Ground water concentration isopleth maps were reviewed as an additional tool to evaluate the potential source of metals in ground water. Based on a review of the isopleth maps for both filtered and unfiltered ground water samples, only arsenic appeared to be potentially elevated at a downgradient location. Therefore, arsenic was included as a potential contaminant of concern for ground water at the PVLF. These isopleths are discussed in Section 3.6.

Predictive ground water and chemical transport modeling were used to evaluate potential future chemical concentrations of the COCs in ground water at the nearest downgradient locations where a ground water supply well would be technically feasible (based on the volume of water in gallons per minute which could be produced). These locations are shown on Figure 5.8-1 and are further discussed in Section 6.1.2. Ground water flow from the PVLF is contained primarily within two ancient depositional drainages, which generally follow Hawthorne and Crenshaw Boulevards. Specifically, ground water from the majority of the main site and the Ernie Howlett Park area generally flows along the Hawthorne Boulevard drainage, and ground water from the South Coast Botanic Garden area and to a lesser extent from part of the main site flows along the Crenshaw Boulevard drainage. Impacts to ground water in the West Coast Basin were modeled from each of the Hawthorne and Crenshaw Boulevard drainage areas. The analytical data are summarized in Tables 6.1-1 through 6.1-3 for on site and downgradient ground water along each of the Hawthorne and Crenshaw Boulevard drainage areas. The methods which were used to derive potential future impacts to ground water in the West Coast Basin resulting from these drainages are discussed in

Section 6.1.2. The chemical transport model is summarized in Section 5.0 and presented in detail in the Contaminant Transport Model Report (Dames & Moore, 1992) included in Appendix E.3.

6.1.1.3.2 VOCs in Landfill Gas, Boundary Probes, and Surface Emissions

Monitoring data were collected for landfill gas generated at the PVLF and potentially released into ambient air, boundary probes which monitor the subsurface around the perimeter of the landfill, and at off site locations using surface flux chamber methodology. The results and their application to this Baseline Risk Assessment are discussed below.

VOCs in Landfill Gas

Monitoring data which did not indicate above background concentrations include ambient air and surface gas monitoring from the landfill. These data are consistent with model results presented in Section 6.1.2.2 which indicate that TAC concentrations from landfill surface gas emissions would be low relative to background concentrations in ambient air and analytical detection limits.

Results of the landfill gas testing were used to model emissions from the landfill surface, using the AB 2588 Gas Emission Rate Estimation Technique (CARB, 1992). Monthly samples of the concentrated landfill gas were collected from the two headerlines in the gas collection system during September 1990 through August 1991. Four additional landfill gas samples were collected in June and July 1994. Header 2 is the main site top deck headerline, and serves the interior landfill gas extraction wells. Therefore, the TAC concentrations measured from Header 2 represent the bulk of the landfill gas. Gas samples were also collected from Header 1. Header 1 is the peripheral headerline, and primarily serves gas migration control wells. TAC concentrations in Header 1 samples were consistently about ten times lower than those detected from Header 2, possibly due to increased dilution with air external to the landfill. The sample ports are located near the terminus of each headerline.

VOC and hydrogen sulfide concentrations in landfill gas collected from Header 2 are summarized on Table 6.1-5. In general, the data indicate very consistent results from month to month with no evident seasonality or trends. Because the data are quite stable over time, it is meaningful

TABLE 6.1-5

VOCS IN LANDFILL GAS FROM HEADERLINE 2 (GAS COLLECTION HEADERLINE)

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

	Acetone	Benzene	Bromodichloromethane	Bromoform	Bromomethane	Butanone, 2-	Carbon Disulfide	Carbon Tetrachloride
Jun-94	13	68	<2	<2	<2	11	<2	<2
Jun-94	14	68	<2	<2	<2	11	<2	<2
Jun-94	15	73	<2	<2	<2	12	<2	<2
Jul-94	52	76	<0.1	<0.1	<0.1	18	0.17	<0.1
Jul-94	41	80	<0.1	<0.1	<0.1	17	0.16	<0.1
Sep-90		79.8						<2.5
Oct-90		76.6						<0.6
Nov-90		79.8						<1.3
Dec-90		70.2						<0.6
Jan-91		79.8						<0.6
Feb-91		79.8						<0.6
Mar-91		92.6						<0.6
Apr-91		102.2						<0.6
May-91		95.8						<0.6
Jun-91		79.8						<0.6
Jul-91		114.9						<0.6
Aug-91		83.0						<0.6

Summary Statistics

No. of Detections	5	17	0	0	0	5	2	0
No. of Samples	5	17	5	5	5	5	5	17
Minimum Detected	13.0	68.0	NA	NA	NA	11.0	0.2	NA
Maximum Detected	52.0	114.9	NA	NA	NA	18.0	0.2	NA
Average	27.0	82.3	NA	NA	NA	13.8	0.7	NA
Standard Deviation	18.2	12.5	NA	NA	NA	3.4	0.5	NA
95 % UCL	44.4	87.6	NA	NA	NA	17.1	1.4	NA

Selected Exposure Concentration

95% UCL, Maximum detected, or Jul-94 Detection limit	44.4	87.6	0.1	0.1	0.1	17.1	0.17	0.1

Notes: All values in mg/m^3

One-half the detection limit was used as a proxy for nondetects in UCL calculations.

TABLE 6.1-5 (CONTINUED)
VOCS IN LANDFILL GAS FROM HEADERLINE 2 (GAS COLLECTION HEADERLINE)
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

	Chlorobenzene	Chloroethane	Chloroform	Chloromethane	Dibromochloromethane	Dibromoethane, 1,2-	Dichlorobenzene, 1,2-	Dichlorobenzene, 1,3-	Dichlorobenzene, 1,4-
Jun-94	37	<2	<2	<2	<2	<2	<2	<2	4.5
Jun-94	34	<2	<2	<2	<2	<2	<2	<2	4.6
Jun-94	36	<2	<2	<2	<2	<2	<2	<2	4.5
Jul-94	49	0.14	<0.1	<0.1	<0.1	<0.1	6.5	<0.1	19
Jul-94	50	0.15	<0.1	<0.1	<0.1	<0.1	8.2	<0.1	22
Sep-90	17.9		<2.0						<12.0
Oct-90	23.5		<0.5						<18.0
Nov-90	27.2		<1.0						<5.7
Dec-90	32.2		<0.5						<14.4
Jan-91	24.4		<0.5						<2.4
Feb-91	27.6		<0.5						<2.4
Mar-91	29.5		<0.5						<18.6
Apr-91	24.9		<0.5						<10.8
May-91	32.2		<0.5						<16.8
Jun-91	21.6		<0.5						<6.0
Jul-91	27.2		<0.5						<7.8
Aug-91	29.0		<0.5						<12.6

Summary Statistics

No. of Detections	17	2	0	0	0	0	2	0	5
No. of Samples	17	5	17	5	5	5	5	5	17
Minimum Detected	17.9	0.1	NA	NA	NA	NA	6.5	NA	4.5
Maximum Detected	50.0	0.2	NA	NA	NA	NA	8.2	NA	22.0
Average	30.8	0.7	NA	NA	NA	NA	3.5	NA	7.0
Standard Deviation	8.7	0.5	NA	NA	NA	NA	3.5	NA	5.7
95 % UCL	34.4	1.4	NA	NA	NA	NA	8.9	NA	11.4

Selected Exposure Concentration

95% UCL, Maximum detected, or Jul-94 Detection limit	34.4	0.15	0.1	0.1	0.1	0.1	8.2	0.1	11.4

Notes: All values in mg/m^3
One-half the detection limit was used as a proxy for nondetects in UCL calculations.

TABLE 6.1-5 (CONTINUED)

VOCS IN LANDFILL GAS FROM HEADERLINE 2 (GAS COLLECTION HEADERLINE)

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

	Dichloroethane, 1,1-	Dichloroethane, 1,2-	Dichloroethene, 1,1-	Dichloroethene, cis-1,2-	Dichloroethene, trans-1,2-	Dichloropropane, 1,2-	Dichloropropene, cis-1,3-	Dichloropropene, trans-1,3-	Ethylbenzene
Jun-94	<2	<2	<2	25	<2	<2	<2	<2	180
Jun-94	<2	<2	<2	26	<2	<2	<2	<2	170
Jun-94	<2	<2	<2	27	<2	<2	<2	<2	180
Jul-94	0.99	<0.1	0.69	29	1.4	<0.1	<0.1	<0.1	230
Jul-94	0.99	<0.1	0.69	29	1.4	<0.1	<0.1	<0.1	230
Sep-90	<4.0	<1.6	<7.9						
Oct-90	1.2	0.8	<0.4						
Nov-90	1.1	<0.8	<0.8						
Dec-90	1.6	0.8	0.8						
Jan-91	0.8	0.4	<0.4						
Feb-91	0.8	0.4	<0.4						
Mar-91	1.2	0.8	0.4						
Apr-91	1.2	0.8	0.8						
May-91	0.8	0.8	0.8						
Jun-91	0.8	0.4	<0.4						
Jul-91	0.8	0.4	<0.4						
Aug-91	0.8	0.8	<0.8						

Summary Statistics

No. of Detections	13	10	6	5	2	0	0	0	5
No. of Samples	17	17	17	5	5	5	5	5	5
Minimum Detected	0.8	0.4	0.4	25.0	1.4	NA	NA	NA	170.0
Maximum Detected	1.6	0.8	0.8	29.0	1.4	NA	NA	NA	230.0
Average	1.1	0.6	0.8	27.2	1.2	NA	NA	NA	198.0
Standard Deviation	0.3	0.3	0.9	1.8	0.2	NA	NA	NA	29.5
95 % UCL	1.2	0.8	1.4	28.9	1.5	NA	NA	NA	226.1

Selected Exposure Concentration

95% UCL, Maximum detected, or Jul-94 Detection limit	1.2	0.8	0.8	28.9	1.4	0.1	0.1	0.1	226.1

Notes: All values in mg/m^3

One-half the detection limit was used as a proxy for nondetects in UCL calculations.

TABLE 6.1-5 (CONTINUED)

VOCS IN LANDFILL GAS FROM HEADERLINE 2 (GAS COLLECTION HEADERLINE)

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

	Hexanone, 2-	Methane	Methyl tert-butyl Ether	Methylene Chloride	Pentanone, 4-Methyl-2-	Styrene	Tetrachloroethane, 1,1,2,2-	Tetrachloroethene
Jun-94	<4	31.6	<2	<2	<4	4.5	<2	<2
Jun-94	<4	31.6	<2	<2	<4	4.1	<2	<2
Jun-94	<4	31.7	<2	<2	<4	4.4	<2	<2
Jul-94	<0.2	32.9	<0.1	0.8	14	12	<0.1	3.5
Jul-94	<0.2	32.9	<0.1	0.79	14	14	<0.1	3.9
Sep-90				1.7				6.8
Oct-90				1.4				5.4
Nov-90				3.8				6.6
Dec-90				1.7				7.5
Jan-91				0.7				4.7
Feb-91				1.0				6.1
Mar-91				1.7				8.1
Apr-91				1.4				6.1
May-91				1.4				5.4
Jun-91				<0.3				2.7
Jul-91				<0.3				2.7
Aug-91				1.0				5.4

Summary Statistics

No. of Detections	0	5	0	12	2	5	0	14
No. of Samples	5	5	5	17	5	5	5	17
Minimum Detected	NA	31.6	NA	0.7	14.0	4.1	NA	2.7
Maximum Detected	NA	32.9	NA	3.8	14.0	14.0	NA	8.1
Average	NA	32.1	NA	1.2	6.8	7.8	NA	4.6
Standard Deviation	NA	0.7	NA	0.8	6.6	4.8	NA	2.3
95 % UCL	NA	32.8	NA	1.6	16.7	12.4	NA	5.7

Selected Exposure Concentration

95% UCL, Maximum detected, or Jul-94 Detection limit	0.2	32.8	0.1	1.6	14	12.4	0.1	5.7

Notes: All values in mg/m^3

One-half the detection limit was used as a proxy for nondetects in UCL calculations.

TABLE 6.1-5 (CONTINUED)
VOCS IN LANDFILL GAS FROM HEADERLINE 2 (GAS COLLECTION HEADERLINE)
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

	Toluene	Trichloroethane, 1,1,1-	Trichloroethane, 1,1,2-	Trichloroethene	Trichlorofluoromethane	Trichlorotrifluoroethane	Vinyl Acetate	Vinyl Chloride	Xylenes
Jun-94	160	<2	<2	<2	<2	<2	<4	5.1	259
Jun-94	150	<2	<2	<2	<2	<2	<4	5.5	232
Jun-94	160	<2	<2	<2	<2	<2	<4	6.2	258
Jul-94	170	<0.1	<0.1	4	<0.1	<0.1	<0.2	12	327
Jul-94	170	<0.1	<0.1	4.5	<0.1	<0.1	<0.2	12	328
Sep-90	165.6	<2.2		3.2				7.9	225.7
Oct-90	161.9	<0.5		3.2				7.2	203.5
Nov-90	180.7	<1.1		3.2				10.8	282.1
Dec-90	158.1	<0.5		3.8				10.8	238.7
Jan-91	184.5	<0.5		2.7				5.1	303.8
Feb-91	161.9	<0.5		3.2				7.4	312.5
Mar-91	188.2	<0.5		4.3				6.2	420.9
Apr-91	207.1	<0.5		3.8				8.7	364.5
May-91	210.8	<0.5		3.2				7.2	308.1
Jun-91	233.4	<0.5		2.1				5.6	264.7
Jul-91	252.2	<0.5		2.7				5.6	390.6
Aug-91	188.2	<0.5		3.2				7.9	282.1

Summary Statistics

No. of Detections	17	0	0	14	0	0	0	17	17
No. of Samples	17	17	5	17	5	5	5	17	17
Minimum Detected	150.0	NA	NA	2.1	NA	NA	NA	5.1	203.5
Maximum Detected	252.2	NA	NA	4.5	NA	NA	NA	12.0	420.9
Average	182.5	NA	NA	2.9	NA	NA	NA	7.7	294.2
Standard Deviation	28.5	NA	NA	1.1	NA	NA	NA	2.4	59.5
95 % UCL	194.6	NA	NA	3.5	NA	NA	NA	8.7	319.4

Selected Exposure Concentration

95% UCL, Maximum detected, or Jul-94 Detection limit	194.6	0.1	0.1	3.5	0.1	0.1	0.2	8.7	319.4

Notes: All values in mg/m^3
One-half the detection limit was used as a proxy for nondetects in UCL calculations.

to calculate the arithmetic average concentration and (as a reasonable maximum estimate) the 95 percent upper confidence limit on the arithmetic average to represent long-term average concentrations. However, an eventual decrease in landfill gas concentrations is expected as VOC sources within the landfill are depleted.

Several of the VOCs were not detected in landfill gas from either Header 2 or Header 1, but were detected in ground water from the landfill. These VOCs were assumed to be present in each sample at one-half the sample quantitation limit, in accordance with EPA guidance for risk assessment.

TACs in Landfill Boundary Probes

In addition to the analyses of landfill gas from the headerlines, samples from the PVLF boundary probes have been analyzed for TACs. The perimeter or boundary probe monitoring system at the landfill includes a total of 256 boundary probes: 155 on the perimeter of the main site, 63 around Parcel 1 (the South Coast Botanic Garden), and 38 around Parcel 4 (Ernie Howlett Park). Routine monitoring of boundary probes for methane is conducted on at least a monthly basis. Probes which are closer to residences are monitored more frequently. Where detectable methane concentrations are found, monitoring is performed daily, and actions are taken to eliminate methane from the area. Strategies available to prevent methane from reaching a probe location include valve adjustments on nearby gas wells, dewatering gas wells, increasing the vacuum on gas wells, and installing new gas wells. In June 1991, three new gas wells were installed on the northeast boundary of the landfill site near probe MN31 due to the consistent methane detections at this probe for eight months between October 1990 and May 1991.

Each month from September 1990 to June 1994, a sample was collected from one probe for TAC analysis. The probes were selected randomly for sampling. Eleven compounds (tetrachloroethene, chloroform, trichloroethene, 1,1-dichloroethane, chlorobenzene, 1,1,1-trichloroethane, 1,1-dichloroethene, methylene chloride, benzene, toluene, and xylene) were detected in one or more probes at concentrations above those measured in ambient air from upwind locations.

The TAC data from the boundary probes were not used in the risk assessment calculations, because these data cannot be used in any direct way to predict potential exposure concentrations. The TAC concentrations detected in the boundary probes represent soil vapor concentrations near the landfill boundary which could either be emitted to ambient air on site, or which could potentially be transported through the soil to off site locations. The TAC concentrations detected in the boundary probes are much lower than the TAC concentrations detected in the landfill gas samples from Header 2, which were used to calculate potential vapor emissions. The potential for subsurface migration of landfill gas to adjacent residences was evaluated directly through a soil vapor emission flux survey.

VOCs in Off Site Emission Flux Survey

An off site emission flux survey using a surface flux chamber was conducted by the Sanitation Districts in September 1993 to investigate the subsurface air migration pathways. The potential subsurface air pathways include landfill gas migration and VOC emissions from contaminated ground water. To investigate these pathways, a total of 32 field samples were collected at six areas around the landfill: background (two locations); over each of two off site ground water contamination plumes (six locations each, for a total of twelve locations); beyond the estimated extent of each of these two plumes (two locations each, for a total of four locations); and directly northeast of the site in a residential area (fourteen locations).

The surface flux chamber samples were tested for eight VOCs:

- vinyl chloride
- 1,1-dichloroethylene (1,1-DCE)
- 1,1-dichloroethane (1,1-DCA)
- 1,2-dichloroethane (1,2-DCA)
- benzene
- trichloroethylene (TCE)
- tetrachloroethylene (perchloroethylene, PCE)
- p-dichlorobenzene (1,4-dichlorobenzene, 1,4-DCB)

These chemicals are estimated to account for 99 percent of the potential risk from VOCs in landfill gas (see Section 6.1.4). Results of the off site emission flux survey indicated that there were no measurable emissions of VOCs from ground water plumes or from landfill gas migration above background levels in ambient air. However, any extrapolations of these results should be made with care since they represent a "snapshot" of emissions at a single point in time.

6.1.1.3.3 Chemicals in Surface Soil

To evaluate the soil cover, surface soil samples were collected at 56 different locations (34 locations in October 1990 and an additional 22 locations in October 1993) throughout the landfill and analyzed for priority pollutant VOCs, semivolatile organic compounds, chlorinated pesticides and PCBs, and metals. The locations of the surface soil samples are shown on Exhibit 2.1-7. The data for the chemicals which were detected are summarized on Table 6.1-6. The data include the original 34 samples and the additional 22 samples from the soil cover. The additional samples were collected from three frequently visited areas (six samples each from the equestrian center, the South Coast Botanic Garden lake and stream area, and the main site horse trail) and from an area near the third bench access road (four samples) where PAHs were identified by the original sampling.

Twenty-two metals, all of which are naturally occurring, were detected in the samples from the surface cover. These metals concentrations were compared to both published background concentrations for California soils, and were also compared to local background concentrations to identify potential site-related contaminants. The soil for the final cover was largely imported from various off site sources, although native soils were also used, particularly in the South Coast Botanic Garden area. As a result, the soils may represent a variety of different soil types; however, soils on adjacent properties in the PVLF vicinity are also largely imported fill soils from various sources. Therefore, because the origins of the soils are various, off site surface soils in the PVLF vicinity were not considered to represent natural, uncontaminated conditions and were not tested as background samples. However, subsurface soil samples representing native materials to the PVLF area, were analyzed and are compared to on site surface soils.

Comparison of the metal concentrations in the PVLF cover to published background concentrations for California soils is shown in Table 6.1-7. The comparison considered both the

TABLE 6.1-6

OVERALL RANGES FOR THE SOIL COVER SAMPLE RESULTS

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

CONSTITUENT	UNITS	OVERALL RANGE INITIAL SAMPLES (34 SAMPLES)	OVERALL RANGE EQUESTRIAN CENTER (6 SAMPLES)	OVERALL RANGE SCBG LAKE AND STREAM AREA (6 SAMPLES)	OVERALL RANGE MAIN SITE HORSE TRAIL (6 SAMPLES)	OVERALL RANGE AREA WITH PAH DETECTIONS (4 SAMPLES)	COMBINED OVERALL RANGE (56 SAMPLES)
GENERAL							
PH	PH	6.65 - 8.30	7.49 - 8.58	5.85 - 8.34	7.44 - 8.19	7.59 - 8.22	5.85 - 8.58
CONDUCTIVITY	UMHOS/CM	600 - 15100	210 - 3250	490 - 1080	556 - 2430	310 - 1240	210 - 15100
NITRATE NITROGEN	MG/KG	ND - 343	0.15 - 50.5	3.78 - 44.3	15.5 - 220	1.41 - 51.4	ND - 343
SULFATE	MG/KG	48.0 - 12100	15 - 1353	110 - 758	100 - 2170	61 - 482	15 - 12100
CHLORIDE	MG/KG	37.0 - 3240	13 - 2175	28 - 263	33 - 157	9 - 92	9 - 3240
OIL & GREASE	MG/KG	ND - 17000	ND	ND	ND	ND	ND - 17000
HYDROCARBONS - MOD. 8015	MG/KG	ND - 3.40	ND	ND - 11	ND	ND	ND - 11
METALS							
CALCIUM	MG/KG	7230 - 53200	10400 - 48500	11400 - 68500	7350 - 75700	5195 - 17500	5195 - 75700
MAGNESIUM	MG/KG	4000 - 16700	4380 - 19600	2140 - 13900	6530 - 19100	4440 - 8010	2140 - 19600
ARSENIC	MG/KG	0.470 - 20.0	3.3 - 14.2	3.3 - 27.9	2.8 - 8.7	3.5 - 7.5	0.47 - 27.9
BARIUM	MG/KG	116 - 2130	150 - 766	330 - 954	2.41 - 3220	136 - 1010	2.41 - 3220
CADMIUM	MG/KG	ND - 10.9	ND - 3.3	ND - 8.4	ND - 5.7	ND - 1.2	ND - 10.9
TOTAL CHROMIUM	MG/KG	20.7 - 165	18.3 - 101	48.1 - 149	38.6 - 84.5	27.4 - 56.5	18.3 - 165
COBALT	MG/KG	2.56 - 16.4	ND - 7.1	5.2 - 11	7.4 - 13	5.5 - 7.8	ND - 16.4
IRON	MG/KG	7340 - 32400	8670 - 22600	15100 - 24300	17300 - 30500	14100 - 19300	7340 - 32400
LEAD	MG/KG	ND - 179	4.0 - 14	7.0 - 108	10 - 24	4.0 - 8.0	ND - 179
MANGANESE	MG/KG	172 - 801	104 - 185	140 - 441	227 - 637	165 - 211	104 - 801
MERCURY	MG/KG	ND - 1.17	ND	ND - 0.8	ND	ND	ND - 1.17
NICKEL	MG/KG	14.0 - 84.4	10.3 - 60.3	29.8 - 79.5	18.2 - 71.6	23.6 - 41.9	10.3 - 84.4
POTASSIUM	MG/KG	1597 - 7220	1510 - 4410	1710 - 4740	2630 - 5030	1915 - 2790	1510 - 7223
SELENIUM	MG/KG	ND - 1.20	0.2 - 4.6	0.3 - 9.6	0.2 - 3.2	0.4 - 2.3	ND - 9.6
SILVER	MG/KG	0.420 - 4.55	ND	ND	ND	ND	ND - 4.55
SODIUM	MG/KG	400 - 2480	216 - 1600	515 - 1240	457 - 791	258 - 403	216 - 2481
ZINC	MG/KG	62.6 - 485	38.7 - 113	67.8 - 278	77.3 - 118	42.5 - 81.7	38.7 - 485
ANTIMONY	MG/KG	ND - 8.20	0.5 - 1.6	0.9 - 3.2	0.5 - 2.0	0.5 - 0.9	ND - 8.2
BERYLLIUM	MG/KG	ND - 1.20	ND	ND	ND	ND	ND - 1.20
MOLYBDENUM	MG/KG	ND - 10.9	ND - 7.8	ND - 20	ND - 6.3	ND - 3.0	ND - 20
THALLIUM	MG/KG	ND - 0.500	ND	ND - 2.0	ND	ND	ND - 2.0
VANADIUM	MG/KG	34.3 - 350	31.8 - 166	69.8 - 188	59.8 - 245	41.0 - 79.3	31.8 - 350
VOLATILE ORGANIC COMPOUNDS							
TOLUENE	MG/KG	ND - 0.02	NA	NA	NA	NA	ND - 0.02
O-XYLENE	MG/KG	ND - 0.01	NA	NA	NA	NA	ND - 0.01
M+P-XYLENE	MG/KG	ND - 0.02	NA	NA	NA	NA	ND - 0.02

TABLE 6.1-6 (CONTINUED)

OVERALL RANGES FOR THE SOIL COVER SAMPLE RESULTS

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

CONSTITUENT	UNITS	OVERALL RANGE INITIAL SAMPLES (34 SAMPLES)	OVERALL RANGE EQUESTRIAN CENTER (6 SAMPLES)	OVERALL RANGE SCBG LAKE AND STREAM AREA (6 SAMPLES)	OVERALL RANGE MAIN SITE HORSE TRAIL (6 SAMPLES)	OVERALL RANGE AREA WITH PAH DETECTIONS (4 SAMPLES)	COMBINED OVERALL RANGE (56 SAMPLES)
SEMI-VOLATILE ORGANIC COMPOUNDS BY EPA METHOD 8270							
ACENAPHTHENE	MG/KG	ND - 11	ND	ND	ND	ND - 15	ND - 15
ANTHRACENE	MG/KG	ND - 11	ND	ND	ND	ND - 10	ND - 11
BENZO (A) ANTHRACENE	MG/KG	ND - 16	ND	ND	ND	2 - 13	ND - 16
BENZO (A) PYRENE	MG/KG	ND - 15	ND	ND	ND	7 - 12	ND - 15
BENZO (B) FLUORANTHENE	MG/KG	ND - 13	ND	ND	ND	2 - 15	ND - 15
BENZO (K) FLUORANTHENE	MG/KG	ND - 15	ND	ND	ND	ND - 9	ND - 15
DIETHYLHEXYL PHTHALATE	MG/KG	ND	ND	ND	ND	ND - 3	ND - 3
CHRYSENE	MG/KG	ND - 18	ND	ND	ND	2 - 14	ND - 18
FLUORANTHENE	MG/KG	ND - 42	ND	ND	ND	5 - 37	ND - 42
FLUORENE	MG/KG	ND - 9	ND	ND	ND	ND - 11	ND - 11
INDENO (1,2,3-C,D) PYRENE	MG/KG	ND	ND	ND	ND	ND - 5	ND - 5
NAPHTHALENE	MG/KG	ND - 4	ND	ND	ND	ND - 6	ND - 6
PHENANTHRENE	MG/KG	ND - 48	ND	ND	ND	4 - 48	ND - 48
PYRENE	MG/KG	ND - 45	ND	ND	ND	4 - 31	ND - 45
PHENOL	MG/KG	ND	ND	ND	ND	ND - 8	ND - 8
POLYNUCLEAR AROMATIC HYDROCARBONS BY EPA METHOD 8310							
ACENAPHTHENE	UG/KG	NA	ND	ND	ND	ND - 13502	ND - 13502
BENZO (A) ANTHRACENE	UG/KG	NA	ND - 1.8	ND - 1.9	ND - 3.0	350 - 3550	ND - 3550
BENZO (A) PYRENE	UG/KG	NA	ND - 36	ND - 2.7	ND - 3.8	430 - 3700	ND - 3700
BENZO (B) FLUORANTHENE	UG/KG	NA	ND - 22	ND	ND - 7.3	310.8 - 3850	ND - 3850
BENZO (G.H.I.) PERYLENE	UG/KG	NA	ND	ND	ND - 6.1	ND	ND - 6.1
CHRYSENE	UG/KG	NA	ND - 2.7	ND - 2.7	ND - 2.6	340 - 3400	ND - 3400
DIBENZO (A,H) ANTHRACENE	UG/KG	NA	ND	ND - 7.9	ND	ND	ND - 7.9
FLUORANTHENE	UG/KG	NA	ND - 51	ND - 4.6	ND - 5.0	1000 - 14500	ND - 14500
FLUORENE	UG/KG	NA	ND	ND	ND	ND - 5050	ND - 5050
INDENO (1,2,3-C,D) PYRENE	UG/KG	NA	ND	ND - 3.6	ND	ND - 1601	ND - 1601
NAPHTHALENE	UG/KG	NA	ND	ND	ND	1200 - 21500	ND - 21500
PHENANTHRENE	UG/KG	NA	ND	ND	ND - 10.0	850 - 16000	ND - 16000
PYRENE	UG/KG	NA	ND - 3.7	ND - 3.7	ND - 4.1	440 - 9350	ND - 9350

NOTES: SCBG - South Coast Botanic Garden ND - Not Detected NA - Not Applicable

TABLE 6.1-7

COMPARISON OF METALS CONCENTRATIONS IN PVLF SOIL COVER SAMPLES TO CALIFORNIA SOILS BACKGROUND CONCENTRATIONS

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Metal	Range or Highest Measured Concentration		Arithmetic Mean	
	Site	Background[(a)]	Site	Background[(a)]
Antimony	<0.5 to 8.2	<1 to 2	1.5	<1
Arsenic	0.47 to 27.9	0.3 to 69	6.7	6.6
Barium	2.41 to 3220	150 to 1500	541	687
Beryllium	<0.5 to 1.2	3	0.5	0.54
Cadmium	<0.15 to 10.9	0.01 to 22	2.6	3.5
Chromium	18.3 to 165	10 to 1500	64.8	118
Cobalt	2.56 to 16.4	50	9	13.3
Lead	<2.0 to 179	300	23.3	29
Manganese	104 to 801	30 to 5000	304	480
Mercury	<0.05 to 1.17	0.01 to 1.5	0.1	0.154
Molybdenum	<1 to 20	5	3.9	0.59
Nickel	10.3 to 84.4	<5 to 200	44.5	38
Selenium	<0.01 to 9.6	<0.1 to 1.5	0.7	0.29
Silver	0.42 to 4.6	<0.5 to 5	1.8	NA
Thallium	<0.5 to 2.0	<0.25 to 10	0.6	0.22
Vanadium	31.8 to 350	30 to 500	113	125
Zinc	38.7 to 485	25 to 212	128	78

(a) Data obtained from Dragun and Chiasson (1991).

NA = Not available.

All values in mg/kg.

arithmetic average and range of concentrations measured from the site, in comparison to the arithmetic average and range of concentrations reported for background locations throughout California. Based on this qualitative comparison, three metals, antimony, molybdenum, and zinc, were found to be present at higher concentrations than are typical for background sites in California.

Comparison of the metal concentrations in the PVLF cover to background concentrations near the PVLF are shown on Table 6.1-8. Native soils in the PVLF vicinity derive from various members of the Monterey Formation which crop out to the surface near the PVLF. Background samples of subsurface soils from the Malaga Mudstone, Valmonte Diatomite, and Altamira Shale members of the Monterey Formation were tested from seventeen borings upgradient of the landfill. Qualitative comparison of the arithmetic average and range of concentrations measured from the site, in comparison to the arithmetic average and range of concentrations reported for the nearby background locations, indicates that the site concentrations of antimony, molybdenum, and zinc are consistent with natural conditions from marine sediments found in the PVLF vicinity. Similar marine sediments are found throughout the Los Angeles basin.

Three VOCs (xylenes and toluene) were detected at concentrations near the detection limit in one of the original 34 samples (the additional 22 samples were not analyzed for VOCs). Two phthalate esters (di-n-octyl phthalate and diethylhexyl phthalate) were detected in one and four samples respectively, in each case at concentrations below the usual detection limit.

Eleven PAHs were detected in one of the original 34 samples from the landfill cover. This sample (SC6) is located near a surface access road on the third bench of the PVLF main site. An additional four samples (SC53 through SC56) were collected in the area of the third deck access road. All of the analytical results for the samples collected from this area are shown on Table 6.1-9. The third bench of the main site is used by workers for maintenance purposes, but is not readily accessible to the public. The third deck access road is covered by a layer of crushed asphalt mixed in with the soil to a depth of at least one foot. Two samples of the asphalt material were also tested for PAHs. The asphalt is previously used material which was brought in from off site locations. The asphalt is suspected as the source of the PAHs. Public access areas on the main site are primarily located on the top deck and the southern corner. PAHs were detected at much lower concentrations

TABLE 6.1-8
COMPARISON OF METALS CONCENTRATIONS IN PVLF SOIL COVER TO BACKGROUND CONCENTRATIONS NEAR THE PVLF
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Metal	Range		Arithmetic Mean	
	Site	Background[(a)]	Site	Background[(a)]
Antimony	<0.5 to 8.2	<0.5 to 5.5	1.5	1.2
Arsenic	0.47 to 27.9	0.17 to 58	6.7	5.0
Barium	2.41 to 3220	5.59 to 4400	541	409
Beryllium	<0.5 to 1.2	<0.5 to 2.94	0.5	0.90
Cadmium	<0.15 to 10.9	<0.15 to 18.9	2.6	4.7
Chromium	18.3 to 165	16.2 to 193	64.8	86.7
Cobalt	2.56 to 16.4	<1.8 to 24.3	9	7.4
Lead	<2.0 to 179	<2.0 to 5.31	23.3	2.4
Manganese	104 to 801	25.2 to 590	304	192
Mercury	<0.05 to 1.17	<0.05 to 0.318	0.1	0.10
Molybdenum	<1 to 20	<0.86 to 70.6	3.9	12.19
Nickel	10.3 to 84.4	13.4 to 294	44.5	69.9
Selenium	<0.01 to 9.6	<0.01 to 2.9	0.7	0.47
Silver	0.42 to 4.6	<1 to 4.25	1.8	1.0
Thallium	<0.5 to 2.0	<0.5	0.6	0.25
Vanadium	31.8 to 350	37.5 to 645	113	184
Zinc	38.7 to 485	30.8 to 408	128	106

[(a)] Data obtained from subsurface samples in background locations near the PVLF.

All values in mg/kg.

TABLE 6.1-9

SUMMARY OF PAHS IN SURFACE COVER SOIL SAMPLES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

COMPOUND	SAMPLE CONCENTRATION (MG/KG) IN SOIL					STATISTICAL SUMMARY		
	SC53	SC54	SC55	SC56	SC6	X	S(X)	UCL95
Benzo(a)anthracene	7	2	13	4	16	7	6	12
Benzo(a)pyrene	6.5	2	11.5	3	15	7	5	11
Benzo(b)fluoranthene	9	2	14.5	3	13	7	6	12
Benzo(k)fluoranthene	9	1	6	2	15	6	6	10
Chrysene	7	2	14	3	18	8	7	13
Dibenzo(a,h)anthracene	<6	<6	2.5	<6	<6	3	0	3
Indeno(1,2,3-cd)pyrene	3	<6	5	<6	<6	3	1	4
Acenaphthene	7	<2	15	4	11	6	5	11
Anthracene	6	<1	10	3	11	5	4	9
Benzo(g,h,i)perylene	2	1	4	1	<6	2	1	3
Fluoranthene	20	5	37	11	42	19	17	33
Fluorene	5	<2	11	3	9	5	4	8
Naphthalene	2	<2	6	<2	4	2	2	4
Phenanthrene	23	4	48	14	48	23	21	40
Pyrene	17	4	31	8	45	18	17	32

X = The arithmetic average of the soil concentrations.

S(X) = The standard deviation of the soil concentrations.

UCL95 =The upper 95 percent confidence limit of the arithmetic average of the normally distributed soil concentrations.

Samples SC6, SC53, SC54, SC55, and SC56 were collected from the third bench access road area.

(approximately one hundred times less than the results from near the third deck access road) in the remaining portions of the PVLF.

The soil cover data were evaluated to identify COCs in surface soil and airborne particulate. This evaluation is presented in Section 6.1.1.4.

Exposure concentrations in surface soil and airborne particulates were calculated from the soil cover data. These calculations are further discussed in Section 6.1.2.

6.1.1.4 Rationale for the Potential Contaminants of Concern

This section discusses the rationale for the choice of COCs for the landfill. Generally, COCs were chosen based upon several criteria that are consistent with EPA guidance (EPA, 1989a). With the exception of known and probable human carcinogens, chemicals were considered COCs if they were:

1) Detected in greater than five percent of the non-background samples (on a medium by medium basis, and on a well by well basis for ground water); and

2) Found at levels significantly exceeding background or upgradient values.

Known and probable human carcinogens were chosen as COCs regardless of their frequency of detection as long as they met the condition of criterion 2. RAGS noted nutrients, and chemicals which are generally regarded as safe were not considered as COCs.

The following sections present the specific rationale for choosing the COCs in ground water, landfill gas, and surface soil.

6.1.1.4.1 COCs in Ground Water

Generally, chemicals which were detected in at least five percent of samples from any downgradient well were selected as COCs. To date, few chemicals have been tested more than twenty

times in any single well at the PVLF. Therefore, with the exceptions listed below, all of the chemicals detected in on site or downgradient ground water were selected as COCs. Exceptions are:

- RAGS noted nutrients were not considered COCs (sodium, potassium, sulfate, magnesium, and iron);
- Acetic acid and propionic acid were not considered COCs (generally considered safe food additives);
- PAHs were not considered COCs, because they were detected infrequently and at similar concentrations in both on site or downgradient and background wells, and are known to be naturally occurring in crude oil in the Malaga mudstone;
- With the exception of arsenic, metals were not considered COCs, because the metals concentrations in ground water are consistent with natural conditions at the PVLF, particularly the mineral content of the diatomite (see Section 3.6.5); and
- Di-n-octylphthalate and diethylhexylphthalate were not considered COCs because they were detected in similar concentrations and at similar rates of detection in upgradient wells.

Because the phthalate esters are common laboratory contaminants, they were considered to be likely false positive detections if they were detected in similar concentrations and at similar detection rates in upgradient samples.

6.1.1.4.2 COCs in Landfill Gas

Chemicals that were tested in landfill gas include all of the priority pollutant VOCs which comprise the TO-14 target analyte list. The TO-14 list includes chemicals which were never detected in either landfill gas or ground water at the PVLF. Nevertheless, all of the TO-14 chemicals were retained as COCs for the purpose of this risk assessment. Potential risks were calculated for all of the TO-14 chemicals so that the potential health significance of any undetected chemicals could be evaluated. For comparison, the monitoring data for all of the TO-14 chemicals in landfill gas are

summarized on Table 6.1-5. The risk contribution from each TO-14 chemical and the likelihood of its presence at the PVLF are discussed in Section 6.1.4.

6.1.1.4.3 COCs in Surface Soil

As for the other media, chemicals which were detected in more than five percent of samples were in general considered as COCs. However, known and probable carcinogens were considered as COCs even if they were detected in fewer than five percent of samples. In the case of surface soils, seven compounds which are classified as known or probable carcinogens (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene) were detected, and were considered as COCs.

6.1.2 Exposure Assessment

Exposure refers to the potential contact of an individual with a chemical. Exposure assessment is the quantification of the magnitude, frequency, duration, and routes of exposure to a chemical. Human exposure to chemicals is typically evaluated by estimating the amount of a chemical which could come into contact with an individual (via the lungs, gastrointestinal tract, or skin) during a specified period of time. This chapter describes the assumptions, data, and methods used to evaluate the potential for human exposure to COCs originating from the PVLF, and involves the following steps:

- Description of features of the PVLF site that could influence exposure;
- Identification of potentially exposed populations;
- Identification of potential exposure pathways and selection of complete exposure pathways (exposure scenarios);
- Evaluation of the environmental fate and transport of chemicals in air and ground water;
- Estimation of exposure point concentrations used to quantify chemical intakes;
- Selection of appropriate exposure parameters; and
- Quantification of chemical intakes for each exposure pathway.

Each exposure is examined under two scenarios: 1) a reasonable maximum exposure (RME) scenario; and 2) an average exposure scenario. In general, EPA-recommended default exposure parameters were used for the RME scenario while site-specific or 50th percentile approximations were used for the Average exposure scenario. It should be noted that in both scenarios, exposure point concentrations used were either the 95 percent upper confidence limit (UCL) of the arithmetic mean of chemical concentrations or the highest concentration detected or modeled, depending on the data set available for that particular medium. While in some instances, it might be more appropriate to use the arithmetic mean of chemical concentrations as the exposure point concentrations when evaluating the Average Case, for the PVLF risk assessment, the nature of the contamination and the media contaminated did not lend themselves to the use of average concentrations for computation of intakes and, consequently, risks. For example, the surface soil contamination is limited to a very small portion of the site and computation of a site-wide average would result in a dilution of the exposure point concentration based on the potential for exposure to that discrete area. Separate evaluation of the hot spot area based on the concentrations detected in this area, as used in this case, essentially obviates the possibility of underestimating the exposure from the contaminated soil.

6.1.2.1 Exposure Setting

This section provides information useful in the identification of exposure pathways and definition of exposure scenarios for the PVLF site.

Climate

The PVLF is located in a semi-arid to temperate region having the following annual climatic characteristics:

- Average temperature: 64° F (17.8° C);
- Mean Wind Speed: 6.3 mph (2.8 m/sec); prevailing winds are out of the southwest;
- Average annual precipitation - 14.8 inches (451 cm); and

- Rainy season from November to March (accounting for 88 percent of total annual rainfall).

Soils and Surface Features

The final cover material at the PVLF is primarily from off site sources although native soils were also used, particularly in the South Coast Botanic Garden area. As a result, the soil cover consists of a diverse array of soil types. The top deck of the main site is partially covered with dry grasses and contains dirt and gravel maintenance roads. The main site slopes are maintained with shrubs, trees, and grass. Both the South Coast Botanic Garden and Ernie Howlett Park are landscaped in a fashion appropriate to their designated use. Approximately one-third to one-half of the South Coast Botanic Garden is covered with deciduous trees.

Surface Drainage Patterns

Surface drainage at the landfill is channeled into municipal storm drains. The landfill stormwater system consists of the following elements:

- Graded channels (grass-lined, concrete, or asphalt);
- Corrugated steel pipes, or lattice type down drains;
- Road flow control such as concrete or asphalt curbs; and
- Concrete aprons.

Surface drainage at the South Coast Botanic Garden collects in an artificial pond at the center of the garden and then enters the municipal storm system through an underground drain. This pond also receives make-up city tap water. Surface waters draining from Ernie Howlett Park enter the storm system along Hawthorne Boulevard.

Hydrogeologic Considerations

The Palos Verdes peninsula is a northwest trending uplift that forms a physiographic promontory extending westward between Santa Monica and San Pedro bays. The Palos Verdes fault

zone passes approximately one-quarter mile northeast of the PVLF, structurally separating the Palos Verdes Peninsula from the Los Angeles Coastal Plain and the regional aquifers of the West Coast Ground Water Basin.

Ground water flow in the Palos Verdes Peninsula is contained primarily within ancient depositional drainages, recent alluvium and the fractured bedrock of the Monterey Formation. The fine-grained sedimentary rocks of the Monterey Formation are not considered capable of storing and transmitting significant amounts of ground water for water-supply purposes. Natural ground water quality in the area of the PVLF is poor due to the presence of high levels of total dissolved solids and natural petroleum deposits.

Near the site, ground water occurs mostly in buried alluvial drainages and in weathered bedrock, and flows generally northeast toward the fault zone and the West Coast Basin. However, lateral inflow of ground water from the Palos Verdes Peninsula contributes little to the total recharge of the Basin for the following reasons:

- The local geologic matrices upgradient of the fault have low transmissivity;
- The precipitation rate of the region is low relative to the potential evapotranspiration rate; and
- The intervening fault zone acts as a partial barrier to ground water flow.

Likely sources of site ground water include infiltration from precipitation and local irrigation, and also recharge from upgradient sources.

As noted above, regional aquifers occur approximately a quarter of a mile from the PVLF, in the West Coast Basin. The uppermost Basin aquifer in the area is the Gage aquifer, contained in late Pleistocene alluvial deposits. The Gardena, Lynwood, and Silverado aquifers are contained in the underlying Quaternary undifferentiated sand deposits of the San Pedro Formation. The majority of the ground water wells drilled in the Basin have been developed in these four aquifers. Underlying the San Pedro Formation, in order of increasing depth, are the Pico, Repetto, and Monterey Formations.

Land Use

The PVLF is situated in the City of Rolling Hills Estates and unincorporated Los Angeles County. The cities of Rolling Hills, Rancho Palos Verdes, and Palos Verdes Estates are located south, west and north of the PVLF, respectively. The City of Torrance lies north and east of the site and the Torrance Municipal Airport is approximately one-half mile to the northeast. Land in the surrounding area is predominantly residential with some commercial facilities to the northeast of the PVLF. Rancho Vista School and Rolling Hills Day School are located within about 1,000 feet of the site to the west and southwest, respectively. Horse stables are located on the western boundary and on the main site (see Exhibit 1.3-4). Both workers and recreational visitors are expected to frequent the horse stables.

Recreational land use occurs within the PVLF boundary (see Exhibit 1.3-4). As previously noted, the South Coast Botanic Garden and Ernie Howlett Park exist upon PVLF Parcels 1 and 4, respectively. There is a horse trail on the perimeter of the top deck of the main site and stables in the southern corner of the main site. The surface of the horse trail consists of several inches of shredded wood placed over the landfill cover soil.

Various maintenance activities also occur within the boundaries of the PVLF. The landfill gas collection system and the landfill gas-to-energy generating facility are both located on site. Workers engage in various activities throughout the landfill. These include:

- Monitoring, sampling, and maintenance of the landfill gas collection system at the main site and the South Coast Botanic Garden;
- Operation of the landfill gas-to-energy facility and flares; and
- General maintenance throughout the site.

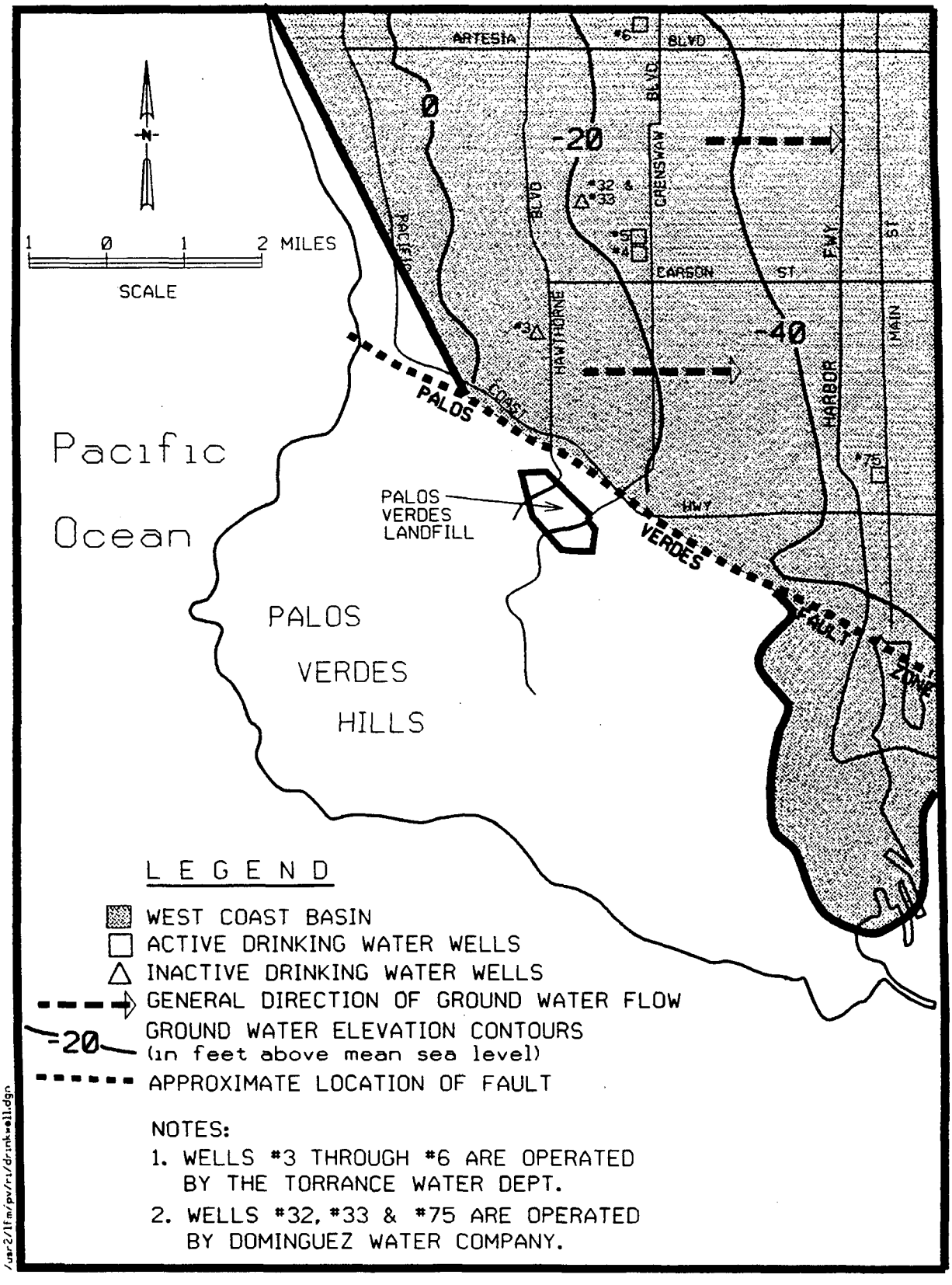
Future land use at and in the vicinity of the PVLF is expected to be similar to current use. The main site may be developed for recreational purposes; the County at one time proposed to convert the main site into an eighteen hole golf course and club house facility.

Water Use

In an effort to determine ground water use in the vicinity of the PVLF, Dames & Moore contacted local water agencies and reviewed maps and reports to assess whether there are any active drinking water supply wells (domestic wells) within the study area, a rectangular boundary which extends approximately two miles north and west of the PVLF, one mile to the south, and three miles to the east. Results of this research indicated that there are no domestic wells in the study area. The nearest active domestic wells are located approximately three and a half miles to the north of PVLF and are operated by the City of Torrance. The next nearest active domestic wells are located approximately four miles east/northeast of the PVLF, and are operated by the Dominguez Water Corporation. Figure 6.1-1 shows those active and inactive drinking water wells in the West Coast Basin that are closest to the PVLF. A summary of the information obtained is presented below.

- According to information presented in "Watermaster Service in the West Coast Basin" (CDWR, 1991), which reports annually on the status of all active and inactive wells in the West Coast Basin, there are five water service agencies within the study area boundaries. These are: 1) the California Water Service Company; 2) the City of Los Angeles; 3) the City of Torrance; 4) the Dominguez Water Corporation; and 5) the Los Angeles County Waterworks District No. 13 (CDWR, 1991, plate 1). Individual water service producers within the study area include: 1) the Palos Verdes Begonia Farm; 2) the Rolling Hills Vista; 3) the Chandler Palos Verdes Sand and Gravel Company; 4) the Union Oil Company; and 5) Chevron U.S.A (CDWR, 1991, plate 2). However, plate 3 of this report shows that the only two active wells in the study area include one at the Palos Verdes Begonia Farm, and one at the Chandler Palos Verdes Sand and Gravel Company. Both of these wells are for industrial or irrigation purposes only, and not for domestic supply (as discussed below).

- According to Mr. John Bauman, owner of the Palos Verdes Begonia Farm (personal communication, 1993), his well has not pumped any water since at least 1987 due to a broken pump and the infilling of sand. When it was in



/usr2/lfm/pw/ri/drinkwell.dgn

FIGURE 6.1-1
DRINKING WATER WELLS NEAR THE PVLF

PALOS VERDES LANDFILL
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operation, it was used solely for irrigation purposes. He does plan to refurbish the well and use the water it produces sometime in the future, again for irrigation purposes only.

- According to Mr. Jack Berry of the Chandler Palos Verdes Sand and Gravel Company (personal communication, 1991), their active well was installed in approximately 1963 for industrial purposes. They currently share the water produced from the well with the golf course located adjacent to their property. The golf course uses the water for irrigation purposes. The water from the well is not used for domestic supply.

- According to Mr. Chuck Schaich of the City of Torrance Water Department (personal communication, 1991), the City has four domestic wells, one of which is abandoned due to poor water quality (high salt content). The active wells are located approximately three and a half miles north of the PVLF, near the corner of Ukon and Artesia, Elm and Sierra, and Alaska and Maricop. The inactive well is located near the corner of Ocean and 226th Streets. He believes that this inactive well will never be used again.

- According to Mark Carney of the Los Angeles County Waterworks District No. 13 (personal communication, 1991), they do not have any active domestic wells in the study area.

- According to Mr. Tom Salvano of the West Basin Municipal Water District (personal communication, 1991), there are no active domestic wells within several miles of the PVLF except for the three City of Torrance wells. The City of Los Angeles and the City of Lomita each have rights to extract approximately 1,500 acre-feet per year near the study area (one acre-foot equals approximately 325,829 gallons), but have not done so for over ten years due to poor water quality (high salt content). Mr. Salvano confirmed that the only active well in the study area is the Chandler well which is used for industrial and irrigation purposes only.

- According to Mr. Tom Coe, Palos Verdes District of the California Water Service Company (personal communication, 1991), they supply potable water to the residents of the Palos Verdes Hills. All of their water is purchased from the Metropolitan Water District which imports their water from Northern California and the Colorado River. The California Water Service Company does not have any active wells in the study area. They do have an abandoned domestic well near Harbor Lake (eastern boundary of the study area, approximately three miles east of the PVLF), but due to high salt content in the ground water, the well was backfilled with cement. They have no plans to drill any new wells.

- According to Mr. Roger Williams of the Harbor Regional Park (personal communication, 1991), the Harbor Lake receives its water only from storm drain inflow. There are no wells supplying the Lake.

- According to Mr. Oscar Luque of the Dominguez Water Company (personal communication, 1991), their nearest domestic wells are near the corner of Lomita and Main, approximately four miles east/northeast of the PVLF. They also have an abandoned domestic well field near the corner of Maple and Columbia, approximately three and a half miles north of the PVLF. The wells were abandoned due to high salt content in the ground water. They are planning on building a desalination plant at this abandoned well field in the future so that the water can be treated and used again. They do not have plans to drill any new wells in the study area.

6.1.2.2 Identification of Exposure Pathways

An exposure pathway describes the mechanism through which a chemical comes into contact with a receptor. There must be a complete exposure pathway from the source of chemicals in the environment (*i.e.*, in soil, ground water, or air) to human receptors in order for chemical intake to occur. In this section, the complete exposure pathways were chosen from all potential pathways, and were evaluated further.

A complete chemical exposure pathway consists of the following four elements:

- A source of chemical release to the environment;
- An environmental transport medium;
- A point of contact (known as the exposure point) for receptors with the COCs; and,
- A route of intake for the chemical into the receptor.

If one of these four elements is missing, then the exposure pathway is incomplete and there is no intake (or subsequent health risks) associated with that pathway. The presence or absence of any of these elements depends on the specific conditions found at the site. Exposure pathways were evaluated as discussed in the following subsections. The pathway analysis is also summarized in Table 6.1-10.

6.1.2.2.1 Possible Sources and Transport Mechanisms for COCs

The main source of COCs at the PVLF consists of solid and liquid wastes contained within the landfill. Mobile substances from the waste materials may be released into the environment via the following mechanisms:

- Landfill gases are formed within the PVLF mainly as the result of microbial action. The landfill gas consists of methane (50 to 60 percent) and carbon dioxide (40 to 50 percent) with generally less than one percent of halogenated and other VOCs. At the landfill, approximately 98 percent of the landfill gas is collected and combusted by a gas collection/energy recovery system based on Sanitation Districts estimates. Chemical vapors not captured by the collection system can migrate through the landfill cover and be transported downwind of the landfill. Landfill gases that escape the collection system can also migrate through soils in a lateral direction away from the site. Vapors diffusing through soils adjacent to the site could be released to the air, possibly underneath nearby building foundations.

TABLE 6.1-10
SUMMARY OF EXPOSURE PATHWAY ANALYSIS
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Pathway	Potential Receptor	Current or Future Scenario	Comment
Outdoor Air Pathway (Vapor and Dust Inhalation)	Off site Resident On site Workers Recreational Visitor	Current and Future	Pathways complete; Results of the AB 2588 Risk Assessment modified and utilized for vapor exposures.
Ground water Pathway (Ingestion, Dermal, Inhalation in Shower)	Off site Resident	Current Future	Pathway incomplete. Ground water not currently used. Pathway may be complete; risks quantified based on monitoring data and contaminant transport modeling.
Indoor Air Pathway (Ground water to Soil Gas to Indoor Air)	Off site Resident	Current and Future	Pathway is unlikely to be complete as shown by surface emissions flux chamber sampling.
Indoor Air Pathway (Landfill Gas to Soil Gas to Indoor Air)	Off site Resident	Current and Future	Pathway is controlled by the existing landfill gas control and monitoring systems.
Surface Water and Sediment Pathways	On site Workers Recreational Visitors	Current and Future	Incomplete since surface waters and sediments are not contaminated.
Surface Soil Pathways (Incidental Ingestion and Dermal Absorption)	On site Workers Recreational Visitors	Current and Future	Pathways complete; exposure potential is limited since only soil beneath gravel roads is contaminated.

- Vapor emissions also result from the combustion of landfill gas at the gas-to-energy facility, from burning excess landfill gas in the flares, and from fuel storage. However, as was demonstrated in the air modeling exercise conducted for the AB 2588 HRA, emissions due to these sources are insignificant relative to emissions through the soil cover (soil cover emissions were shown to produce greater than 99 percent of risks for vapor emissions from the site).

- Chemicals present in the landfill can migrate downward to ground water via bulk flow, in the vapor phase, or dissolved in infiltrating and percolating water. Once released to ground water, chemicals can be transported downgradient of the landfill. Volatile substances migrating through the shallow ground water downgradient of the site (ground water between the PVLF and the Palos Verdes Fault System is approximately 40 feet bgs) could volatilize from ground water to soil gas, and migrate upward via diffusion, potentially entering houses situated near the affected ground water.

6.1.2.2.2 Exposure Pathways

Six specific exposure pathways were evaluated. These pathways, ground water, outdoor air vapor, indoor air vapor, direct soil and air-dust, surface water and sediment, and food chain exposure, are discussed below.

Ground Water Pathway

Ground water can provide a medium for chemicals to reach humans through the following exposure routes:

- Dermal contact with water;
- Ingestion of water; and
- Inhalation of chemicals volatilized from water during use.

In order to come into direct contact with humans, ground water must be brought to the surface for use either by mechanical (*i.e.*, pumping) or natural (*i.e.*, springs) means.

Future ground water pathways are hypothetical and uncertain since exposure to contaminated ground water would only occur if chemicals from the PVLF are transported to locations with usable ground water. This transport is uncertain and was estimated using a number of conservative assumptions, which included the assumption that the PVLF will act as a continuing, unlimited source of chemicals to ground water. The rate of chemical releases from the landfill was assumed to remain unchanged in the future. The subsurface barrier near Hawthorne Boulevard was constructed in 1986 and is expected to result in less potential for future releases to ground water. However, if ground water releases from the landfill should increase in the future, such increased contaminant loadings could result in higher ground water concentrations and potential risks than are estimated here. Moreover, exposure associated with domestic ground water use (which is much greater than exposure which would be associated with other water uses such as irrigation) would only occur if water use patterns change so that new supply wells are developed near the PVLF and/or ground water is withdrawn from existing inactive wells for domestic use. Such changes in water use patterns are considered unlikely since municipal water is available to all residents in the potentially affected area, since development of a domestic well is unlikely to be cost-effective in competition with municipal water, and since water extraction rights in the West Coast Basin are apportioned under the West Coast Basin Judgment.

Exposure to chemicals in ground water could occur at several types of wells in the West Coast Basin: 1) Private, domestic; 2) Commercial or industrial; 3) Agricultural; and 4) Municipal. Generally, ground water use via a private domestic well results in the greatest exposures since in such an instance people would be exposed to contaminants in the water through drinking, showering/bathing and other domestic uses of water. Thus, the ground water pathway was characterized by assuming exposure to residents utilizing ground water from a private well. Moreover, for the purpose of this risk assessment, private wells were assumed to be developed at the locations closest to the landfill as technically feasible.

Outdoor Air-Vapor Pathway

The outdoor air-vapor pathway is considered complete since, to the extent that landfill gas is not captured by the landfill gas collection system, the PVLF is a likely source of air emissions that can be transported to potential receptors either on site (workers or recreational visitors), or in the vicinity of the site (off site residents). The air pathway consists of the following components:

- Inhalation of air containing landfill gases emanating from the landfill surface.
- Inhalation of air containing emissions from the gas-to-energy facility operations, the flares, fuel storage and use of vehicles. The results of the AB 2588 HRA indicated that exposures due to these sources are expected to be insignificant relative to exposures resulting from landfill surface emissions.
- Potential exposures due to air emissions could occur in both the present and future, and are likely to diminish as the degradation of the organic component of the wastes in the PVLF reaches completion.

Indoor Air Vapor Pathways

Chemicals could be transported to residences and office buildings which are located adjacent to the PVLF from both vapors in soil (originating from ground water) and from landfill gas. The indoor air pathways from both ground water and landfill gas is potentially complete, and was evaluated by performing a soil gas emission flux survey near homes close to the PVLF. Results of a one-time emission flux survey indicate that there were no measurable surface emissions at any of the locations above background levels or analytical detection limits during the time period sampled. However, any extrapolations of these results should be made with care since they represent a "snapshot" of emissions at a single point in time. In addition to the active landfill gas extraction and collection system, the existing landfill gas monitoring system at the PVLF includes boundary probes which are screened in soil to depths of at least ten feet beneath the ground surface at the adjacent homes. As a result, subsurface landfill gas migration to soils beneath the homes would be detected by the landfill gas migration monitoring system. Therefore, subsurface gas migration into homes, while a potentially complete pathway, is controlled by the existing landfill gas control and monitoring systems at the PVLF and is not expected to pose unacceptable health risks above DTSC threshold levels.

Direct Soil Contact and Air Dust Pathways

Humans could be exposed to chemicals in surface soils via:

- Incidental ingestion of soil;
- Skin contact with soil followed by absorption of chemicals through the skin; and
- Inhalation of respirable dust.

These exposure pathways are considered complete for individuals engaged in various activities on site in areas where surface soils may be contaminated. Exposures could occur under both present and future conditions at the PVLF.

Based upon the data collected during the RI, contaminated soil appears to be associated with crushed asphalt gravel on unpaved maintenance access roads. The detected concentrations of the PAHs are well within the range of background environmental pollutant levels for roadways in urban areas in Southern California and elsewhere in the United States. The background levels of PAHs are largely attributed to accumulated deposits from automobiles and other vehicular traffic (Venkatavamen et al., 1994a and 1994b). Reported background PAH concentrations in road dust range from 8 to 336 mg/Kg (mean 137 mg/Kg) (Menzi et al., 1992). For PAHs in access roads at the PVLF, exposures were calculated based on default contact rates for soil, which EPA has developed to represent exposure situations involving unpaved soil. However, at the PVLF, the PAHs were brought in on asphalt from off site roads, and the PAHs are believed to be currently either entirely adsorbed to the crushed asphalt gravel, or else, possibly, partially mixed in with soil that lies beneath the crushed asphalt gravel. Contact with the gravel and underlying soil on the PVLF access roads is expected to be much less than the default contact rates for unpaved soil assumed here. Therefore, although both workers and recreational visitors were assumed to be exposed to PAHs in surface soil, the amount of actual contact is uncertain, and is likely to be less than was assumed for the purpose of risk assessment. In addition, off site residents in the vicinity of the PVLF were assumed to be exposed to PAHs in surface soil via transport of respirable dust to off site locations.

Surface Water and Sediment Pathways

Exposure pathways involving surface water and sediments are assumed to be incomplete since surface water runoff at the landfill is channeled into municipal storm drains that surround the perimeter of the site. No runoff migrates on the surface significantly beyond site boundaries. Furthermore, there are no contaminated surface water bodies on site, and the site does not discharge contaminated runoff to off site water bodies.

Food Chain Exposure Pathways

The Risk Assessment Guidance for Superfund (EPA, 1989a) and the Supplemental Guidance (EPA, 1991b) states that the food chain exposure pathway needs to be evaluated only if there is site-specific information to support its being a pathway of concern. There are currently no complete pathways involving edible vegetation. Although in the future scenario, fruits and vegetables could conceivably be irrigated with ground water in off site residences, chlorinated VOCs are not expected to significantly bioaccumulate in plant tissues (DTSC, 1992). Therefore, the food chain exposure pathways are incomplete and will not be quantified.

6.1.2.2.3 Potentially Exposed Populations

The populations that could be exposed to chemicals at or from the PVLF include:

- Current and future residents who live adjacent to, or near the PVLF. These individuals could be exposed via one or more of the following pathways: inhalation of outdoor air; inhalation of indoor air; and/or domestic use of ground water. Nearby residents could also use the PVLF as recreational visitors.
- Current and future workers at the PVLF, as well as workers in areas adjacent to the PVLF (*e.g.*, workers at the stables, on site gardeners, maintenance workers, site technicians, and workers in nearby commercial buildings, *et cetera*).

- Current and future recreational visitors located at the following areas: the horse trail at the main site and the horse stables on site and adjacent to the PVLF; Ernie Howlett Park; the South Coast Botanic Garden; and the future recreational area planned for the main site.
- Other individuals who spend time near the site (*e.g.,* current and future workers at local businesses, and students and teachers at the local schools).

6.1.2.3 Exposure Scenarios

Of the potential receptor populations described in the previous section, there are six types of receptors that characterize the range of exposures that could be incurred at or near the PVLF. These receptors are as follows:

1) Residents who live adjacent to the site near Crenshaw Boulevard. The results of the previously completed air modeling indicated that these receptors would be most affected by outdoor air-vapor emissions from the landfill. These residential receptors were also conservatively assumed to be affected by contaminant-bearing dust concentrations which were actually modeled to the nearest downwind residential location (assumed to be 50 meters downwind). Exposures due to the domestic use of site-impacted ground water are not expected at these receptors because they are located in areas that are considered non-water bearing (*i.e.*, insufficient water is available for a water supply well);

2) Potential exposure of residents who live at the nearest downgradient locations at which ground water could be used in the future have been evaluated in this risk assessment. These receptors were also considered to be exposed via the outdoor air pathways;

3) On site workers could be exposed to chemicals in the outdoor air and via the direct contact pathways; and

4) On site recreational visitors would experience exposure conditions qualitatively similar to the on site worker. The recreational scenario includes children since for some chemicals these receptors might be more sensitive than adults.

6.1.2.4 Exposure Point Concentrations

The exposure point concentrations are the concentrations in the medium of concern (*e.g.*, ground water, soil or air) used to estimate the potential intake of chemicals by humans. These concentrations have been obtained directly from data collected during the various site investigations, or were estimated using the models discussed in Sections 6.1.2.4.1 and 6.1.2.4.2 for ground water and air.

6.1.2.4.1 Ground Water Concentrations

Under current land use conditions, there is no complete exposure pathway to ground water because the nearest water supply wells are not currently affected by the PVLF. In order to estimate future exposure point concentrations at potential receptors, ground water contaminant fate and transport modeling was carried out, the details of which are outlined in Section 5.0 and in the Hydrogeologic Modeling for Remedial Investigation/Feasibility Study, Contaminant Transport Model, Palos Verdes Landfill (Dames & Moore, 1992). Modeling was carried out for five potential receptor wells chosen at the nearest downgradient locations at which production wells exist, or could reasonably be placed. These well locations are referred to as Receptor Wells 1 through 5.

Receptor Well 1 is an inactive agricultural well that had been used to irrigate a begonia farm. Receptor Well 5 is an industrial well owned by the Chandler Sand and Gravel Quarry. Water pumped from this well is used to irrigate a nearby golf course. Receptor Wells 2, 3, and 4 are *hypothetical* well locations that could provide greater than 100 gallons per minute of ground water to a potential user. A review of the records of the California Department of Water Resources-Southern Division did not indicate any other active wells in the West Coast Basin that were closer to the PVLF than Receptor Wells 1 through 5. For the purposes of this risk assessment, all five of

the receptor wells (real and hypothetical) were assumed to be the location of potential domestic wells sometime in the future.

The contaminant fate and transport model (Dames & Moore, 1992) employed conservative assumptions which overestimate the chemical concentrations in ground water in the vicinity of the PVLF. A sensitivity analysis, performed as part of the modeling exercise, determined a range of uncertainty in the predicted concentrations at the receptor wells of approximately 1.5 orders of magnitude (*i.e.*, a factor of 31.62) about the base case (case with best-estimate parameters). The model was found to be sensitive to the variability of adsorptive properties, fault hydraulic properties, and effective porosity. In order to ensure that potential health risks were not underestimated, the most conservative (*i.e.*, upper bound) set of modeling parameters was utilized to predict exposure point concentrations.

Because of the relatively large number of organic COCs identified for the ground water pathway, modeling was not carried out for each chemical. Instead, the chemicals were divided into six groups based upon their potential mobility in ground water. A characteristic chemical was chosen from each of the six mobility groups and subjected to detailed analysis in the model (Dames & Moore, 1992). The remaining chemicals within each group were assumed to mimic the transport characteristics of the indicator chemicals. Thus, exposure point concentrations for chemicals were estimated using a simple scaling relationship exemplified by the following equation:

$$C_i\,(receptor) = \frac{C_i\,(source)}{C_{char}\,(source)} \times C_{char}\,(receptor)$$

where,

C_i(receptor)	=	Chemical concentration at the receptor well (mg/L)
C_i(source)	=	Chemical concentration at the source area (mg/L)
C_{char}(source)	=	Concentration of the appropriate characteristic chemical at the source area (mg/L)
C_{char}(receptor)	=	Concentration of characteristic chemical at the receptor location (mg/L)

The mobilities of groups of organic compounds were based upon the water/organic carbon partition coefficient (K_{oc}). The characteristic chemicals representing each group are as follows:

Mobility Group	K_{oc} Range (ml/g)	Characteristic Chemical
A	0-14	Vinyl Chloride
B	26-69	Benzene
C	97-131	Trichloroethene
D	217-318	Tetrachloroethene
E	550-982	Ethylbenzene
F	> 25,120	Chlordane

Nitrate was modeled as the characteristic inorganic chemical, and cyanide was scaled assuming that it behaved in a fashion similar to nitrate. Nitrate was assumed to be a conservative chemical, *i.e.*, the model assumed that nitrate was transported through ground water with no retardation effects due to matrix interactions and no biodegradation. The nitrate modeling results represent the most conservative case for the transport of inorganics through ground water.

The modeling output for the characteristic chemicals (adapted from Dames & Moore, 1992) are presented graphically in Appendix E.3. The ground water modeling results indicated the following:

- Of the five potential receptor wells, Wells 2 and 5 had the highest future COC concentrations; Wells 1, 3, and 4 had consistently lower concentrations of each of the modeled chemicals throughout the period of simulation; and
- Plots of concentration versus time ("breakthrough curves") indicated, in general, that chemical concentrations at the receptor wells could increase over the course of 50 to 100 years, in some cases reaching maximum steady-state

concentrations, and in some cases reaching maxima followed by decreasing concentrations.

Based upon the above results, Receptor Wells 2 and 5 were chosen for the risk calculations. Future exposure point concentrations at the receptor wells were conservatively assumed to be the highest attained concentrations over the modeling period of 350 years. Ground water exposure point concentrations at Receptor Wells 2 and 5 are provided in Table 6.1-11.

6.1.2.4.2 Outdoor Air Concentrations

This section discusses the development of outdoor air exposure point concentrations due to vapor and airborne particulate emissions.

The risk assessment for vapor and particulates in air is based entirely on models: 1) for potential vapor and particulate emissions from the landfill, and 2) for transport of vapor and particulates in ambient air to potential receptor locations. Actual vapor emissions from the landfill have been tested by sampling ambient air for VOCs. This ambient air sampling has not shown any statistically discernable difference in air quality between upwind and downwind locations. In addition, statistical analyses comparing the integrated surface gas results to the upwind ambient air monitoring results were performed. Although the sample collection methodologies for these two programs were different and cannot be considered fully comparable (grab samples of surface gas were collected approximately six inches above the landfill surface; eight or 24 hour upwind ambient air samples were collected five to six feet above the ground), the two data sets were found to be statistically the same.

Potential receptors for vapor and particulate emissions from the landfill include workers and visitors on the site, and residents at all of the downwind locations at which homes are located. For the purpose of this risk assessment, potential exposures and risks were quantified based on the specific receptor locations where the landfill emissions and air transport models predicted the highest vapor and air particulate concentrations. These locations correspond to "maximum exposed individual" receptor locations as defined by CARB.

TABLE 6.1-11

CALCULATION OF EXPOSURE POINT CONCENTRATIONS AT RECEPTOR WELLS 2 AND 5

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Mobility Group	Source Area Concentration (Hawthorne Blvd.) (a)	Maximum Future Conc. at Receptor Well 2	Source Area Concentration (Crenshaw Blvd.) (a)	Maximum Future Conc. at Receptor Well 5
Acetone	A	1.20E+00	4.55E-05	2.40E-01	6.00E-05
(b) Benzene	B	5.20E-01	2.10E-08	1.60E-02	2.60E-06
Bis-(2-chloroethyl)ether	A	5.00E-04	1.89E-08	2.50E-03	6.25E-07
Bromodichloromethane	C	9.40E-03	6.75E-09	7.40E-03	5.38E-07
Bromoform	D	2.10E-03	1.22E-10	2.50E-04	1.47E-08
Bromomethane	A	2.10E-03	7.95E-08	1.25E-03	3.13E-07
Butanone, 2-	A	5.00E-01	1.89E-05	2.00E-03	5.00E-07
Carbon tetrachloride	D	5.00E-04	2.91E-11	2.50E-04	1.47E-08
(b) Chlordane	F	5.00E-05	2.00E-13	5.20E-04	1.30E-13
Chlorobenzene	D	1.40E+00	8.14E-08	2.40E-02	1.41E-06
Chloroethane	A	1.80E-03	6.82E-08	1.70E-03	4.25E-07
Chloroform	A	1.90E-02	7.20E-07	4.30E-03	1.08E-06
Chloromethane	A	1.50E-01	5.68E-06	1.25E-03	3.13E-07
Chlorophenol, 2-	A	1.30E-02	4.92E-07	4.00E-03	1.00E-06
DDD	F	3.00E-05	1.20E-13	3.30E-04	8.25E-14
DDE	F	2.00E-05	8.00E-14	1.90E-03	4.75E-13
DDT	F	1.10E-04	4.40E-13	1.00E-05	2.50E-15
Di-n-butylphthalate	F	2.10E-02	8.40E-11	8.00E-04	2.00E-13
Dibromochloromethane	C	1.10E-02	7.90E-09	4.80E-03	3.49E-07
Dichlorobenzene, 1,2-	E	4.40E-03	1.62E-11	1.90E-03	5.00E-10
Dichlorobenzene, 1,4-	E	3.80E-02	1.40E-10	2.10E-02	5.53E-09
Dichloroethane, 1,1-	B	2.30E-01	9.29E-09	2.70E-02	4.39E-06
Dichloroethane,1,2-	A	5.90E-01	2.23E-05	1.00E+00	2.50E-04
Dichloroethene, 1,1-	B	4.60E-02	1.86E-09	2.90E-03	6.30E-08
Dichloroethene, cis-1,2-	B	5.60E-01	2.26E-08	1.40E-01	2.28E-05
Dichloroethene, trans-1,2-	B	1.30E-01	5.25E-09	3.70E-02	6.01E-06
Dichloropropane, 1,2-	B	4.60E-02	1.86E-09	5.30E-03	8.61E-07
Dichloropropene, 1,3-	B	9.90E-03	4.00E-10	2.50E-04	4.06E-08
Dieldrin	F	2.50E-05	1.00E-13	6.00E-05	1.50E-14
Diethylphthalate	B	3.00E-02	1.21E-09	3.00E-03	4.88E-07
(b) Ethylbenzene	E	5.00E-03	1.84E-11	2.30E-02	6.06E-09
Freon 11 (CCL3F)	B	5.00E-02	2.02E-09	1.90E-03	3.09E-07
Isophorone	A	7.20E-02	2.73E-06	4.10E-03	1.03E-06
Lindane	E	2.50E-05	9.19E-14	4.00E-05	1.05E-11
Methylene chloride	A	5.80E-01	2.20E-05	1.90E-01	4.75E-05
N-nitrosodi-n-propylamine	A	1.00E-03	3.79E-08	2.00E-03	5.00E-07
N-nitrosodiphenylamine	E	5.20E-03	1.91E-11	2.00E-03	5.27E-10
Pentachlorophenol	E	3.50E-03	1.29E-11	8.00E-03	2.11E-09
Phenol	A	2.00E-02	7.58E-07	7.00E-03	1.75E-06
(b) Tetrachloroethene	D	2.70E-02	1.57E-09	5.60E-02	3.29E-06
Tetrahydrofuran	A	7.60E+00	2.88E-04	2.10E-01	5.25E-05

TABLE 6.1-11 (CONTINUED)

CALCULATION OF EXPOSURE POINT CONCENTRATIONS AT RECEPTOR WELLS 2 AND 5

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Mobility Group	Source Area Concentration (Hawthorne Blvd.) (a)	Maximum Future Conc. at Receptor Well 2	Source Area Concentration (Crenshaw Blvd.) (a)	Maximum Future Conc. at Receptor Well 5
Toluene	D	5.40E-02	3.14E-09	3.10E-01	1.82E-05
Trichlorobenzene, 1,2,4-	E	3.00E-04	1.10E-12	1.50E-03	3.95E-10
Trichloroethane, 1,1,1-	C	2.50E-02	1.80E-08	7.00E-04	5.09E-08
Trichloroethane, 1,1,2-	B	4.00E-03	1.62E-10	7.20E-02	1.17E-05
Ammonia ion	G	1.69E+01	5.56E-04	2.66E+02	1.84E-03
(b) Trichloroethene	C	1.00E-01	7.18E-08	1.10E-01	8.00E-06
(b) Vinyl Chloride	A	6.60E+00	2.50E-04	1.80E-01	4.50E-05
Xylenes	D	2.00E-02	1.16E-09	4.70E-02	2.76E-06
Cyanide ion	G	3.00E-02	9.88E-07	1.00E-02	6.93E-08
(b) Nitrate	G	3.70E+01	1.22E-03	9.09E+01	6.30E-04
Arsenic	G	1.10E+00	3.62E-05	2.13E+00	1.48E-05

(a) Maximum detected concentration during 1986-1994 or 1/2 the reported detection limit if the compound was not detected. The detection limit used was achieved at least once for each well during the monitoring period. Wells used to represent Hawthorne and Crenshaw Boulevard source areas are as indicated on Table 6.1-3.

(b) Representative chemical for class; chemical was modeled and results used to scale other chemicals in the same class.

All values in mg/l.

Specifically, the potential current exposure for off site residents was evaluated based on the Maximum Residential Receptor location, which is the specific off site location where a residence could plausibly be located (i.e., not on site or in the middle of a major highway) which had the highest modeled air concentrations.

Potential worker and recreational visitor exposures were evaluated by considering the Maximum Employment Receptor location, which is the specific on site location where the greatest potential air impacts were predicted.

Air exposure point concentrations were also evaluated for the two off site locations defined to evaluate potential future exposures from ground water use. These receptor locations are:

- Air Receptor 1, used to evaluate residential exposure at the hypothetical future Ground Water Receptor Well 2 location; and
- Air Receptor 3, used to evaluate residential exposure at the hypothetical future Ground Water Receptor Well 5 location.

The four specific receptor locations which were defined for the purpose of the Baseline Risk Assessment are shown on Exhibit 6.1-1.

6.1.2.4.2.1 Estimation of Vapor Concentrations

The vapor emission model predicts potential emissions of VOCs from the landfill, based on a number of assumptions, specifically:

1) some fraction of the landfill gas generated by the landfill contents is not captured by the gas collection system, that is, the gas collection system has a capture rate efficiency of less than 100 percent;

2) the fraction of the landfill gas that is not captured is emitted to ambient air through the landfill cover;

3) the amount of landfill gas that is generated can be predicted from the amount of refuse in place; and

4) VOCs are emitted along with the landfill gas, in proportion to the VOC concentrations in the landfill gas.

Prior to the preparation of the Baseline Risk Assessment, vapor emissions and the resulting air exposure point concentrations at the PVLF and its surroundings had been estimated as part of the AB 2588 HRA. The AB 2588 HRA estimated vapor emissions from the landfill surface using CARB landfill gas emission rate estimation techniques (CARB, 1992). The landfill gas collection system efficiency was assumed to be 95 percent which is conservative since the gas collection system is estimated to be 98 percent efficient. The AB 2588 HRA used two EPA approved dispersion models to calculate exposure point concentrations: 1) The Rough Terrain Dispersion Model (RTDM) was used to model dispersion from stack sources to receptor locations; and, 2) The Industrial Source Complex Short Term (ISCST) Model was used to predict air concentrations at other receptors.

The AB 2588 HRA modeling results were adapted for use in the Baseline Risk Assessment as follows:

- First, a reasonable maximum estimate for long-term landfill gas concentrations was made by calculating the 95 percent upper confidence level (UCL) for landfill gas concentrations measured at Header 2, a collection conduit for gases from extraction wells at the center of the main site. These concentrations were generally higher than those measured in extraction wells at the periphery of the site, and at wells located at the South Coast Botanic Garden, and provided a more conservative estimate of potential emissions from the landfill surface. The 95 percent UCL concentrations for landfill gas were also used to calculate exposure concentrations in the Average case. The average and 95 percent UCL concentrations are very similar for landfill gas because similar concentrations were measured in each of the monthly samples from the gas collection system.

- Second, the UCL concentrations were used to calculate potential emissions from the landfill cover using the method recommended by CARB (1992) and the same assumptions as were used in the AB 2588 HRA. The resulting, more conservative emission estimates, were then used to scale the AB 2588 HRA air exposure point concentrations accordingly. Scaling consisted of proportioning the AB 2588 HRA exposure point concentrations based upon the ratio of the reasonable maximum emission rate to the AB 2588 HRA arithmetic mean emission rate. The effect of considering sources other than the landfill surface in the scaling procedure is minimal since emissions from the landfill surface represented greater than 99 percent of risks due to vapor emissions from all sources at the PVLF which include flares and landfill maintenance vehicles. Table 6.1-12 presents the exposure point concentrations for outdoor air at the most affected off site residential location which is adjacent to the PVLF near Crenshaw Boulevard.

- As discussed in Section 6.1.2.3, residents at the ground water receptor locations were also assumed to be exposed via the Outdoor Air pathways (vapor and dust). Scaling, based on the results of the AB 2588 air modeling calculations, was used to calculate the risks from the Outdoor Air pathways at these receptor locations.

The following sections, describing landfill gas production and transport, the landfill gas control system, and the gas collection system efficiency based on modeling, are condensed from Sections 1.3.4.1.1, 1.3.4.1.2, and 3.1.3.8.3 to present a more detailed description of landfill gas generation and collection at the PVLF. The specific assumptions used to model vapor emissions and transport at the PVLF, and the model results in comparison to site-specific data are then discussed along with a comparison of the CARB model to PVLF data.

Landfill Gas Production And Transport

Landfill gas is produced by naturally occurring anaerobic biological decomposition of the organic fraction of buried refuse. Under ideal conditions, landfill gas is primarily composed of

TABLE 6.1-12

CALCULATION OF EXPOSURE POINT CONCENTRATIONS FOR VAPOR IN OUTDOOR AIR

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

ANALYTE	LANDFILL GAS CONC. (mg/m^3)	EMISSIONS AT 95% GAS COLLECTION EFFICIENCY (kg/yr)	AIR CONCENTRATIONS	
			ON SITE WORKER/ VISITOR	OFF SITE RESIDENT
Benzene	87.6	250.54	1.12E-04	9.25E-05
Carbon Tetrachloride	0.1	0.29	1.28E-07	1.06E-07
Chlorobenzene	34.4	98.50	4.40E-05	3.64E-05
Dichlorobenzene, 1,4-	11.4	32.57	1.46E-05	1.20E-05
Dichloroethane, 1,1-	1.2	3.52	1.58E-06	1.30E-06
Dichloroethane, 1,2-	0.8	2.31	1.03E-06	8.52E-07
Dichloroethene, 1,1-	0.8	2.29	1.02E-06	8.45E-07
Methylene Chloride	1.6	4.69	2.10E-06	1.73E-06
Tetrachloroethene	5.7	16.18	7.24E-06	5.97E-06
Toluene	194.6	556.55	2.49E-04	2.05E-04
Trichloroethane, 1,1,1-	0.1	0.29	1.28E-07	1.06E-07
Trichloroethene	3.5	9.89	4.43E-06	3.65E-06
Vinyl Chloride	8.7	24.94	1.12E-05	9.21E-06
Xylenes	319.4	913.48	4.09E-04	3.37E-04
Acetone	44.4	126.94	5.68E-05	4.69E-05
Bromodichloromethane	0.1	0.29	1.28E-07	1.06E-07
Bromoform	0.1	0.29	1.28E-07	1.06E-07
Bromomethane	0.1	0.29	1.28E-07	1.06E-07
Butanone, 2-	17.1	48.80	2.18E-05	1.80E-05
Carbon Disulfide	0.17	0.49	2.17E-07	1.80E-07
Chloroethane	0.15	0.43	1.92E-07	1.58E-07
Chloroform	0.1	0.29	1.28E-07	1.06E-07
Chloromethane	0.1	0.29	1.28E-07	1.06E-07
Dibromochloromethane	0.1	0.29	1.28E-07	1.06E-07
Dibromoethane, 1,2-	0.1	0.29	1.28E-07	1.06E-07
Dichlorobenzene, 1,2-	8.2	23.45	1.05E-05	8.66E-06
Dichlorobenzene, 1,3-	0.1	0.29	1.28E-07	1.06E-07
Dichloroethene, cis-1,2-	28.9	82.67	3.70E-05	3.05E-05
Dichloroethene, trans-1,2-	1.4	4.00	1.79E-06	1.48E-06
Dichloropropane, 1,2-	0.1	0.29	1.28E-07	1.06E-07
Dichloropropene, cis-1,3-	0.1	0.29	1.28E-07	1.06E-07
Dichloropropene, trans-1,3-	0.1	0.29	1.28E-07	1.06E-07
Ethylbenzene	226.1	646.71	2.89E-04	2.39E-04
Hexanone, 2-	0.2	0.57	2.56E-07	2.11E-07
Methane	2.16E+06	6.18E+06	2.76E+00	2.28E+00
Methyl tert-butyl Ether	0.1	0.29	1.28E-07	1.06E-07
Pentanone, 4-Methyl-2-	14	40.04	1.79E-05	1.48E-05
Styrene	12.4	35.40	1.58E-05	1.31E-05
Tetrachloroethane, 1,1,2,2-	0.1	0.29	1.28E-07	1.06E-07
Trichloroethane, 1,1,2-	0.1	0.29	1.28E-07	1.06E-07
Trichlorofluoromethane	0.1	0.29	1.28E-07	1.06E-07
Trichlorotrifluoroethane	0.1	0.29	1.28E-07	1.06E-07
Vinyl Acetate	0.2	0.57	2.56E-07	2.11E-07

nearly equal amounts of carbon dioxide and methane with traces of other decomposition by-products, such as volatile organic compounds. The rate of gas generation is affected by many factors such as refuse moisture content, nutrient availability, refuse compaction, temperature, and pH. It has been observed from the Sanitation Districts' landfills that the landfill gas generation rate is usually at a maximum soon after refuse placement and then decreases over time. Low levels of gas production may continue for long periods of time. This pattern of gas generation can be described by a first order decay mathematical model.

Landfill gas transport usually occurs by two major mechanisms, advection and diffusion. Advection is the bulk gas flow resulting from the total pressure difference in the landfill. Gas advection is generally described by Darcy's Law (Bird, et. al., 1960), i.e., gas flow is proportional to the gas permeability of the refuse and the total pressure gradient. The following equation identifies the mathematical relationship for Darcy's Law.

$$V_x = -\frac{k}{\mu}\frac{\partial P}{\partial x}$$

where:

V_x	=	gas velocity in the x direction;
μ	=	landfill gas viscosity;
k	=	landfill gas permeability in refuse; and
P	=	pressure in the refuse.

Theoretically, gas permeability is a function of such refuse properties as effective porosity, material size distribution, and moisture content. It is expected that the gas permeability of refuse decreases with increasing refuse moisture content and decreasing effective porosity. No standard method exists to measure in place refuse permeability. The Sanitation Districts made final cover hydraulic permeability measurements for the PVLF in 1986. A variety of infiltrometer designs were used to measure permeability including pond, standard single- and double-ring, and covered single- and double-ring. The range of permeability values found was 1.97×10^{-6} to 77×10^{-6} cm/s, or 5.46×10^{-2} to 21.84×10^{-2} ft/day. In terms of intrinsic permeability, which can be used for gas flow calculations, this is equivalent to a range of 2.01×10^{-11} to 79.3×10^{-11} cm^2 (2.04×10^{-3} to 80.4×10^{-3} Darcy).

The process when a gas spreads to occupy any volume accessible to it is called diffusion. Diffusion occurs as a result of concentration (or partial pressure) gradients of a gas species. Fick's First Law commonly describes diffusion, i.e., the diffusion rate is proportional to the gas diffusivity and the concentration gradient.

The total pressure gradient in a landfill is the result of either gas generation from waste decomposition or vacuum applied for gas extraction. Vacuum applied to a gas collection well creates a negative pressure area which results in a gradient towards the well. A zone of vacuum influence can be defined to describe the effectiveness of a gas collection well.

Landfill Gas Control System

If not properly controlled, landfill gas can migrate through the subsurface and/or escape into the atmosphere by advection and diffusion. The principal movement of landfill gas can be expected along the path of least resistance, typically vertically through the landfill's top surface. Lateral or horizontal migration can also occur through the front slopes of the site as well as through soils adjacent to the site. Gas movement away from the landfill is usually referred to as migration, whereas gas escaping into the atmosphere through the landfill cover is defined as surface emissions. The primary constituents of landfill gas which are of concern are methane and VOCs. Methane migrating through soils into adjacent structures can result in safety hazards. The VOCs in the migrating landfill gas can potentially cause degradation of ground water quality when the gas comes in contact with an aquifer. The same organic compounds can also be emitted through the landfill surface to degrade ambient air quality. The migration or emission of VOCs can result in health hazards.

Gas collection from a landfill depends on refuse characteristics, gas system design, and gas system operation efficiency. Gas permeability of refuse, spacing and depth of gas wells, and vacuum level used to withdraw gas are all important parameters that impact gas collection efficiency. In general, landfill gas collection efficiency increases with applied vacuum level. However, air intrusion into the gas system occurs if the vacuum becomes excessive. In practice, it is difficult to achieve a high gas collection efficiency without causing air intrusion. Air intrusion into the gas system dilutes the landfill gas and results in methane and carbon dioxide contents less than their theoretical levels.

At the PVLF, an active gas collection and control system is present on the main site and the South Coast Botanic Garden. Ernie Howlett Park received mostly inert solid waste material during its operation. Inert solid waste generates limited quantities of landfill gas because it contains little organic material. Field measurements of surface gas emissions were taken at Ernie Howlett Park during the design of the gas collection systems for the main site and the South Coast Botanic Garden and the methane levels were found to be very low in comparison to the other parcels of the PVLF. Consequently, it was determined that a passive rock trench installed along the western boundary would satisfy gas control needs at Ernie Howlett Park.

At present the PVLF produces approximately 7,000 to 9,000 cubic feet per minute (cfm) of landfill gas containing approximately 19 to 20 percent methane. To collect and control landfill gas, a gas collection system consisting of vertical gas collection wells and horizontal gas trenches has been installed throughout the landfill. These wells and trenches are connected to blowers through a network of headerlines, and a vacuum is applied to create a pressure gradient around each well or trench. The gas is drawn from the refuse into the collection system thereby substantially reducing subsurface migration and air emissions. The existing gas collection system at the PVLF currently consists of 458 gas wells, approximately 2,300 feet of gas trenches, a gas-to-energy facility, and two flare stations. The layout of the gas wells and trenches is shown on Exhibit 1.3-5. The locations of the gas-to-energy facility and the flare stations are shown on Exhibit 1.3-6. The installation of the gas control system began in the early 1970's and has occurred in phases over the years.

The effectiveness of the gas collection system can be measured using integrated surface gas monitoring. This is a method developed by the Sanitation Districts in 1981 at the Puente Hills Landfill. It was later modified by the SCAQMD for use in their Rule 1150.1 gas monitoring and control program. System efficiency is most clearly measured with integrated surface monitoring at a site with no prior gas extraction. The efficiency is calculated as the ratio between the drop in gas levels and the amount of gas observed above background prior to system startup.

By the time integrated surface gas monitoring was developed, the PVLF already had an extensive gas control system and the surface gas levels before gas extraction could not be directly measured. However, the Puente Hills site in 1981 was of comparable size and depth as the PVLF. Its surface gas level prior to gas extraction, 107.7 ppm, can be used as a surrogate for PVLF

calculations. The average surface gas level at the PVLF measured from September 1990 through August 1991 was 8.1 ppm. The average ambient air reading for the same time period was 6.8 ppm. The formula for calculating gas collection efficiency is:

$$E = \frac{(SGb - SGa)}{(SGb - A)} * 100$$

where:

E	=	gas collection efficiency, percent
SGb	=	surface gas levels before gas extraction, ppm
SGa	=	surface gas levels after gas extraction, ppm
A	=	ambient air gas level, ppm

Substituting in the values given above yields an apparent gas collection efficiency on the order of 98.7 percent. These results indicate excellent gas control at the PVLF.

Of the 458 gas wells at the PVLF, 217 are peripheral wells, located at the boundary of the main site and the South Coast Botanic Garden. They have been installed for gas migration control. The remaining 241 wells, located on the top deck and slopes of the main site and in the South Coast Botanic Garden have been installed for gas recovery. The depth of these gas collection wells ranges from 25 to 150 feet.

Gas control trenches are located on the northeast boundary of the main site (660 feet), the southeast boundary of the South Coast Botanic Garden (820 feet), the southwest boundary of the South Coast Botanic Garden (250 feet) and the west boundary of Ernie Howlett Park (600 feet). Trenches under vacuum are referred to as active trenches and those not under vacuum are called passive trenches. The Ernie Howlett Park trench is a passive trench, whereas the remaining are active.

As discussed in the previous section, the primary constituents of landfill gas which are of concern are methane and VOCs. A gas-to-energy facility has been in operation at the PVLF since 1988 which produces electricity through a steam turbine system. The generated electricity is sold to Southern California Edison for use in the local power grid network. Two landfill gas flare stations serve as backup disposal facilities for the collected landfill gas when the gas-to-energy facility is being maintained.

Gas Collection System Efficiency

The objective of a landfill gas control system is to minimize the release of gas through either lateral soil migration at the fill perimeter or vertical venting of the fill cover soil to the air. Migration and venting are caused by the buildup of gas due to the natural decomposition of the wastes. A gas control system is designed to remove this buildup by placing the refuse fill under a vacuum and collecting the gas. The Sanitation Districts pioneered landfill gas collection systems twenty years ago and have developed experience-based design practices providing for their reliable and flexible operation.

The efficiency of the gas collection system at the main site was evaluated with a computer model that accounted for refuse gas generation, refuse and soil cover permeabilities and depths, refuse density, the area covered by a well, and the vacuum level in the gas collection system (this derivation is shown in Section 3.1.3.8.3). The methane generation potential was estimated from EPA waste stream surveys to be 2.0 ft^3/lb.[1] The first order landfill gas generation rate constant value was the median value typically used in gas projections for Sanitation Districts' landfills, 0.0198 yr^{-1}. A refuse permeability of 2×10^{-3} cm/s was assumed, as this was the empirically determined value which most closely corresponded with observed conditions at the main site. The cover permeability was assumed to be 2×10^{-6} cm/s, the typical value determined in a cover permeability study performed at PVLF in 1986. The refuse density was assumed to be 1,000 kg/m^3, as this was the average of the ultimate refuse density determined by Sanitation Districts' refuse research[2] and the baseline refuse density listed in the EPA's NSPS regulations.[3]

Computer modeling was done for the performance of a typical well. For the modeling, the radius of the landfill R_{max} is the circular area covered by a well. The main site has an area of 173 acres, with 219 refuse wells. The average well, then, covers an area of 34,410 ft^2, and the radius of

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[1] Characterization of Municipal Solid Waste in the United States: 1990 Update, U.S. EPA, June 1990, pp. 34-47.

[2] Huitric, R., Landfill Disposal Demonstration Project - Phase I, Los Angeles County Sanitation Districts, May 1978.

[3] Federal Register, "Standards of Performance for New Stationary Sources and Guidelines for Control of Existing Sources: Municipal Solid Waste Landfills", May 30, 1991, pp. 24468-24528.

an equivalent area R_{max} is approximately 100 feet. The value for the landfill depth Z_{max} is the average for the main site, calculated to be approximately 100 feet. The well vacuum was assumed to be thirteen inches of water, the average vacuum for all refuse wells monitored at PVLF in November 1994.

The computer modeling shows that, under normal operating conditions, 100 percent of the generated gas would be collected. If a refuse permeability of half the calibrated value were used, the model shows that, at the same vacuum, the gas system would collect at 96 percent efficiency.

Comparison of the Vapor Emission and Air Transport Models to PVLF Data

This section discusses specific assumptions and results of the vapor emission and transport models in comparison to site-specific data.

Model Assumptions. The CARB model used to calculate potential landfill gas emissions is based on the following assumptions:

1) the total potential generation capacity of the refuse is 170 m^3 of landfill gas (made up of approximately 50 percent carbon dioxide and 50 percent methane) per ton of refuse in place;

2) over 70 years, all of the gas produced in the landfill escapes to the atmosphere or is collected by the landfill gas collection system; and

3) VOCs are emitted along with the landfill gas. Therefore, the emission rate for any VOC (mg/year) is equal to its concentration in the landfill gas (mg/m^3) multiplied by the volume of landfill gas emitted per year (m^3/year).

The EPA-approved ISCST model was used to calculate ambient air concentrations at receptor locations, based on VOC emissions from the landfill surface. The modeling approach employed is described in the following sections excerpted from the AB 2588 HRA Report.

Source Modeling Parameters - The landfill surface was modeled as an area source, and was subdivided into 125 sub-areas as shown in Exhibit 6.1-2. Only the areas which have received refuse were considered (i.e., areas of native soil were not included as an area source of landfill gas surface emissions). The only requirement governing the geometry of the sub-areas was that they are squares with north-south and east-west boundaries. The southwest coordinate of each square was input into the model to locate the sources. The elevation at the approximate centroid of each sub-area was used as the base elevation input for each source. The total landfilled area of 886,719 m^2 was divided into sub-areas varying in size from 62.5m x 62.5m to 250m x 250m. The emission rates ($g/sec/m^2$) of individual VOCs were calculated by dividing the total emissions of the VOC in landfill gas (g/sec) by the total area of landfilled trash (m^2).

Meteorological Data - Based on SCAQMD recommendations, one year of data (1981) from the Long Beach monitoring station was used in the modeling study to best represent conditions in the PVLF area. The data were obtained from SCAQMD modeling staff.

Receptor Grid - A rectangular coordinate grid was constructed to estimate the off site ground level concentrations resulting from the emissions of the landfill sources. This type of grid is consistent with the grids constructed for other Sanitation Districts' landfill modeling studies that were previously accepted and approved by SCAQMD. The receptor grid is presented in Figure 6.1-2. The receptor coordinates and elevations were obtained from 7.5 minute USGS topographic maps with Universal Transverse Mercator (UTM) coordinates. The grid contains 345 receptor points designated by dots on the grid. The receptor spacing varies from 125 m to 1 km intervals. The more closely spaced receptors were placed in sensitive, nearby residential areas to ensure that a potential maximum concentration was not overlooked. The South Coast Botanic Garden, the portion of the landfill property south of Crenshaw Boulevard, were modeled as a source of landfill surface gas emissions, but were also considered as a receptor area; this portion of the property is open to the public. Calculation of ground-level concentrations at receptors on this area was included in this study.

CARB Emissions Model vs. Actual Gas Generation Rate. There is a permitted total of 23.6 million tons of refuse in place at the PVLF that could generate gas. Therefore, using the CARB methodology, the estimated 70-year average annual gas generation rate for the PVLF is approximately 5.73×10^7 m^3/year.

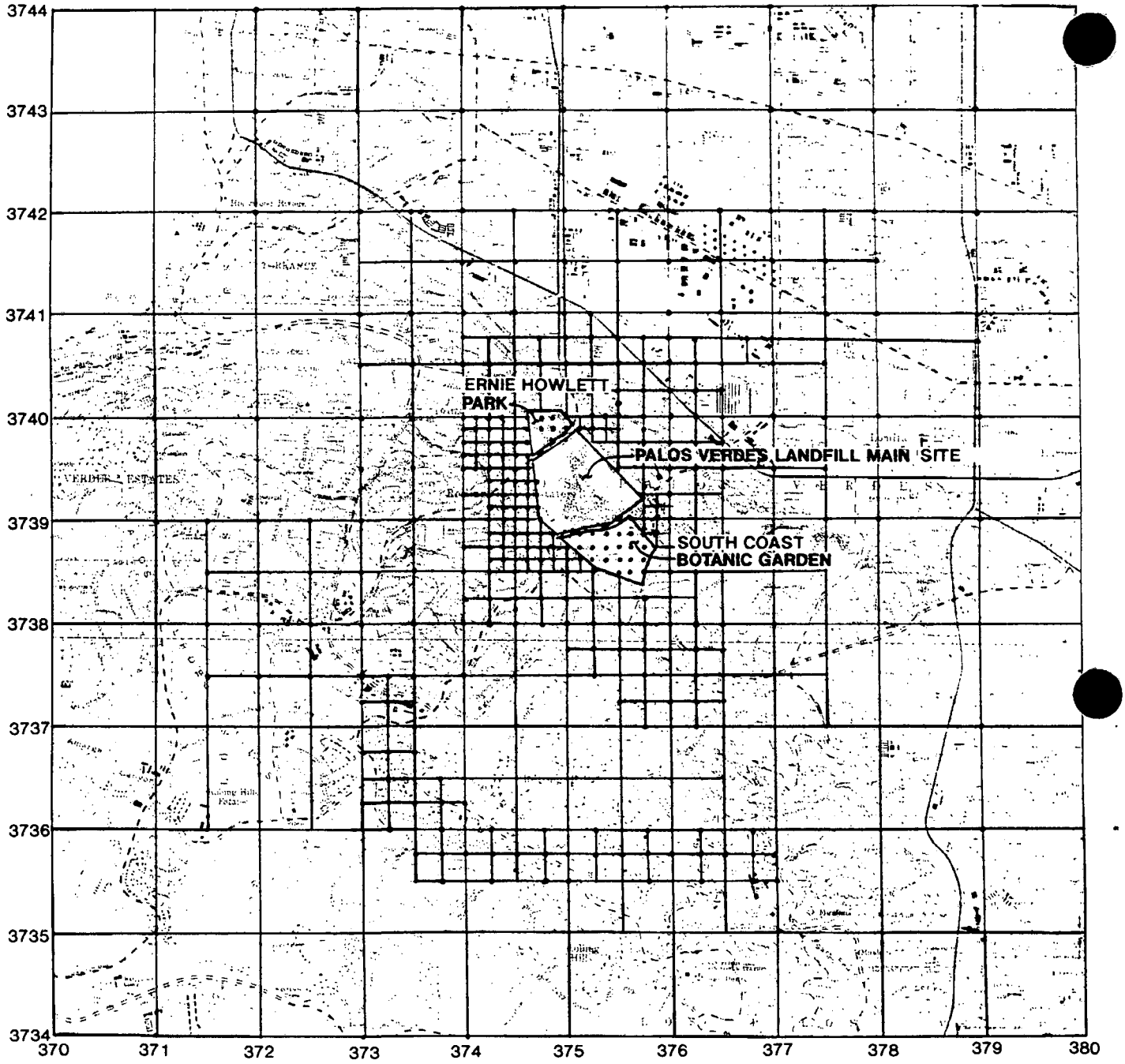

FIGURE 6.1-2

AIR DISPERSION MODELING RECEPTOR GRID

For comparison to the CARB estimate, at present the PVLF gas collection system collects approximately 7,000 cubic feet per minute (equivalent to 1.04×10^8 m^3/yr) of landfill gas containing nineteen to twenty percent methane. This includes the gas collected from Header 1 which serves the peripheral gas migration control wells, and the gas collected from Header 2 which serves the central gas extraction well system. Measured methane concentrations are approximately six percent in Header 1 and 32 percent in Header 2. The landfill gas collection system maintains a vacuum to prevent surface emissions or subsurface migration of landfill gas. The lower methane content in Header 1 results from the collection of outside air which is drawn into the landfill gas collection system by the vacuum.

Based on the data presented above, the volume of gas collected from Header 2 is approximately 5.6×10^7 m^3/yr. The volume of gas collected from Header 2 is calculated from the two relationships:

$0.06H_1 + 0.32H_2 = 0.20 * (1.04 \times 10^8 m^3)$; and

$H_1 + H_2 = 1.04 \times 10^8 m^3$.

where,

H_1 = the volume of gas collected from Header 1, and

H_2 = the volume of gas collected from Header 2.

The calculated value for the volume of landfill gas currently collected from Header 2, 5.6×10^7 m^3/yr, is very similar to the CARB estimate of the 70-year average annual gas generation rate for the PVLF of approximately 5.73×10^7 m^3/year.

As previously noted, the 95 percent UCL for landfill gas concentrations measured at Header 2 was used as a reasonable maximum estimate for long-term landfill gas concentrations. Therefore the current 95 percent UCL VOC concentrations in Header 2 are multiplied by the CARB estimate of the long-term average gas generation rate in order to estimate the long-term average VOC emissions from the landfill. Since the current gas volume collected from Header 2 is very close to the CARB long-term estimate, the current gas generation rate at the PVLF appears to be well represented by the CARB model. However, no wastes have been placed in the PVLF since 1980,

and future gas generation rates are expected to decline. Therefore the CARB model is expected to overestimate future gas generation at the PVLF.

Vapor Emission Model Assumption vs. Estimated Landfill Gas Collection System Efficiency. As previously discussed, the landfill gas collection efficiency at the PVLF is estimated at greater than 98 percent, based on measured gas collection at the Puente Hills landfill, and model calculations. However, for the purpose of this risk assessment, gas collection efficiencies ranging from 75 to 95 percent were considered.

A gas collection efficiency of 95 percent corresponds to a landfill gas emission rate equal to five percent of the total volume of gas generated annually. Similarly, a gas collection efficiency of 75 percent corresponds to a landfill gas emission rate equal to 25 percent of the total volume of landfill gas generated annually. VOCs are assumed to be emitted from the landfill along with the landfill gas in proportion to the concentrations of the VOCs in the landfill gas. Therefore, the mass of VOCs emitted from the landfill is assumed to be five times higher at an assumed gas collection efficiency of 75 percent than at the 95 percent gas collection efficiency level. Similarly, the mass of VOCs emitted is approximately 1.7 times higher assuming 95 percent gas collection efficiency than at the 98 percent gas collection efficiency level.

Comparison of Model Receptor Concentrations to Ambient Air Data. Model concentrations at the Maximum Employment Receptor are shown in comparison to measured air data on Table 6.1-13. The measured air concentrations include ambient air monitoring data from air monitoring stations located both upwind and downwind of the PVLF, and data compiled by the South Coast Air Quality Management District for ambient air quality in the Los Angeles Basin and at the Hawthorne air station. For comparison, model predictions assuming gas collection efficiencies of 75 percent and 95 percent are shown.

Comparison of the data shown on Table 6.1-13 indicates that the predicted maximum air concentrations of benzene originating from the PVLF are less than one-tenth of measured background values. The predicted maximum vinyl chloride concentrations are less than analytical detection limits. These model predictions are consistent with the results of the ambient air monitoring, which indicate no measurable difference between upwind and downwind locations. In particular, the

TABLE 6.1-13

MODELED LANDFILL GAS EMISSIONS AND MONITORING DATA FOR CHEMICALS IN AMBIENT AIR

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

COMPOUND	MAXIMUM MODELED AIR CONCENTRATION AT 95% GAS COLLECTION EFFICIENCY	MAXIMUM MODELED AIR CONCENTRATION AT 75% GAS COLLECTION EFFICIENCY	1994 AMBIENT AIR SAMPLING AT PVLF	SCAQMD AMBIENT AIR MONITORING DATA	
				LOS ANGELES BASIN	HAWTHORNE AIR STATION
Chloroform	0.0000	0.0001	<0.41	<0.4 - 0.86	<0.4
Trichloroethane, 1,1,1-	0.0000	0.0001	<0.37 - 0.83	0.94 - 12.6	0.81 - 4.61
Carbon Tetrachloride	0.0000	0.0001	<0.32	0.1 - 0.17	0.1 - 0.16
Trichloroethene	0.0008	0.0041	<0.38	<0.1 - 2.3	<0.1 - 0.64
Tetrachloroethene	0.0011	0.0053	<0.3	0.6 - 2.4	0.06 - 0.93
Vinyl Chloride	0.0044	0.0218	<0.79	<0.2	<0.2
Dichloroethane, 1,2-	0.0003	0.0013	<0.5	<15	<15
Benzene	0.0351	0.1755	<0.63 - 3.1	<1.0 - 10.2	<1.0 - 5.5
Toluene	0.0661	0.3306	0.6 - 5.5	<1.0 - 10.8	<1.0 - 9.4
Xylenes	0.0941	0.4707	<0.46 - 2.58	<1 - 16.5	<1.0 - 8.1

Notes:

1) "<" indicates compound was not detected (below the stated detection limit).

2) All concentrations are in parts per billion (ppb).

3) Model values are predicted concentrations at the Maximum Employment Receptor located on the landfill, and used to calculate potential worker and visitor exposures.

4) PVLF data are from Additional Ambient Air Sampling Program (June-July 1994) for both upwind and downwind sampling locations.

5) Los Angeles basin and Hawthorne air station data are from "Analysis of Ambient Air Toxics, January 1993 to June 1994, South Coast Air Quality Management District.

highest predicted benzene contribution from the landfill (assuming 75 percent gas collection efficiency) is approximately five percent of the background benzene concentration in ambient air. This contribution is too small to be statistically distinguishable from background, given the observed variation over time in background benzene concentrations.

For the purpose of this risk assessment, potential air impacts from the PVLF were calculated for gas collection efficiencies of both 75 percent and 95 percent to show the range of possible vapor concentrations and risks originating from the PVLF.

6.1.2.4.2.2 Estimates of Particulate Concentrations

Outdoor air particulate concentrations of PAHs resulting from windblown dust and vehicular disturbances were estimated through the use of two conservative screening level models presented by the EPA. The details of these procedures and the estimated screening level exposure point concentrations are presented in Appendix D.9.

The 95 percent upper confidence limit for PAH concentrations in surface soil in the area of the third bench access road was calculated based on the six samples tested from this area during the RI. The PAH concentrations measured by EPA Method 8270 were used, because these results were consistently higher for the carcinogenic PAHs than were the concentrations detected using EPA Method 8310 for the same samples. PAH impacted soil was assumed to be present within 1/16th of the main site area (approximately 200 x 200 m^2). The area of the source term for modeling PAHs was defined based upon this consideration. The emissions modeling (see Appendix D.9) indicated that the main potential source of airborne particulates is vehicular traffic upon the unpaved roads of the main site area. The screening calculations indicated that particulate emissions due to wind erosion throughout the whole landfill were relatively insignificant.

Emissions rates for the site were converted into exposure point concentrations via screening level dispersion models presented by the EPA. These concentrations were utilized to calculate both the on site worker and recreational visitor exposures and the most impacted downwind residential exposure. As previously noted, scaling based on the results of the AB 2588 air modeling

calculations was used to calculate the risks from Outdoor Air pathways at the ground water receptor locations.

6.1.2.5 Quantification of Chemical Intakes

This section describes the methods for calculating potential chemical intakes for the populations and exposure pathways identified for quantitative evaluation. The intakes calculated in this section are expressed as the amount of chemical at the exchange boundary (*i.e.*, skin, lungs, or gut) and available for absorption into the body. Chemical intakes were estimated for residents (adults and children), workers, and for recreational visitors (adults and children) to the PVLF under current and future land use scenarios. Calculations and input parameters used for estimating intake rates through ingestion, inhalation, and dermal contact with soils and ground water were obtained from EPA (EPA, 1989a; 1990a; 1991a). The input parameters and exposure assumptions used to estimate the intake rates for the exposure scenarios are summarized in Table 6.1-14. The calculated intake rates are combined with toxicity criteria values (Reference Doses and Slope Factors for noncarcinogens and carcinogens, respectively, discussed in Section 6.1.3) in order to quantify potential health risks (Section 6.1.4).

The calculations used to estimate exposure or intake from contact with chemicals in soils or ground water have the same general components: 1) a variable representing chemical concentration; 2) variables describing the characteristics of the exposed population; and 3) an assessment-determined variable that defines the time frame over which exposure occurs. The general mathematical relationship between these variables and chemical intake in humans is given by the equation:

$$I = \frac{(C)\ (CR)\ (EF)\ (ED)}{(AT)\ (BW)} \qquad (3)$$

where,

I = Intake (mg/kg/day)

C = Average concentration in the contaminated medium contacted over the exposure period (either mg/kg, mg/L or mg/m^3)

TABLE 6.1-14

SUMMARY OF EXPOSURE ASSUMPTIONS AND PARAMETERS

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Parameter	RME Exposure	Average Exposure
GENERAL PARAMETERS		
Exposure Frequency (EF)		
Worker	250 days/year	250 days/year
Resident	350 days/year	350 days/year
Recreational Visitor (Current)	104 days/year	52 days/year
Recreational Visitor (Future)	155 days/year	52 days/year
Exposure Duration (ED)		
Worker	25 years	10 years
Child Resident/Recreational Visitor	6 years	6 years
Adult Resident/Recreational Visitor	24 years	9 years
Body Weight (BW)		
Child	15 kg	15 kg
Adult	70 kg	70 kg
Averaging Time (AT)		
Carcinogenic	70 years	70 years
Noncarcinogenic	variable--see ED	variable--see ED
SOIL DERMAL CONTACT		
Soil-to-Skin Adherence Factor (AF)	0.2 $mg/cm^2/day$	0.2 $mg/cm^2/day$
Fraction from Contaminated Source (FC)		
Worker	0.0625	0.0625
Recreational Visitor	0.0625	0.0625
Surface Area of Exposed Skin (SA)		
Worker	5,800 cm^2	5,000 cm^2
Child Recreational Visitor	3,160 cm^2	2,000 cm^2
Adult Recreational Visitor	5,800 cm^2	5,000 cm^2 (note: can vary with amount of clothing worn in a specific area/situation)
Absorption Factor (ABS)		
PAHs	0.15 (DTSC-recommended default value)	0.15 (DTSC-recommended default value)

Most RME parameters reflect either EPA or DTSC-recommended upper-bound default values. Average case parameters reflect either 50th percentile values or average exposure-related values based on site-specific conditions at the PVLF.

RME - Reasonable Maximum Exposure

TABLE 6.1-14 (CONTINUED)

SUMMARY OF EXPOSURE ASSUMPTIONS AND PARAMETERS

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

SOIL INGESTION		
Fraction from Contaminated Source (FC)		
Worker	0.0625	0.0625
Recreational Visitor	0.0625	0.0625
Ingestion Rate (IRs)		
Worker	50 mg/day	50 mg/day
Child Recreational Visitor	200 mg/day	100 mg/day
Adult Recreational Visitor	100 mg/day	40 mg/day
PARTICULATE INHALATION		
Exposure Time (ET)		
Worker	0.5 hours/day	
Resident	24 hours/day	
Recreational Visitor	0.5 hours/day	0.5 hours/day 16 hours/day 0.5 hours/day
Inhalation Rate (IR)		
Worker	2.5 m3/hr	2.5 m3/hr
Resident	0.83 m3/hr	0.83 m3/hr
Recreational Visitor	2.5 m3/hr	2.5 m3/hr
Particulate Deposition to Lung (Pd)	1	0.5
Exposure Time (ET)		
Worker	8 hours/day	8 hours/day
Resident	24 hours/day	16 hours/day
Recreational Visitor	2 hours/day	1 hour/day
GROUNDWATER INGESTION		
Ingestion Rate (IRw)		
Child Resident	1 L/day	1 L/day
Adult Resident	2 L/day	1.4 L/day
GROUNDWATER DERMAL CONTACT		
Skin Surface Area (whole body) (SA)		
Child Resident	7,280 cm^2	7,280 cm^2
Adult Resident	19,400 cm^2	19,400 cm^2
Exposure Time (ET)		
Resident	0.25 hours/day	0.25 hours/day

Most RME parameters reflect either EPA or DTSC-recommended upper-bound default values. Average case parameters reflect either 50th percentile values or average exposure-related values based on site-specific conditions at the PVLF.

RME - Reasonable Maximum Exposure

TABLE 6.1-14 (CONTINUED)
SUMMARY OF EXPOSURE ASSUMPTIONS AND PARAMETERS
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

VAPOR INHALATION		
Inhalation Rate (IR)		
Worker	2.5 m^3/hour	2.5 m^3/hour
Resident	0.83 m^3/hour	0.83 m^3/hour
Recreational Visitor	2.5 m^3/hour	2.5 m^3/hour
Exposure Time (ET)		
Worker	8 hours/day	8 hours/day
Resident	24 hours/day	16 hours/day
Recreational Visitor	2 hours/day	1 hour/day

Most RME parameters reflect either EPA or DTSC-recommended upper-bound default values. Average case parameters reflect either 50th percentile values or average exposure-related values based on site-specific conditions at the PVLF.

RME - Reasonable Maximum Exposure

CR	=	Contact rate; the quantity of contaminated medium contacted per unit time (*e.g.*, mg/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
AT	=	Averaging time; period over which exposure is averaged (days)
BW	=	Body weight (kg)

Intake is calculated in the equations shown below as either the Average Daily Dose (ADD) for non-carcinogenic health effects, or the Lifetime Average Daily Dose (LADD) for carcinogenic effects. The differences in the methods used in calculating these values is based on the difference in the averaging time (*AT*) selected. When evaluating non-carcinogenic effects, intake (ADD) is calculated by averaging intake over the exposure duration (*ED*). For carcinogens, intake (LADD) is calculated by pro-rating the average daily dose over a lifetime (assumed to be 70 years by EPA/DTSC). Current scientific opinion holds that the mechanisms of action between carcinogenic and non-carcinogenic chemicals differ. For carcinogens, it is assumed that a high dose received over a short period of time is equivalent to a low dose spread over a lifetime (EPA, 1989a). Non-carcinogenic effects are expected to occur only after some threshold has been exceeded during the period of exposure. Therefore, the *AT* used to calculate the ADD is computed as *ED* times 365 days/year. The *AT* used to calculate the LADD is computed as 70 years times 365 days/year (the EPA/DTSC-recommended default value). The other exposure parameters are presented in Table 6.1-14, and are discussed in the following subsections. The results of the ADD and LADD calculations are presented and discussed in Section 6.1.4.

In addition to the pathway-specific parameters which are discussed in the following sections, several general considerations were used to derive intake estimates for inhalation, dermal contact, and ingestion of PAHs in surface soil. Since only a small area of the surface soils at the PVLF were shown to be contaminated by PAHs, and the extent of suspected contamination is limited to other portions of the gravel-covered maintenance access roads, the limited potential for exposure with this portion of the entire PVLF was accounted for by adjusting the hours spent per day and the fraction of ingested/contacted soil from the contaminated portion per day in the following manner:

Workers:

RME and Average Case:

Total time spent at PVLF = 8 hours/day

Time spent in (or downwind of) PAH-contaminated area = 8/16 = 0.5 hours/day

Fraction of ingested/contacted soil at PVLF = 1.0

Fraction from PAH-contaminated area = 1/16 = 0.0625

Recreational Visitors:

RME and Average Case:

Total time spent at PVLF = 2 hours/day

Time spent in (or downwind of) PAH-contaminated area = 0.5 hours/day

Fraction of ingested/contacted soil at PVLF = 1.0

Fraction from PAH-contaminated area = 1/16 = 0.0625

In accordance with DTSC guidelines, the cancer risks for each individual carcinogenic PAH were estimated using the Toxicity Equivalency Factor (TEF) approach recommended by EPA Regions III, IV, V and VIII. This TEF method is currently recommended by DTSC and assumes that most of the individual carcinogenic PAHs are only one-tenth as potent as benzo(a)pyrene with chrysene being only one hundredth as potent as benzo(a)pyrene.

Ingestion of Ground Water

Chemical intakes due to ingestion of ground water in a residential setting were calculated with the following equation:

$$Intake(mg/kg\text{-}day) = \frac{CW \times IR \times EF \times ED}{AT \times BW}$$

where,

CW = Concentration of constituent in ground water (mg/L)

IR = Ingestion rate (L/day)

EF = Exposure frequency (days/year)

ED = Exposure duration (years)

AT = Averaging time, or the period over which exposure is averaged (days)

BW = Body weight (kg)

Variable values:

CW: Chemical concentrations based upon transport modeling

IR: RME or Average values as shown in Table 6.1-14

EF: 350 days/year for residents or as shown in Table 6.1-14

ED: RME or Average values as shown in Table 6.1-14
6 years for child resident between the ages of 0 and 6 years

AT: For non-carcinogenic effects, AT = ED × 365 days/year; For carcinogenic effects, AT = 70 years × 365 days/year, average life-span)

BW: 70 kg for adult residents (average)
15 kg for a child aged 0-6 years (average)

Ground water exposures for two locations, Receptor Well 2 and Receptor Well 5, were selected as discussed in Section 6.1.2.4.1. Since ground water sources currently in use are not impacted by the PVLF, intake values were calculated only for the future scenario. These intakes are tabulated on Tables 6.1-15 through 6.1-22 for the RME and Average exposure cases.

Dermal Contact with Ground Water

Chemical intakes from dermal contact with ground water while showering were calculated as follows:

$$Absorbed\ Dose(mg/kg\text{-}day) = \frac{CW \times SA \times PC \times ET \times EF \times ED \times CF}{AT \times BW}$$

where,

CW = Chemical concentration in water (mg/L)

TABLE 6.1-15

GROUND WATER PATHWAY INTAKES FOR THE ADULT RESIDENT USING RECEPTOR WELL 2 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day)					
		Adult ADI			Adult LADI		
		Oral	Inhalation (Shower)	Dermal	Oral	Inhalation (Shower)	Dermal
Acetone	4.55E-05	1.25E-06	1.25E-06	1.72E-09	6.76E-07	6.76E-07	8.49E-10
Benzene	2.10E-08	5.76E-10	5.76E-10	2.93E-11	3.12E-10	3.12E-10	1.45E-11
Bis-(2-chloroethyl)ether	1.89E-08	5.19E-10	5.19E-10	2.64E-12	2.82E-10	2.82E-10	1.30E-12
Bromodichloromethane	6.75E-09	1.85E-10	1.85E-10	2.60E-12	1.00E-10	1.00E-10	1.28E-12
Bromoform	1.22E-10	3.35E-12	3.35E-12	2.11E-14	1.82E-12	1.82E-12	1.04E-14
Bromomethane	7.95E-08	2.18E-09	2.18E-09	1.85E-11	1.18E-09	1.18E-09	9.12E-12
Butanone, 2-	1.89E-05	5.19E-07	5.19E-07	1.38E-09	2.82E-07	2.82E-07	6.82E-10
Carbon tetrachloride	2.91E-11	7.96E-13	7.96E-13	4.25E-14	4.32E-13	4.32E-13	2.09E-14
Chlordane	2.00E-13	5.48E-15	5.48E-15	6.91E-16	2.97E-15	2.97E-15	3.41E-16
Chlorobenzene	8.14E-08	2.23E-09	2.23E-09	2.22E-10	1.21E-09	1.21E-09	1.09E-10
Chloroethane	6.82E-08	1.87E-09	1.87E-09	3.62E-11	1.01E-09	1.01E-09	1.79E-11
Chloroform	7.20E-07	1.97E-08	1.97E-08	4.26E-10	1.07E-08	1.07E-08	2.10E-10
Chloromethane	5.68E-06	1.56E-07	1.56E-07	1.59E-09	8.45E-08	8.45E-08	7.82E-10
Chlorophenol, 2-	4.92E-07	1.35E-08	1.35E-08	3.60E-10	7.32E-09	7.32E-09	1.77E-10
DDD	1.20E-13	3.29E-15	3.29E-15	2.23E-15	1.78E-15	1.78E-15	1.10E-15
DDE	8.00E-14	2.19E-15	2.19E-15	1.28E-15	1.19E-15	1.19E-15	6.29E-16
DDT	4.40E-13	1.21E-14	1.21E-14	1.26E-14	6.54E-15	6.54E-15	6.20E-15
Di-n-butylphthalate	8.40E-11	2.30E-12	2.30E-12	1.84E-13	1.25E-12	1.25E-12	9.08E-14
Dibromochloromethane	7.90E-09	2.16E-10	2.16E-10	1.63E-12	1.17E-10	1.17E-10	8.02E-13
Dichlorobenzene, 1,2-	1.62E-11	4.43E-13	4.43E-13	6.55E-14	2.40E-13	2.40E-13	3.23E-14
Dichlorobenzene, 1,4-	1.40E-10	3.83E-12	3.83E-12	5.75E-13	2.08E-12	2.08E-12	2.84E-13
Dichloroethane, 1,1-	9.29E-09	2.55E-10	2.55E-10	5.49E-12	1.38E-10	1.38E-10	2.71E-12
Dichloroethane,1,2-	2.23E-05	6.12E-07	6.12E-07	7.87E-09	3.32E-07	3.32E-07	3.88E-09
Dichloroethene, 1,1-	1.86E-09	5.09E-11	5.09E-11	1.98E-12	2.76E-11	2.76E-11	9.74E-13
Dichloroethene, cis-1,2-	2.26E-08	6.20E-10	6.20E-10	1.50E-11	3.37E-10	3.37E-10	7.41E-12
Dichloroethene, trans-1,2-	5.25E-09	1.44E-10	1.44E-10	3.49E-12	7.81E-11	7.81E-11	1.72E-12
Dichloropropane, 1,2-	1.86E-09	5.09E-11	5.09E-11	1.23E-12	2.76E-11	2.76E-11	6.09E-13

RME = Reasonable Maximum Exposure
ADI = Average Daily Intake
= Lifetime Average Daily Intake

TABLE 6.1-15 (CONTINUED)

GROUND WATER PATHWAY INTAKES FOR THE ADULT RESIDENT USING RECEPTOR WELL 2 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day)					
		Adult ADI			Adult LADI		
		Oral	Inhalation (Shower)	Dermal	Oral	Inhalation (Shower)	Dermal
Dichloropropene, 1,3-	4.00E-10	1.10E-11	1.10E-11	1.46E-13	5.95E-12	5.95E-12	7.21E-14
Dieldrin	1.00E-13	2.74E-15	2.74E-15	1.06E-16	1.49E-15	1.49E-15	5.24E-17
Diethylphthalate	1.21E-09	3.32E-11	3.32E-11	3.87E-13	1.80E-11	1.80E-11	1.91E-13
Ethylbenzene	1.84E-11	5.03E-13	5.03E-13	9.03E-14	2.73E-13	2.73E-13	4.45E-14
Freon 11 (CCL3F)	2.02E-09	5.53E-11	5.53E-11	2.28E-12	3.00E-11	3.00E-11	1.12E-12
Isophorone	2.73E-06	7.47E-08	7.47E-08	7.97E-10	4.06E-08	4.06E-08	3.93E-10
Lindane	9.19E-14	2.52E-15	2.52E-15	8.54E-17	1.37E-15	1.37E-15	4.21E-17
Methylene chloride	2.20E-05	6.02E-07	6.02E-07	6.57E-09	3.27E-07	3.27E-07	3.24E-09
N-nitrosodi-n-propylamine	3.79E-08	1.04E-09	1.04E-09	8.96E-12	5.63E-10	5.63E-10	4.42E-12
N-nitrosodiphenylamine	1.91E-11	5.23E-13	5.23E-13	2.59E-14	2.84E-13	2.84E-13	1.28E-14
Pentachlorophenol	1.29E-11	3.52E-13	3.52E-13	5.55E-13	1.91E-13	1.91E-13	2.74E-13
Phenol	7.58E-07	2.08E-08	2.08E-08	2.77E-10	1.13E-08	1.13E-08	1.36E-10
Tetrachloroethene	1.57E-09	4.30E-11	4.30E-11	5.01E-12	2.33E-11	2.33E-11	2.47E-12
Tetrahydrofuran	2.88E-04	7.89E-06	7.89E-06	2.87E-08	4.28E-06	4.28E-06	1.41E-08
Toluene	3.14E-09	8.60E-11	8.60E-11	9.39E-12	4.67E-11	4.67E-11	4.63E-12
Trichlorobenzene, 1,2,4-	1.10E-12	3.02E-14	3.02E-14	8.06E-15	1.64E-14	1.64E-14	3.97E-15
Trichloroethane, 1,1,1-	1.80E-08	4.92E-10	4.92E-10	2.03E-11	2.67E-10	2.67E-10	1.00E-11
Trichloroethane, 1,1,2-	1.62E-10	4.43E-12	4.43E-12	9.02E-14	2.40E-12	2.40E-12	4.45E-14
Trichloroethene	5.56E-04	1.52E-05	1.52E-05	5.91E-07	8.27E-06	8.27E-06	2.92E-07
Vinyl chloride	7.18E-08	1.97E-09	1.97E-09	3.48E-11	1.07E-09	1.07E-09	1.72E-11
Xylenes	2.50E-04	6.85E-06	6.85E-06	1.33E-06	3.72E-06	3.72E-06	6.55E-07
Cyanide	1.16E-09	3.19E-11		7.73E-14	1.73E-11	0.00E+00	3.81E-14
Nitrate	9.88E-07	2.71E-08		6.56E-11	1.47E-08	0.00E+00	3.23E-11
Arsenic	1.22E-03	3.34E-05		8.09E-08	1.81E-05	0.00E+00	3.99E-08

RME = Reasonable Maximum Exposure
ADI = Average Daily Intake
LADI = Lifetime Average Daily Intake

TABLE 6.1-16

GROUND WATER PATHWAY INTAKES FOR THE CHILD RESIDENT USING RECEPTOR WELL 2 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day)		
		Child ADI		
		Oral	Inhalation (Shower)	Dermal
Acetone	4.55E-05	2.91E-06	2.91E-06	3.01E-09
Benzene	2.10E-08	1.34E-09	1.34E-09	5.13E-11
Bis-(2-chloroethyl)ether	1.89E-08	1.21E-09	1.21E-09	4.63E-12
Bromodichloromethane	6.75E-09	4.32E-10	4.32E-10	4.56E-12
Bromoform	1.22E-10	7.81E-12	7.81E-12	3.69E-14
Bromomethane	7.95E-08	5.09E-09	5.09E-09	3.24E-11
Butanone, 2-	1.89E-05	1.21E-06	1.21E-06	2.42E-09
Carbon tetrachloride	2.91E-11	1.86E-12	1.86E-12	7.44E-14
Chlordane	2.00E-13	1.28E-14	1.28E-14	1.21E-15
Chlorobenzene	8.14E-08	5.20E-09	5.20E-09	3.88E-10
Chloroethane	6.82E-08	4.36E-09	4.36E-09	6.35E-11
Chloroform	7.20E-07	4.60E-08	4.60E-08	7.45E-10
Chloromethane	5.68E-06	3.63E-07	3.63E-07	2.78E-09
Chlorophenol, 2-	4.92E-07	3.15E-08	3.15E-08	6.30E-10
DDD	1.20E-13	7.67E-15	7.67E-15	3.91E-15
DDE	8.00E-14	5.11E-15	5.11E-15	2.23E-15
DDT	4.40E-13	2.81E-14	2.81E-14	2.20E-14
Di-n-butylphthalate	8.40E-11	5.37E-12	5.37E-12	3.23E-13
Dibromochloromethane	7.90E-09	5.05E-10	5.05E-10	2.85E-12
Dichlorobenzene, 1,2-	1.62E-11	1.03E-12	1.03E-12	1.15E-13
Dichlorobenzene, 1,4-	1.40E-10	8.93E-12	8.93E-12	1.01E-12
Dichloroethane, 1,1-	9.29E-09	5.94E-10	5.94E-10	9.62E-12
Dichloroethane,1,2-	2.23E-05	1.43E-06	1.43E-06	1.38E-08
Dichloroethene, 1,1-	1.86E-09	1.19E-10	1.19E-10	3.46E-12
Dichloroethene, cis-1,2-	2.26E-08	1.45E-09	1.45E-09	2.63E-11
Dichloroethene, trans-1,2-	5.25E-09	3.36E-10	3.36E-10	6.11E-12

RME = Reasonable Maximum Exposure

ADI = Average Daily Intake

TABLE 6.1-16 (CONTINUED)

GROUND WATER PATHWAY INTAKES FOR THE CHILD RESIDENT USING RECEPTOR WELL 2 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day)		
		Child ADI		
		Oral	Inhalation (Shower)	Dermal
Dichloropropane, 1,2-	1.86E-09	1.19E-10	1.19E-10	2.16E-12
Dichloropropene, 1,3-	4.00E-10	2.56E-11	2.56E-11	2.56E-13
Dieldrin	1.00E-13	6.39E-15	6.39E-15	1.86E-16
Diethylphthalate	1.21E-09	7.75E-11	7.75E-11	6.77E-13
Ethylbenzene	1.84E-11	1.17E-12	1.17E-12	1.58E-13
Freon 11 (CCL3F)	2.02E-09	1.29E-10	1.29E-10	4.00E-12
Isophorone	2.73E-06	1.74E-07	1.74E-07	1.40E-09
Lindane	9.19E-14	5.87E-15	5.87E-15	1.50E-16
Methylene chloride	2.20E-05	1.40E-06	1.40E-06	1.15E-08
N-nitrosodi-n-propylamine	3.79E-08	2.42E-09	2.42E-09	1.57E-11
N-nitrosodiphenylamine	1.91E-11	1.22E-12	1.22E-12	4.54E-14
Pentachlorophenol	1.29E-11	8.22E-13	8.22E-13	9.73E-13
Phenol	7.58E-07	4.84E-08	4.84E-08	4.85E-10
Tetrachloroethene	1.57E-09	1.00E-10	1.00E-10	8.77E-12
Tetrahydrofuran	2.88E-04	1.84E-05	1.84E-05	5.02E-08
Toluene	3.14E-09	2.01E-10	2.01E-10	1.64E-11
Trichlorobenzene, 1,2,4-	1.10E-12	7.05E-14	7.05E-14	1.41E-14
Trichloroethane, 1,1,1-	1.80E-08	1.15E-09	1.15E-09	3.55E-11
Trichloroethane, 1,1,2-	1.62E-10	1.03E-11	1.03E-11	1.58E-13
Trichloroethene	5.56E-04	3.56E-05	3.56E-05	1.04E-06
Vinyl chloride	7.18E-08	4.59E-09	4.59E-09	6.10E-11
Xylenes	2.50E-04	1.60E-05	1.60E-05	2.33E-06
Cyanide	1.16E-09	7.43E-11		1.35E-13
Nitrate	9.88E-07	6.31E-08		1.15E-10
Arsenic	1.22E-03	7.79E-05		1.42E-07

RME = Reasonable Maximum Exposure
ADI = Average Daily Intake

TABLE 6.1-17

GROUND WATER PATHWAY INTAKES FOR THE ADULT RESIDENT USING RECEPTOR WELL 5 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day)					
		Adult ADI			Adult LADI		
		Oral	Inhalation (Shower)	Dermal	Oral	Inhalation (Shower)	Dermal
Acetone	6.00E-05	1.64E-06	1.64E-06	2.27E-09	8.92E-07	8.92E-07	1.12E-09
Benzene	2.60E-06	7.12E-08	7.12E-08	3.63E-09	3.87E-08	3.87E-08	1.79E-09
Bis-(2-chloroethyl)ether	6.25E-07	1.71E-08	1.71E-08	8.72E-11	9.30E-09	9.30E-09	4.30E-11
Bromodichloromethane	5.38E-07	1.47E-08	1.47E-08	2.07E-10	8.00E-09	8.00E-09	1.02E-10
Bromoform	1.47E-08	4.03E-10	4.03E-10	2.54E-12	2.19E-10	2.19E-10	1.25E-12
Bromomethane	3.13E-07	8.56E-09	8.56E-09	7.27E-11	4.65E-09	4.65E-09	3.58E-11
Butanone, 2-	5.00E-07	1.37E-08	1.37E-08	3.65E-11	7.44E-09	7.44E-09	1.80E-11
Carbon tetrachloride	1.47E-08	4.03E-10	4.03E-10	2.15E-11	2.19E-10	2.19E-10	1.06E-11
Chlordane	1.30E-13	3.56E-15	3.56E-15	4.49E-16	1.93E-15	1.93E-15	2.21E-16
Chlorobenzene	1.41E-06	3.87E-08	3.87E-08	3.85E-09	2.10E-08	2.10E-08	1.90E-09
Chloroethane	4.25E-07	1.16E-08	1.16E-08	2.26E-10	6.32E-09	6.32E-09	1.11E-10
Chloroform	1.08E-06	2.95E-08	2.95E-08	6.36E-10	1.60E-08	1.60E-08	3.13E-10
Chloromethane	3.13E-07	8.56E-09	8.56E-09	8.72E-11	4.65E-09	4.65E-09	4.30E-11
Chlorophenol, 2-	1.00E-06	2.74E-08	2.74E-08	7.31E-10	1.49E-08	1.49E-08	3.60E-10
DDD	8.25E-14	2.26E-15	2.26E-15	1.53E-15	1.23E-15	1.23E-15	7.57E-16
DDE	4.75E-13	1.30E-14	1.30E-14	7.57E-15	7.06E-15	7.06E-15	3.73E-15
DDT	2.50E-15	6.85E-17	6.85E-17	7.14E-17	3.72E-17	3.72E-17	3.52E-17
Di-n-butylphthalate	2.00E-13	5.48E-15	5.48E-15	4.38E-16	2.97E-15	2.97E-15	2.16E-16
Dibromochloromethane	3.49E-07	9.56E-09	9.56E-09	7.19E-11	5.19E-09	5.19E-09	3.54E-11
Dichlorobenzene, 1,2-	5.00E-10	1.37E-11	1.37E-11	2.03E-12	7.44E-12	7.44E-12	1.00E-12
Dichlorobenzene, 1,4-	5.53E-09	1.52E-10	1.52E-10	2.28E-11	8.22E-11	8.22E-11	1.12E-11
Dichloroethane, 1,1-	4.39E-06	1.20E-07	1.20E-07	2.59E-09	6.53E-08	6.53E-08	1.28E-09
Dichloroethane,1,2-	2.50E-04	6.85E-06	6.85E-06	8.80E-08	3.72E-06	3.72E-06	4.34E-08
Dichloroethene, 1,1-	6.30E-08	1.73E-09	1.73E-09	6.70E-11	9.37E-10	9.37E-10	3.30E-11
Dichloroethene, cis-1,2-	2.28E-05	6.23E-07	6.23E-07	1.51E-08	3.38E-07	3.38E-07	7.45E-09
Dichloroethene, trans-1,2-	6.01E-06	1.65E-07	1.65E-07	3.99E-09	8.94E-08	8.94E-08	1.97E-09

RME = Reasonable Maximum Exposure
ADI = Average Daily Intake
[redacted] = Lifetime Average Daily Intake

TABLE 6.1-17 (CONTINUED)

GROUND WATER PATHWAY INTAKES FOR THE ADULT RESIDENT USING RECEPTOR WELL 5 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day)					
		Adult ADI			Adult LADI		
		Oral	Inhalation (Shower)	Dermal	Oral	Inhalation (Shower)	Dermal
Dichloropropane, 1,2-	8.61E-07	2.36E-08	2.36E-08	5.72E-10	1.28E-08	1.28E-08	2.82E-10
Dichloropropene, 1,3-	4.06E-08	1.11E-09	1.11E-09	1.48E-11	6.04E-10	6.04E-10	7.32E-12
Dieldrin	1.50E-14	4.11E-16	4.11E-16	1.59E-17	2.23E-16	2.23E-16	7.86E-18
Diethylphthalate	4.88E-07	1.34E-08	1.34E-08	1.55E-10	7.25E-09	7.25E-09	7.66E-11
Ethylbenzene	6.06E-09	1.66E-10	1.66E-10	2.98E-11	9.01E-11	9.01E-11	1.47E-11
Freon 11 (CCL3F)	3.09E-07	8.46E-09	8.46E-09	3.49E-10	4.59E-09	4.59E-09	1.72E-10
Isophorone	1.03E-06	2.81E-08	2.81E-08	3.00E-10	1.52E-08	1.52E-08	1.48E-10
Lindane	1.05E-11	2.89E-13	2.89E-13	9.80E-15	1.57E-13	1.57E-13	4.83E-15
Methylene chloride	4.75E-05	1.30E-06	1.30E-06	1.42E-08	7.06E-07	7.06E-07	7.00E-09
N-nitrosodi-n-propylamine	5.00E-07	1.37E-08	1.37E-08	1.18E-10	7.44E-09	7.44E-09	5.83E-11
N-nitrosodiphenylamine	5.27E-10	1.44E-11	1.44E-11	7.14E-13	7.83E-12	7.83E-12	3.52E-13
Pentachlorophenol	2.11E-09	5.77E-11	5.77E-11	9.10E-11	3.13E-11	3.13E-11	4.48E-11
Phenol	1.75E-06	4.79E-08	4.79E-08	6.39E-10	2.60E-08	2.60E-08	3.15E-10
Tetrachloroethene	3.29E-06	9.02E-08	9.02E-08	1.05E-08	4.90E-08	4.90E-08	5.18E-09
Tetrahydrofuran	5.25E-05	1.44E-06	1.44E-06	5.23E-09	7.81E-07	7.81E-07	2.58E-09
Toluene	1.82E-05	5.00E-07	5.00E-07	5.45E-08	2.71E-07	2.71E-07	2.69E-08
Trichlorobenzene, 1,2,4-	3.95E-10	1.08E-11	1.08E-11	2.89E-12	5.87E-12	5.87E-12	1.42E-12
Trichloroethane, 1,1,1-	5.09E-08	1.39E-09	1.39E-09	5.75E-11	7.57E-10	7.57E-10	2.83E-11
Trichloroethane, 1,1,2-	1.17E-05	3.21E-07	3.21E-07	6.53E-09	1.74E-07	1.74E-07	3.22E-09
Trichloroethene	1.84E-03	5.05E-05	5.05E-05	1.96E-06	2.74E-05	2.74E-05	9.66E-07
Vinyl Chloride	8.00E-06	2.19E-07	2.19E-07	3.88E-09	1.19E-07	1.19E-07	1.91E-09
Xylenes	4.50E-05	1.23E-06	1.23E-06	2.39E-07	6.69E-07	6.69E-07	1.18E-07
Cyanide	2.76E-06	7.57E-08		1.84E-10	4.11E-08	0.00E+00	9.05E-11
Nitrate	6.93E-08	1.90E-09		4.60E-12	1.03E-09	0.00E+00	2.27E-12
Arsenic	6.30E-04	1.73E-05		4.19E-08	9.37E-06	0.00E+00	2.06E-08

RME = Reasonable Maximum Exposure
ADI = Average Daily Intake
LADI = Lifetime Average Daily Intake

TABLE 6.1-18

GROUND WATER PATHWAY INTAKES FOR THE CHILD RESIDENT USING RECEPTOR WELL 5 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day)		
		Child ADI		
		Oral	Inhalation (Shower)	Dermal
Acetone	6.00E-05	3.84E-06	3.84E-06	3.98E-09
Benzene	2.60E-06	1.66E-07	1.66E-07	6.35E-09
Bis-(2-chloroethyl)ether	6.25E-07	4.00E-08	4.00E-08	1.53E-10
Bromodichloromethane	5.38E-07	3.44E-08	3.44E-08	3.63E-10
Bromoform	1.47E-08	9.40E-10	9.40E-10	4.45E-12
Bromomethane	3.13E-07	2.00E-08	2.00E-08	1.27E-10
Butanone, 2-	5.00E-07	3.20E-08	3.20E-08	6.40E-11
Carbon tetrachloride	1.47E-08	9.40E-10	9.40E-10	3.76E-11
Chlordane	1.30E-13	8.31E-15	8.31E-15	7.87E-16
Chlorobenzene	1.41E-06	9.02E-08	9.02E-08	6.73E-09
Chloroethane	4.25E-07	2.72E-08	2.72E-08	3.96E-10
Chloroform	1.08E-06	6.87E-08	6.87E-08	1.11E-09
Chloromethane	3.13E-07	2.00E-08	2.00E-08	1.53E-10
Chlorophenol, 2-	1.00E-06	6.39E-08	6.39E-08	1.28E-09
DDD	8.25E-14	5.27E-15	5.27E-15	2.69E-15
DDE	4.75E-13	3.04E-14	3.04E-14	1.33E-14
DDT	2.50E-15	1.60E-16	1.60E-16	1.25E-16
Di-n-butylphthalate	2.00E-13	1.28E-14	1.28E-14	7.68E-16
Dibromochloromethane	3.49E-07	2.23E-08	2.23E-08	1.26E-10
Dichlorobenzene, 1,2-	5.00E-10	3.20E-11	3.20E-11	3.55E-12
Dichlorobenzene, 1,4-	5.53E-09	3.54E-10	3.54E-10	3.99E-11
Dichloroethane, 1,1-	4.39E-06	2.80E-07	2.80E-07	4.54E-09
Dichloroethane,1,2-	2.50E-04	1.60E-05	1.60E-05	1.54E-07
Dichloroethene, 1,1-	6.30E-08	4.03E-09	4.03E-09	1.17E-10
Dichloroethene, cis-1,2-	2.28E-05	1.45E-06	1.45E-06	2.65E-08
Dichloroethene, trans-1,2-	6.01E-06	3.84E-07	3.84E-07	7.00E-09

RME = Reasonable Maximum Exposure
ADI = Average Daily Intake

TABLE 6.1-18 (CONTINUED)

GROUND WATER PATHWAY INTAKES FOR THE CHILD RESIDENT USING RECEPTOR WELL 5 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day) Child ADI		
		Oral	Inhalation (Shower)	Dermal
Dichloropropane, 1,2-	8.61E-07	5.51E-08	5.51E-08	1.00E-09
Dichloropropene, 1,3-	4.06E-08	2.60E-09	2.60E-09	2.60E-11
Dieldrin	1.50E-14	9.59E-16	9.59E-16	2.79E-17
Diethylphthalate	4.88E-07	3.12E-08	3.12E-08	2.72E-10
Ethylbenzene	6.06E-09	3.87E-10	3.87E-10	5.21E-11
Freon 11 (CCL3F)	3.09E-07	1.97E-08	1.97E-08	6.11E-10
Isophorone	1.03E-06	6.55E-08	6.55E-08	5.25E-10
Lindane	1.05E-11	6.73E-13	6.73E-13	1.72E-14
Methylene chloride	4.75E-05	3.04E-06	3.04E-06	2.49E-08
N-nitrosodi-n-propylamine	5.00E-07	3.20E-08	3.20E-08	2.07E-10
N-nitrosodiphenylamine	5.27E-10	3.37E-11	3.37E-11	1.25E-12
Pentachlorophenol	2.11E-09	1.35E-10	1.35E-10	1.59E-10
Phenol	1.75E-06	1.12E-07	1.12E-07	1.12E-09
Tetrachloroethene	3.29E-06	2.11E-07	2.11E-07	1.84E-08
Tetrahydrofuran	5.25E-05	3.36E-06	3.36E-06	9.16E-09
Toluene	1.82E-05	1.17E-06	1.17E-06	9.55E-08
Trichlorobenzene, 1,2,4-	3.95E-10	2.53E-11	2.53E-11	5.06E-12
Trichloroethane, 1,1,1-	5.09E-08	3.25E-09	3.25E-09	1.01E-10
Trichloroethane, 1,1,2-	1.17E-05	7.48E-07	7.48E-07	1.14E-08
Trichloroethene	1.84E-03	1.18E-04	1.18E-04	3.43E-06
Vinyl Chloride	8.00E-06	5.11E-07	5.11E-07	6.79E-09
Xylenes	4.50E-05	2.88E-06	2.88E-06	4.19E-07
Cyanide	2.76E-06	1.77E-07		3.22E-10
Nitrate	6.93E-08	4.43E-09		8.06E-12
Arsenic	6.30E-04	4.03E-05		7.33E-08

RME = Reasonable Maximum Exposure
ADI = Average Daily Intake

TABLE 6.1-19

GROUND WATER PATHWAY INTAKES FOR THE ADULT RESIDENT USING RECEPTOR WELL 2 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day)					
		Adult ADI			Adult LADI		
		Oral	Inhalation (Shower)	Dermal	Oral	Inhalation (Shower)	Dermal
Acetone	4.55E-05	8.72E-07	8.72E-07	1.72E-09	3.61E-07	3.61E-07	4.80E-10
Benzene	2.10E-08	4.03E-10	4.03E-10	2.93E-11	1.67E-10	1.67E-10	8.17E-12
Bis-(2-chloroethyl)ether	1.89E-08	3.63E-10	3.63E-10	2.64E-12	1.50E-10	1.50E-10	7.36E-13
Bromodichloromethane	6.75E-09	1.29E-10	1.29E-10	2.60E-12	5.36E-11	5.36E-11	7.25E-13
Bromoform	1.22E-10	2.34E-12	2.34E-12	2.11E-14	9.70E-13	9.70E-13	5.88E-15
Bromomethane	7.95E-08	1.53E-09	1.53E-09	1.85E-11	6.32E-10	6.32E-10	5.15E-12
Butanone, 2-	1.89E-05	3.63E-07	3.63E-07	1.38E-09	1.50E-07	1.50E-07	3.86E-10
Carbon tetrachloride	2.91E-11	5.58E-13	5.58E-13	4.25E-14	2.31E-13	2.31E-13	1.18E-14
Chlordane	2.00E-13	3.84E-15	3.84E-15	6.91E-16	1.59E-15	1.59E-15	1.93E-16
Chlorobenzene	8.14E-08	1.56E-09	1.56E-09	2.22E-10	6.47E-10	6.47E-10	6.18E-11
Chloroethane	6.82E-08	1.31E-09	1.31E-09	3.62E-11	5.42E-10	5.42E-10	1.01E-11
Chloroform	7.20E-07	1.38E-08	1.38E-08	4.26E-10	5.72E-09	5.72E-09	1.19E-10
Chloromethane	5.68E-06	1.09E-07	1.09E-07	1.59E-09	4.51E-08	4.51E-08	4.42E-10
Chlorophenol, 2-	4.92E-07	9.44E-09	9.44E-09	3.60E-10	3.91E-09	3.91E-09	1.00E-10
DDD	1.20E-13	2.30E-15	2.30E-15	2.23E-15	9.53E-16	9.53E-16	6.22E-16
DDE	8.00E-14	1.53E-15	1.53E-15	1.28E-15	6.36E-16	6.36E-16	3.55E-16
DDT	4.40E-13	8.44E-15	8.44E-15	1.26E-14	3.50E-15	3.50E-15	3.50E-15
Di-n-butylphthalate	8.40E-11	1.61E-12	1.61E-12	1.84E-13	6.67E-13	6.67E-13	5.13E-14
Dibromochloromethane	7.90E-09	1.52E-10	1.52E-10	1.63E-12	6.28E-11	6.28E-11	4.53E-13
Dichlorobenzene, 1,2-	1.62E-11	3.10E-13	3.10E-13	6.55E-14	1.28E-13	1.28E-13	1.83E-14
Dichlorobenzene, 1,4-	1.40E-10	2.68E-12	2.68E-12	5.75E-13	1.11E-12	1.11E-12	1.60E-13
Dichloroethane, 1,1-	9.29E-09	1.78E-10	1.78E-10	5.49E-12	7.38E-11	7.38E-11	1.53E-12
Dichloroethane,1,2-	2.23E-05	4.29E-07	4.29E-07	7.87E-09	1.78E-07	1.78E-07	2.19E-09
Dichloroethene, 1,1-	1.86E-09	3.56E-11	3.56E-11	1.98E-12	1.48E-11	1.48E-11	5.51E-13
Dichloroethene, cis-1,2-	2.26E-08	4.34E-10	4.34E-10	1.50E-11	1.80E-10	1.80E-10	4.19E-12
Dichloroethene, trans-1,2-	5.25E-09	1.01E-10	1.01E-10	3.49E-12	4.17E-11	4.17E-11	9.72E-13

ADI = Average Daily Intake
= Lifetime Average Daily Intake

TABLE 6.1-19 (CONTINUED)

GROUND WATER PATHWAY INTAKES FOR THE ADULT RESIDENT USING RECEPTOR WELL 2 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day)					
		Adult ADI			Adult LADI		
		Oral	Inhalation (Shower)	Dermal	Oral	Inhalation (Shower)	Dermal
Dichloropropane, 1,2-	1.86E-09	3.56E-11	3.56E-11	1.23E-12	1.48E-11	1.48E-11	3.44E-13
Dichloropropene, 1,3-	4.00E-10	7.67E-12	7.67E-12	1.46E-13	3.18E-12	3.18E-12	4.07E-14
Dieldrin	1.00E-13	1.92E-15	1.92E-15	1.06E-16	7.95E-16	7.95E-16	2.96E-17
Diethylphthalate	1.21E-09	2.32E-11	2.32E-11	3.87E-13	9.63E-12	9.63E-12	1.08E-13
Ethylbenzene	1.84E-11	3.52E-13	3.52E-13	9.03E-14	1.46E-13	1.46E-13	2.52E-14
Freon 11 (CCL3F)	2.02E-09	3.87E-11	3.87E-11	2.28E-12	1.61E-11	1.61E-11	6.36E-13
Isophorone	2.73E-06	5.23E-08	5.23E-08	7.97E-10	2.17E-08	2.17E-08	2.22E-10
Lindane	9.19E-14	1.76E-15	1.76E-15	8.54E-17	7.30E-16	7.30E-16	2.38E-17
Methylene chloride	2.20E-05	4.21E-07	4.21E-07	6.57E-09	1.75E-07	1.75E-07	1.83E-09
N-nitrosodi-n-propylamine	3.79E-08	7.26E-10	7.26E-10	8.96E-12	3.01E-10	3.01E-10	2.50E-12
N-nitrosodiphenylamine	1.91E-11	3.66E-13	3.66E-13	2.59E-14	1.52E-13	1.52E-13	7.22E-15
Pentachlorophenol	1.29E-11	2.47E-13	2.47E-13	5.55E-13	1.02E-13	1.02E-13	1.55E-13
Phenol	7.58E-07	1.45E-08	1.45E-08	2.77E-10	6.02E-09	6.02E-09	7.71E-11
Tetrachloroethene	1.57E-09	3.01E-11	3.01E-11	5.01E-12	1.25E-11	1.25E-11	1.40E-12
Tetrahydrofuran	2.88E-04	5.52E-06	5.52E-06	2.87E-08	2.29E-06	2.29E-06	7.99E-09
Toluene	3.14E-09	6.02E-11	6.02E-11	9.39E-12	2.49E-11	2.49E-11	2.62E-12
Trichlorobenzene, 1,2,4-	1.10E-12	2.11E-14	2.11E-14	8.06E-15	8.76E-15	8.76E-15	2.25E-15
Trichloroethane, 1,1,1-	1.80E-08	3.44E-10	3.44E-10	2.03E-11	1.43E-10	1.43E-10	5.65E-12
Trichloroethane, 1,1,2-	1.62E-10	3.10E-12	3.10E-12	9.02E-14	1.28E-12	1.28E-12	2.51E-14
Trichloroethene	5.56E-04	1.07E-05	1.07E-05	5.91E-07	4.42E-06	4.42E-06	1.65E-07
Vinyl Chloride	7.18E-08	1.38E-09	1.38E-09	3.48E-11	5.71E-10	5.71E-10	9.71E-12
Xylenes	2.50E-04	4.79E-06	4.79E-06	1.33E-06	1.99E-06	1.99E-06	3.70E-07
Cyanide	1.16E-09	2.23E-11		7.73E-14	9.24E-12	0.00E+00	2.15E-14
Nitrate	9.88E-07	1.89E-08		6.56E-11	7.85E-09	0.00E+00	1.83E-11
Arsenic	1.22E-03	2.34E-05		8.09E-08	9.68E-06	0.00E+00	2.25E-08

ADI = Average Daily Intake
LADI = Lifetime Average Daily Intake

TABLE 6.1-20

GROUND WATER PATHWAY INTAKES FOR THE CHILD RESIDENT USING RECEPTOR WELL 2 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day) Child ADI		
		Oral	Inhalation (Shower)	Dermal
Acetone	4.55E-05	2.91E-06	2.91E-06	3.01E-09
Benzene	2.10E-08	1.34E-09	1.34E-09	5.13E-11
Bis-(2-chloroethyl)ether	1.89E-08	1.21E-09	1.21E-09	4.63E-12
Bromodichloromethane	6.75E-09	4.32E-10	4.32E-10	4.56E-12
Bromoform	1.22E-10	7.81E-12	7.81E-12	3.69E-14
Bromomethane	7.95E-08	5.09E-09	5.09E-09	3.24E-11
Butanone, 2-	1.89E-05	1.21E-06	1.21E-06	2.42E-09
Carbon tetrachloride	2.91E-11	1.86E-12	1.86E-12	7.44E-14
Chlordane	2.00E-13	1.28E-14	1.28E-14	1.21E-15
Chlorobenzene	8.14E-08	5.20E-09	5.20E-09	3.88E-10
Chloroethane	6.82E-08	4.36E-09	4.36E-09	6.35E-11
Chloroform	7.20E-07	4.60E-08	4.60E-08	7.45E-10
Chloromethane	5.68E-06	3.63E-07	3.63E-07	2.78E-09
Chlorophenol, 2-	4.92E-07	3.15E-08	3.15E-08	6.30E-10
DDD	1.20E-13	7.67E-15	7.67E-15	3.91E-15
DDE	8.00E-14	5.11E-15	5.11E-15	2.23E-15
DDT	4.40E-13	2.81E-14	2.81E-14	2.20E-14
Di-n-butylphthalate	8.40E-11	5.37E-12	5.37E-12	3.23E-13
Dibromochloromethane	7.90E-09	5.05E-10	5.05E-10	2.85E-12
Dichlorobenzene, 1,2-	1.62E-11	1.03E-12	1.03E-12	1.15E-13
Dichlorobenzene, 1,4-	1.40E-10	8.93E-12	8.93E-12	1.01E-12
Dichloroethane, 1,1-	9.29E-09	5.94E-10	5.94E-10	9.62E-12
Dichloroethane,1,2-	2.23E-05	1.43E-06	1.43E-06	1.38E-08
Dichloroethene, 1,1-	1.86E-09	1.19E-10	1.19E-10	3.46E-12
Dichloroethene, cis-1,2-	2.26E-08	1.45E-09	1.45E-09	2.63E-11
Dichloroethene, trans-1,2-	5.25E-09	3.36E-10	3.36E-10	6.11E-12

= Average Daily Intake

TABLE 6.1-20 (CONTINUED)

GROUND WATER PATHWAY INTAKES FOR THE CHILD RESIDENT USING RECEPTOR WELL 2 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day)		
		Child ADI		
		Oral	Inhalation (Shower)	Dermal
Dichloropropane, 1,2-	1.86E-09	1.19E-10	1.19E-10	2.16E-12
Dichloropropene, 1,3-	4.00E-10	2.56E-11	2.56E-11	2.56E-13
Dieldrin	1.00E-13	6.39E-15	6.39E-15	1.86E-16
Diethylphthalate	1.21E-09	7.75E-11	7.75E-11	6.77E-13
Ethylbenzene	1.84E-11	1.17E-12	1.17E-12	1.58E-13
Freon 11 (CCL3F)	2.02E-09	1.29E-10	1.29E-10	4.00E-12
Isophorone	2.73E-06	1.74E-07	1.74E-07	1.40E-09
Lindane	9.19E-14	5.87E-15	5.87E-15	1.50E-16
Methylene chloride	2.20E-05	1.40E-06	1.40E-06	1.15E-08
N-nitrosodi-n-propylamine	3.79E-08	2.42E-09	2.42E-09	1.57E-11
N-nitrosodiphenylamine	1.91E-11	1.22E-12	1.22E-12	4.54E-14
Pentachlorophenol	1.29E-11	8.22E-13	8.22E-13	9.73E-13
Phenol	7.58E-07	4.84E-08	4.84E-08	4.85E-10
Tetrachloroethene	1.57E-09	1.00E-10	1.00E-10	8.77E-12
Tetrahydrofuran	2.88E-04	1.84E-05	1.84E-05	5.02E-08
Toluene	3.14E-09	2.01E-10	2.01E-10	1.64E-11
Trichlorobenzene, 1,2,4-	1.10E-12	7.05E-14	7.05E-14	1.41E-14
Trichloroethane, 1,1,1-	1.80E-08	1.15E-09	1.15E-09	3.55E-11
Trichloroethane, 1,1,2-	1.62E-10	1.03E-11	1.03E-11	1.58E-13
Trichloroethene	5.56E-04	3.56E-05	3.56E-05	1.04E-06
Vinyl Chloride	7.18E-08	4.59E-09	4.59E-09	6.10E-11
Xylenes	2.50E-04	1.60E-05	1.60E-05	2.33E-06
Cyanide	1.16E-09	7.43E-11		1.35E-13
Nitrate	9.88E-07	6.31E-08		1.15E-10
Arsenic	1.22E-03	7.79E-05		1.42E-07

ADI = Average Daily Intake

TABLE 6.1-21

GROUND WATER PATHWAY INTAKES FOR THE ADULT RESIDENT USING RECEPTOR WELL 5 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day)					
		Adult ADI			Adult LADI		
		Oral	Inhalation (Shower)	Dermal	Oral	Inhalation (Shower)	Dermal
Acetone	6.00E-05	1.15E-06	1.15E-06	2.27E-09	4.77E-07	4.77E-07	6.33E-10
Benzene	2.60E-06	4.99E-08	4.99E-08	3.63E-09	2.07E-08	2.07E-08	1.01E-09
Bis-(2-chloroethyl)ether	6.25E-07	1.20E-08	1.20E-08	8.72E-11	4.97E-09	4.97E-09	2.43E-11
Bromodichloromethane	5.38E-07	1.03E-08	1.03E-08	2.07E-10	4.28E-09	4.28E-09	5.78E-11
Bromoform	1.47E-08	2.82E-10	2.82E-10	2.54E-12	1.17E-10	1.17E-10	7.08E-13
Bromomethane	3.13E-07	5.99E-09	5.99E-09	7.27E-11	2.48E-09	2.48E-09	2.03E-11
Butanone, 2-	5.00E-07	9.59E-09	9.59E-09	3.65E-11	3.97E-09	3.97E-09	1.02E-11
Carbon tetrachloride	1.47E-08	2.82E-10	2.82E-10	2.15E-11	1.17E-10	1.17E-10	5.99E-12
Chlordane	1.30E-13	2.49E-15	2.49E-15	4.49E-16	1.03E-15	1.03E-15	1.25E-16
Chlorobenzene	1.41E-06	2.71E-08	2.71E-08	3.85E-09	1.12E-08	1.12E-08	1.07E-09
Chloroethane	4.25E-07	8.15E-09	8.15E-09	2.26E-10	3.38E-09	3.38E-09	6.29E-11
Chloroform	1.08E-06	2.06E-08	2.06E-08	6.36E-10	8.54E-09	8.54E-09	1.77E-10
Chloromethane	3.13E-07	5.99E-09	5.99E-09	8.72E-11	2.48E-09	2.48E-09	2.43E-11
Chlorophenol, 2-	1.00E-06	1.92E-08	1.92E-08	7.31E-10	7.95E-09	7.95E-09	2.04E-10
DDD	8.25E-14	1.58E-15	1.58E-15	1.53E-15	6.55E-16	6.55E-16	4.28E-16
DDE	4.75E-13	9.11E-15	9.11E-15	7.57E-15	3.77E-15	3.77E-15	2.11E-15
DDT	2.50E-15	4.79E-17	4.79E-17	7.14E-17	1.99E-17	1.99E-17	1.99E-17
Di-n-butylphthalate	2.00E-13	3.84E-15	3.84E-15	4.38E-16	1.59E-15	1.59E-15	1.22E-16
Dibromochloromethane	3.49E-07	6.69E-09	6.69E-09	7.19E-11	2.77E-09	2.77E-09	2.00E-11
Dichlorobenzene, 1,2-	5.00E-10	9.60E-12	9.60E-12	2.03E-12	3.98E-12	3.98E-12	5.65E-13
Dichlorobenzene, 1,4-	5.53E-09	1.06E-10	1.06E-10	2.28E-11	4.39E-11	4.39E-11	6.35E-12
Dichloroethane, 1,1-	4.39E-06	8.41E-08	8.41E-08	2.59E-09	3.49E-08	3.49E-08	7.23E-10
Dichloroethane,1,2-	2.50E-04	4.79E-06	4.79E-06	8.80E-08	1.99E-06	1.99E-06	2.45E-08
Dichloroethene, 1,1-	6.30E-08	1.21E-09	1.21E-09	6.70E-11	5.01E-10	5.01E-10	1.87E-11
Dichloroethene, cis-1,2-	2.28E-05	4.36E-07	4.36E-07	1.51E-08	1.81E-07	1.81E-07	4.21E-09
Dichloroethene, trans-1,2-	6.01E-06	1.15E-07	1.15E-07	3.99E-09	4.78E-08	4.78E-08	1.11E-09

ADI = Average Daily Intake

= Lifetime Average Daily Intake

TABLE 6.1-21 (CONTINUED)

GROUND WATER PATHWAY INTAKES FOR THE ADULT RESIDENT USING RECEPTOR WELL 5 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day)					
		Adult ADI			Adult LADI		
		Oral	Inhalation (Shower)	Dermal	Oral	Inhalation (Shower)	Dermal
Dichloropropane, 1,2-	8.61E-07	1.65E-08	1.65E-08	5.72E-10	6.84E-09	6.84E-09	1.59E-10
Dichloropropene, 1,3-	4.06E-08	7.79E-10	7.79E-10	1.48E-11	3.23E-10	3.23E-10	4.14E-12
Dieldrin	1.50E-14	2.88E-16	2.88E-16	1.59E-17	1.19E-16	1.19E-16	4.44E-18
Diethylphthalate	4.88E-07	9.35E-09	9.35E-09	1.55E-10	3.87E-09	3.87E-09	4.33E-11
Ethylbenzene	6.06E-09	1.16E-10	1.16E-10	2.98E-11	4.81E-11	4.81E-11	8.30E-12
Freon 11 (CCL3F)	3.09E-07	5.92E-09	5.92E-09	3.49E-10	2.45E-09	2.45E-09	9.72E-11
Isophorone	1.03E-06	1.97E-08	1.97E-08	3.00E-10	8.14E-09	8.14E-09	8.35E-11
Lindane	1.05E-11	2.02E-13	2.02E-13	9.80E-15	8.37E-14	8.37E-14	2.73E-15
Methylene chloride	4.75E-05	9.11E-07	9.11E-07	1.42E-08	3.77E-07	3.77E-07	3.96E-09
N-nitrosodi-n-propylamine	5.00E-07	9.59E-09	9.59E-09	1.18E-10	3.97E-09	3.97E-09	3.30E-11
N-nitrosodiphenylamine	5.27E-10	1.01E-11	1.01E-11	7.14E-13	4.18E-12	4.18E-12	1.99E-13
Pentachlorophenol	2.11E-09	4.04E-11	4.04E-11	9.10E-11	1.67E-11	1.67E-11	2.54E-11
Phenol	1.75E-06	3.36E-08	3.36E-08	6.39E-10	1.39E-08	1.39E-08	1.78E-10
Tetrachloroethene	3.29E-06	6.32E-08	6.32E-08	1.05E-08	2.62E-08	2.62E-08	2.93E-09
Tetrahydrofuran	5.25E-05	1.01E-06	1.01E-06	5.23E-09	4.17E-07	4.17E-07	1.46E-09
Toluene	1.82E-05	3.50E-07	3.50E-07	5.45E-08	1.45E-07	1.45E-07	1.52E-08
Trichlorobenzene, 1,2,4-	3.95E-10	7.58E-12	7.58E-12	2.89E-12	3.14E-12	3.14E-12	8.04E-13
Trichloroethane, 1,1,1-	5.09E-08	9.76E-10	9.76E-10	5.75E-11	4.04E-10	4.04E-10	1.60E-11
Trichloroethane, 1,1,2-	1.17E-05	2.24E-07	2.24E-07	6.53E-09	9.30E-08	9.30E-08	1.82E-09
Trichloroethene	1.84E-03	3.54E-05	3.54E-05	1.96E-06	1.46E-05	1.46E-05	5.46E-07
Vinyl Chloride	8.00E-06	1.53E-07	1.53E-07	3.88E-09	6.36E-08	6.36E-08	1.08E-09
Xylenes	4.50E-05	8.63E-07	8.63E-07	2.39E-07	3.58E-07	3.58E-07	6.67E-08
Cyanide	2.76E-06	5.30E-08		1.84E-10	2.20E-08	0.00E+00	5.12E-11
Nitrate	6.93E-08	1.33E-09		4.60E-12	5.51E-10	0.00E+00	1.28E-12
Arsenic	6.30E-04	1.21E-05		4.19E-08	5.01E-06	0.00E+00	1.17E-08

ADI = Average Daily Intake
LADI = Lifetime Average Daily Intake

TABLE 6.1-22

GROUND WATER PATHWAY INTAKES FOR THE CHILD RESIDENT USING RECEPTOR WELL 5 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day)		
		Child ADI		
		Oral	Inhalation (Shower)	Dermal
Acetone	6.00E-05	3.84E-06	3.84E-06	3.98E-09
Benzene	2.60E-06	1.66E-07	1.66E-07	6.35E-09
Bis-(2-chloroethyl)ether	6.25E-07	4.00E-08	4.00E-08	1.53E-10
Bromodichloromethane	5.38E-07	3.44E-08	3.44E-08	3.63E-10
Bromoform	1.47E-08	9.40E-10	9.40E-10	4.45E-12
Bromomethane	3.13E-07	2.00E-08	2.00E-08	1.27E-10
Butanone, 2-	5.00E-07	3.20E-08	3.20E-08	6.40E-11
Carbon tetrachloride	1.47E-08	9.40E-10	9.40E-10	3.76E-11
Chlordane	1.30E-13	8.31E-15	8.31E-15	7.87E-16
Chlorobenzene	1.41E-06	9.02E-08	9.02E-08	6.73E-09
Chloroethane	4.25E-07	2.72E-08	2.72E-08	3.96E-10
Chloroform	1.08E-06	6.87E-08	6.87E-08	1.11E-09
Chloromethane	3.13E-07	2.00E-08	2.00E-08	1.53E-10
Chlorophenol, 2-	1.00E-06	6.39E-08	6.39E-08	1.28E-09
DDD	8.25E-14	5.27E-15	5.27E-15	2.69E-15
DDE	4.75E-13	3.04E-14	3.04E-14	1.33E-14
DDT	2.50E-15	1.60E-16	1.60E-16	1.25E-16
Di-n-butylphthalate	2.00E-13	1.28E-14	1.28E-14	7.68E-16
Dibromochloromethane	3.49E-07	2.23E-08	2.23E-08	1.26E-10
Dichlorobenzene, 1,2-	5.00E-10	3.20E-11	3.20E-11	3.55E-12
Dichlorobenzene, 1,4-	5.53E-09	3.54E-10	3.54E-10	3.99E-11
Dichloroethane, 1,1-	4.39E-06	2.80E-07	2.80E-07	4.54E-09
Dichloroethane,1,2-	2.50E-04	1.60E-05	1.60E-05	1.54E-07
Dichloroethene, 1,1-	6.30E-08	4.03E-09	4.03E-09	1.17E-10
Dichloroethene, cis-1,2-	2.28E-05	1.45E-06	1.45E-06	2.65E-08

= Average Daily Intake

TABLE 6.1-22 (CONTINUED)

GROUND WATER PATHWAY INTAKES FOR THE CHILD RESIDENT USING RECEPTOR WELL 5 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Highest Estimated Ground Water Conc. (mg/L)	Ground Water Pathway Intakes (mg/kg-day)		
		Child ADI		
		Oral	Inhalation (Shower)	Dermal
Dichloroethene, trans-1,2-	6.01E-06	3.84E-07	3.84E-07	7.00E-09
Dichloropropane, 1,2-	8.61E-07	5.51E-08	5.51E-08	1.00E-09
Dichloropropene, 1,3-	4.06E-08	2.60E-09	2.60E-09	2.60E-11
Dieldrin	1.50E-14	9.59E-16	9.59E-16	2.79E-17
Diethylphthalate	4.88E-07	3.12E-08	3.12E-08	2.72E-10
Ethylbenzene	6.06E-09	3.87E-10	3.87E-10	5.21E-11
Freon 11 (CCL3F)	3.09E-07	1.97E-08	1.97E-08	6.11E-10
Isophorone	1.03E-06	6.55E-08	6.55E-08	5.25E-10
Lindane	1.05E-11	6.73E-13	6.73E-13	1.72E-14
Methylene chloride	4.75E-05	3.04E-06	3.04E-06	2.49E-08
N-nitrosodi-n-propylamine	5.00E-07	3.20E-08	3.20E-08	2.07E-10
N-nitrosodiphenylamine	5.27E-10	3.37E-11	3.37E-11	1.25E-12
Pentachlorophenol	2.11E-09	1.35E-10	1.35E-10	1.59E-10
Phenol	1.75E-06	1.12E-07	1.12E-07	1.12E-09
Tetrachloroethene	3.29E-06	2.11E-07	2.11E-07	1.84E-08
Tetrahydrofuran	5.25E-05	3.36E-06	3.36E-06	9.16E-09
Toluene	1.82E-05	1.17E-06	1.17E-06	9.55E-08
Trichlorobenzene, 1,2,4-	3.95E-10	2.53E-11	2.53E-11	5.06E-12
Trichloroethane, 1,1,1-	5.09E-08	3.25E-09	3.25E-09	1.01E-10
Trichloroethane, 1,1,2-	1.17E-05	7.48E-07	7.48E-07	1.14E-08
Trichloroethene	1.84E-03	1.18E-04	1.18E-04	3.43E-06
Vinyl Chloride	8.00E-06	5.11E-07	5.11E-07	6.79E-09
Xylenes	4.50E-05	2.88E-06	2.88E-06	4.19E-07
Cyanide	2.76E-06	1.77E-07		3.22E-10
Nitrate	6.93E-08	4.43E-09		8.06E-12
Arsenic	6.30E-04	4.03E-05		7.33E-08

ADI = Average Daily Intake

SA	=	Skin surface area available for contact (cm^2)
PC	=	Chemical-specific dermal permeability constant (cm/hr)
ET	=	Exposure time (hours/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
CF	=	Volumetric conversion factor for water (1 liter/1000 cm^3)
BW	=	Body weight (kg)
AT	=	Averaging time (period over which exposure is averaged--days)

Variable Values:

CW:	Chemical concentrations based upon transport modeling
SA:	RME and Average values presented in Table 6.1-14
PC:	Chemical-specific values obtained from EPA guidance (1991b)
ET:	RME and Average values presented in Table 6.1-14
EF:	RME and Average values presented in Table 6.1-14
ED:	RME and Average values as presented in Table 6.1-14
CF:	1 liter/1000 cm^3
AT:	For non-carcinogenic effects, AT = ED x 365 days/year; For carcinogenic effects, AT = 70 years x 365 days/year)
BW:	70 kg for an adult 15 kg for a child aged 0-6 years

Dermal permeability constants were utilized in the above equation to characterize the rate at which a chemical passes through the skin. These constants were based upon experimental values reported in EPA guidance on dermal exposure (EPA, 1991f), or in cases for which experimental values were not available, the constants were estimated using a regression formula presented in the same EPA guidance document. The dermal permeability constants for the COCs are presented in Table 6.1-23.

TABLE 6.1-23

DERMAL PERMEABILITY CONSTANTS

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Molecular Weight	Log K(ow)	Dermal Permeability Constant {K(p)} (cm/hour) (a,b)	Note
Acetone	58	-0.24	5.7E-04	b
Benzene	--	--	2.1E-02	a
Bis-(2-chloroethyl)ether	--	--	2.1E-03	a
Bromodichloromethane	--	--	5.8E-03	a
Bromoform	--	--	2.6E-03	a
Bromomethane	--	--	3.5E-03	a
Butanone, 2-	--	--	1.1E-03	a
Carbon tetrachloride	--	--	2.2E-02	a
Chlordane	--	--	5.2E-02	a
Chlorobenzene	--	--	4.1E-02	a
Chloroethane	--	--	8.0E-03	a
Chloroform	--	--	8.9E-03	a
Chloromethane	--	--	4.2E-03	a
Chlorophenol, 2-	--	--	1.1E-02	a
DDD	--	--	2.8E-01	a
DDE	--	--	2.4E-01	a
DDT	--	--	4.3E-01	a
Di-n-butylphthalate	--	--	3.3E-02	a
Dibromochloromethane	--	--	3.1E-03	a
Dichlorobenzene, 1,2-	--	--	6.1E-02	a
Dichlorobenzene, 1,4-	--	--	6.2E-02	a
Dichloroethane, 1,1-	--	--	8.9E-03	a
Dichloroethane,1,2-	--	--	5.3E-03	a
Dichloroethene, 1,1-	--	--	1.6E-02	a
Dichloroethene, cis-1,2-	--	--	1.0E-02	a,c
Dichloroethene, trans-1,2-	--	--	1.0E-02	a,c
Dichloropropane, 1,2-	--	--	1.0E-02	a
Dichloropropene, 1,3-	--	--	5.5E-03	a
Dieldrin	--	--	1.6E-02	a
Diethylphthalate	--	--	4.8E-03	a
Ethylbenzene	--	--	7.4E-02	a
Freon 11 (CCL3F)	--	--	1.7E-02	a
Isophorone	--	--	4.4E-03	a
Lindane	--	--	1.4E-02	a
Methylene chloride	--	--	4.5E-03	a
N-nitrosodi-n-propylamine	130	1.5	3.6E-03	b
N-nitrosodiphenylamine	198	3.15	2.0E-02	b
Pentachlorophenol	--	--	6.5E-01	a
Phenol	--	--	5.5E-03	a
Tetrachloroethene	--	--	4.8E-02	a
Tetrahydrofuran	72	0.46	1.5E-03	b

TABLE 6.1-23 (CONTINUED)
DERMAL PERMEABILITY CONSTANTS
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Molecular Weight	Log K(ow)	Dermal Permeability Constant {K(p)} (cm/hour) (a,b)	Note
Toluene	--	--	4.5E-02	a
Trichlorobenzene, 1,2,4-	--	--	1.1E-01	a
Trichloroethane, 1,1,1-	--	--	1.7E-02	a
Trichloroethane, 1,1,2-	--	--	8.4E-03	a
Trichloroethene	--	--	1.6E-02	a
Vinyl chloride	--	--	7.3E-03	a
Xylenes	--	--	8.0E-02	a,d
Cyanide	--	--	1.0E-03	b
Nitrate	--	--	1.0E-03	b
Arsenic	--	--	1.0E-03	b

Dermal permeability constants obtained as per EPA guidance (EPA, 1992a):

(a) Value obtained directly from table of constants.
(b) Value obtained as follows:

for organics: $\text{Log K(p)} = -2.72 + 0.71 \text{ Log K(ow)} - 0.0061 \text{ MW}$

where:
K(p) = the Dermal Permeability Constant in (cm/hr);
K(ow) = the Organic/Water Partition Coefficient in (ml/g);
MW = the molecular weight of the chemical

for inorganics: K(p) = 1.0E-03 cm/hr (default value)

(c) Value from table of constants is for 1,2-dichloroethene.
(d) Value from table of constants is for m-xylene.
(e) Default value for inorganics recommended by EPA (1992a).

Vapor Inhalation of Ground Water

The vapor inhalation from showering with contaminated ground water was assumed to result in the same volatile chemical intake as oral ingestion of ground water used for drinking.

Soil Ingestion

Chemical intakes through the soil ingestion exposure route were estimated for workers or recreational visitors who might come into contact with surface soils at the PVLF using the following equation:

$$Intake\ (mg/kg\text{-}day) = \frac{CS \times IR \times FC \times EF \times ED}{AT \times BW}$$

where,

CS	=	Chemical concentration in soil
IR	=	Ingestion rate of soil or sediments (kg/day)
FC	=	Fraction ingested from contaminated source (unitless)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
AT	=	Averaging time (period over which exposure is averaged--days)
BW	=	Body Weight (kg)

Variable Values:

CS: Site-specific measured values

IR: RME and Average values as shown in Table 6.1-14

FC: RME and Average values as shown in Table 6.1-14 (values selected based on estimated area of PAH-contaminated hot spot and human activity patterns)

EF: 250 days/year for on site workers
RME and Average for recreational visitors as shown in Table 6.1-14

ED: RME and Average values as shown in Table 6.1-14 for workers, recreational visitors and off site residents

BW: 70 kg (average adult bodyweight)
15 kg (average body weight for child aged 0-6)

AT: Pathway-specific period of exposure for non-carcinogenic effects (*i.e.*, ED x 365 days/year), and 70 year lifetime for carcinogenic effects (*i.e.*, 70 years x 365 days/year = 25,550 days)

Intakes for the soil contact pathway are summarized on Tables 6.1-24 and 6.1-25 for on site workers and recreational visitors for current and future scenarios.

Dermal Contact with Soil

Chemical intakes through dermal contact with soil were calculated for the organic COCs present in soil using the following equation:

$$Absorbed\ Dose(mg/kg\text{-}day) = \frac{CS \times SA \times AF \times ABS \times FC \times EF \times ED}{BW \times AT}$$

where,

CS	=	Chemical concentration in soil (mg/kg)
SA	=	Skin surface area available for contact (cm^2/event)
AF	=	Soil to skin adherence factor (kg/cm^2)
ABS	=	Absorption fraction (unitless)
FC	=	Fraction contacted from contaminated source (unitless)
EF	=	Exposure frequency (events/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (period over which exposure is averaged--days)

TABLE 6.1-24

DIRECT SOIL CONTACT PATHWAY INTAKES FOR ON SITE WORKERS AND RECREATIONAL VISITORS - CURRENT AND FUTURE RME CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Soil Concentration (mg/kg)	Current and Future On Site Worker Intakes				Current Recreational Visitor Intakes					
		ADI Soil Ingestion	ADI Dermal Contact	LADI Soil Ingestion	LADI Dermal Contact	Adult ADI Soil Ingestion	Adult ADI Dermal Contact	Child ADI Soil Ingestion	Child ADI Dermal Contact	LADI Soil Ingestion	LADI Dermal Contact
Benzo(a)anthracene	12	3.73E-07	1.30E-06	1.33E-07	4.63E-07	3.10E-07	5.40E-07	2.90E-06	1.37E-06	3.55E-07	3.03E-07
Benzo(a)pyrene	11	3.43E-07	1.20E-06	1.23E-07	4.27E-07	2.86E-07	4.97E-07	2.67E-06	1.26E-06	3.27E-07	2.79E-07
Benzo(b)fluoranthene	12	3.65E-07	1.27E-06	1.30E-07	4.53E-07	3.03E-07	5.28E-07	2.83E-06	1.34E-06	3.47E-07	2.96E-07
Benzo(k)fluoranthene	10	3.13E-07	1.09E-06	1.12E-07	3.90E-07	2.61E-07	4.54E-07	2.43E-06	1.15E-06	2.98E-07	2.54E-07
Chrysene	13	4.06E-07	1.41E-06	1.45E-07	5.04E-07	3.37E-07	5.87E-07	3.15E-06	1.49E-06	3.86E-07	3.29E-07
Dibenzo(a,h)anthracene	3	9.43E-08	3.28E-07	3.37E-08	1.17E-07	7.85E-08	1.37E-07	7.32E-07	3.47E-07	8.97E-08	7.66E-08
Indeno(1,2,3-cd)pyrene	4	1.22E-07	4.26E-07	4.37E-08	1.52E-07	1.02E-07	1.77E-07	9.51E-07	4.51E-07	1.16E-07	9.94E-08
Acenaphthene	11	3.35E-07	1.16E-06	1.19E-07	4.16E-07	2.78E-07	4.84E-07	2.60E-06	1.23E-06	3.18E-07	2.72E-07
Anthracene	9	2.66E-07	9.25E-07	9.50E-08	3.31E-07	2.21E-07	3.85E-07	2.07E-06	9.79E-07	2.53E-07	2.16E-07
Benzo(g,h,i)perylene	3	9.61E-08	3.34E-07	3.43E-08	1.19E-07	7.99E-08	1.39E-07	7.46E-07	3.54E-07	9.13E-08	7.80E-08
Fluoranthene	33	1.02E-06	3.53E-06	3.63E-07	1.26E-06	8.44E-07	1.47E-06	7.88E-06	3.74E-06	9.65E-07	8.24E-07
Fluorene	8	2.50E-07	8.70E-07	8.92E-08	3.11E-07	2.08E-07	3.62E-07	1.94E-06	9.20E-07	2.38E-07	2.03E-07
Naphthalene	4	1.27E-07	4.42E-07	4.53E-08	1.58E-07	1.06E-07	1.84E-07	9.85E-07	4.67E-07	1.21E-07	1.03E-07
Phenanthrene	40	1.23E-06	4.27E-06	4.39E-07	1.53E-06	1.02E-06	1.78E-06	9.53E-06	4.52E-06	1.17E-06	9.97E-07
Pyrene	32	9.67E-07	3.36E-06	3.45E-07	1.20E-06	8.04E-07	1.40E-06	7.51E-06	3.56E-06	9.19E-07	7.85E-07

All values in mg/kg-day.
RME = Reasonable Maximum Exposure
ADI = Average Daily Intake
LADI = Lifetime Average Daily Intake

TABLE 6.1-24 (CONTINUED)

DIRECT SOIL CONTACT PATHWAY INTAKES FOR ON SITE WORKERS AND RECREATIONAL VISITORS - CURRENT AND FUTURE RME CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Soil Concentration (mg/kg)	Future Recreational Visitor Intakes					
		Adult ADI Soil Ingestion	Adult ADI Dermal Contact	Child ADI Soil Ingestion	Child ADI Dermal Contact	LADI Soil Ingestion	LADI Dermal Contact
Benzo(a)anthracene	12	4.62E-07	8.05E-07	4.32E-06	2.05E-06	5.28E-07	4.51E-07
Benzo(a)pyrene	11	4.26E-07	7.41E-07	3.98E-06	1.88E-06	4.87E-07	4.16E-07
Benzo(b)fluoranthene	12	4.52E-07	7.87E-07	4.22E-06	2.00E-06	5.17E-07	4.41E-07
Benzo(k)fluoranthene	10	3.89E-07	6.76E-07	3.63E-06	1.72E-06	4.44E-07	3.79E-07
Chrysene	13	5.03E-07	8.75E-07	4.69E-06	2.22E-06	5.75E-07	4.91E-07
Dibenzo(a,h)anthracene	3	1.17E-07	2.04E-07	1.09E-06	5.17E-07	1.34E-07	1.14E-07
Indeno(1,2,3-cd)pyrene	4	1.52E-07	2.64E-07	1.42E-06	6.72E-07	1.74E-07	1.48E-07
Acenaphthene	11	4.15E-07	7.22E-07	3.87E-06	1.84E-06	4.74E-07	4.05E-07
Anthracene	9	3.30E-07	5.74E-07	3.08E-06	1.46E-06	3.77E-07	3.22E-07
Benzo(g,h,i)perylene	3	1.19E-07	2.07E-07	1.11E-06	5.27E-07	1.36E-07	1.16E-07
Fluoranthene	33	1.26E-06	2.19E-06	1.17E-05	5.57E-06	1.44E-06	1.23E-06
Fluorene	8	3.10E-07	5.39E-07	2.89E-06	1.37E-06	3.54E-07	3.02E-07
Naphthalene	4	1.57E-07	2.74E-07	1.47E-06	6.96E-07	1.80E-07	1.54E-07
Phenanthrene	40	1.52E-06	2.65E-06	1.42E-05	6.74E-06	1.74E-06	1.49E-06
Pyrene	32	1.20E-06	2.09E-06	1.12E-05	5.30E-06	1.37E-06	1.17E-06

All values in mg/kg-day.
RME = Reasonable Maximum Exposure
ADI = Average Daily Intake
[illegible] = Lifetime Average Daily Intake

TABLE 6.1-25

DIRECT SOIL CONTACT PATHWAY INTAKES FOR ON SITE WORKERS AND RECREATIONAL VISITORS - CURRENT AND FUTURE AVERAGE CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Average Soil Concentration (mg/kg)	On Site Worker Intakes				Current Recreational Visitor Intakes					
		ADI Soil Ingestion	ADI Dermal Contact	LADI Soil Ingestion	LADI Dermal Contact	Adult ADI Soil Ingestion	Adult ADI Dermal Contact	Child ADI Soil Ingestion	Child ADI Dermal Contact	LADI Soil Ingestion	LADI Dermal Contact
Benzo(a)anthracene	7	2.19E-07	6.57E-07	3.13E-08	9.39E-08	3.65E-08	1.37E-07	4.25E-07	2.55E-07	4.12E-08	3.95E-08
Benzo(a)pyrene	7	2.11E-07	6.34E-07	3.02E-08	9.06E-08	3.52E-08	1.32E-07	4.11E-07	2.46E-07	3.97E-08	3.81E-08
Benzo(b)fluoranthene	7	2.17E-07	6.50E-07	3.09E-08	9.28E-08	3.60E-08	1.35E-07	4.20E-07	2.52E-07	4.07E-08	3.90E-08
Benzo(k)fluoranthene	6	1.73E-07	5.20E-07	2.48E-08	7.43E-08	2.88E-08	1.08E-07	3.36E-07	2.02E-07	3.25E-08	3.12E-08
Chrysene	8	2.29E-07	6.88E-07	3.28E-08	9.83E-08	3.82E-08	1.43E-07	4.45E-07	2.67E-07	4.31E-08	4.13E-08
Dibenzo(a,h)anthracene	3	8.92E-08	2.68E-07	1.27E-08	3.82E-08	1.48E-08	5.57E-08	1.73E-07	1.04E-07	1.67E-08	1.61E-08
Indeno(1,2,3-cd)pyrene	3	1.02E-07	3.06E-07	1.46E-08	4.37E-08	1.70E-08	6.36E-08	1.98E-07	1.19E-07	1.91E-08	1.84E-08
Acenaphthene	6	1.96E-07	5.89E-07	2.80E-08	8.41E-08	3.26E-08	1.22E-07	3.81E-07	2.29E-07	3.68E-08	3.53E-08
Anthracene	5	1.53E-07	4.59E-07	2.18E-08	6.55E-08	2.54E-08	9.54E-08	2.97E-07	1.78E-07	2.87E-08	2.75E-08
Benzo(g,h,i)perylene	2	6.88E-08	2.06E-07	9.83E-09	2.95E-08	1.14E-08	4.29E-08	1.34E-07	8.01E-08	1.29E-08	1.24E-08
Fluoranthene	19	5.89E-07	1.77E-06	8.41E-08	2.52E-07	9.79E-08	3.67E-07	1.14E-06	6.86E-07	1.11E-07	1.06E-07
Fluorene	5	1.48E-07	4.43E-07	2.11E-08	6.33E-08	2.46E-08	9.22E-08	2.87E-07	1.72E-07	2.78E-08	2.66E-08
Naphthalene	2	7.39E-08	2.22E-07	1.06E-08	3.17E-08	1.23E-08	4.61E-08	1.43E-07	8.61E-08	1.39E-08	1.33E-08
Phenanthrene	23	7.08E-07	2.13E-06	1.01E-07	3.04E-07	1.18E-07	4.42E-07	1.38E-06	8.25E-07	1.33E-07	1.28E-07
Pyrene	18	5.35E-07	1.61E-06	7.64E-08	2.29E-07	8.90E-08	3.34E-07	1.04E-06	6.23E-07	1.00E-07	9.64E-08

All values in mg/kg-day
ADI = Average Daily Intake
LADI = Lifetime Average Daily Inake

TABLE 6.1-25 (CONTINUED)

DIRECT SOIL CONTACT PATHWAY INTAKES FOR ON SITE WORKERS AND RECREATIONAL VISITORS - CURRENT AND FUTURE AVERAGE CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Average Soil Concentration (mg/kg)	Future Recreational Visitor Intakes					
		Adult ADI Soil Ingestion	Adult ADI Dermal Contact	Child ADI Soil Ingestion	Child ADI Dermal Contact	LADI Soil Ingestion	LADI Dermal Contact
Benzo(a)anthracene	7	3.65E-08	1.37E-07	4.25E-07	2.55E-07	4.12E-08	3.95E-08
Benzo(a)pyrene	7	3.52E-08	1.32E-07	4.11E-07	2.46E-07	3.97E-08	3.81E-08
Benzo(b)fluoranthene	7	3.60E-08	1.35E-07	4.20E-07	2.52E-07	4.07E-08	3.90E-08
Benzo(k)fluoranthene	6	2.88E-08	1.08E-07	3.36E-07	2.02E-07	3.25E-08	3.12E-08
Chrysene	8	3.82E-08	1.43E-07	4.45E-07	2.67E-07	4.31E-08	4.13E-08
Dibenzo(a,h)anthracene	3	1.48E-08	5.57E-08	1.73E-07	1.04E-07	1.67E-08	1.61E-08
Indeno(1,2,3-cd)pyrene	3	1.70E-08	6.36E-08	1.98E-07	1.19E-07	1.91E-08	1.84E-08
Acenaphthene	6	3.26E-08	1.22E-07	3.81E-07	2.29E-07	3.68E-08	3.53E-08
Anthracene	5	2.54E-08	9.54E-08	2.97E-07	1.78E-07	2.87E-08	2.75E-08
Benzo(g,h,i)perylene	2	1.14E-08	4.29E-08	1.34E-07	8.01E-08	1.29E-08	1.24E-08
Fluoranthene	19	9.79E-08	3.67E-07	1.14E-06	6.86E-07	1.11E-07	1.06E-07
Fluorene	5	2.46E-08	9.22E-08	2.87E-07	1.72E-07	2.78E-08	2.66E-08
Naphthalene	2	1.23E-08	4.61E-08	1.43E-07	8.61E-08	1.39E-08	1.33E-08
Phenanthrene	23	1.18E-07	4.42E-07	1.38E-06	8.25E-07	1.33E-07	1.28E-07
Pyrene	18	8.90E-08	3.34E-07	1.04E-06	6.23E-07	1.00E-07	9.64E-08

All values in mg/kg-day

ADI = Average Daily Intake

= Lifetime Average Daily Inake

Variable values:

CS: Based on Site-specific measured value

SA: RME and Average values as shown in Table 6.1-14

AF: RME and Average values as shown in Table 6.1-14

ABS: Chemical-specific value (this value accounts for desorption of chemical from the soil matrix and absorption of chemical across the skin) (0.01 for organics. 0.001 for inorganics; EPA, 1991f)

FC: RME and Average values as shown in Table 6.1-14 (values selected based on estimated area of PAH-contaminated hot spot and human activity patterns)

EF: 250 days per year for a worker

104 days per year for a recreational visitor (2 day/week for each week of the year)

ED: 25 years for a worker

24 years for an adult recreational visitor

6 years for a child recreational visitor

BW: 70 kg (average adult body weight)

15 kg (average child body weight, 0-6 years)

AT: Pathway-specific period of exposure for non-carcinogenic effects (*i.e.*, ED x 365 days/year), and 70 year lifetime for carcinogenic effects (*i.e.*, 70 years x 365 days/year = 25,550 days)

Outdoor Air Dust Inhalation Pathway

Exposures from inhalation of chemicals adsorbed to respirable particulates were estimated for both the worker and resident as follows:

$$Intake(mg/kg-day) = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT}$$

where,

CA	=	Contaminant concentration in air (mg/m^3)
IR	=	Inhalation rate (m^3/day)
ET	=	Exposure time (hours/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
AT	=	Averaging time (period over which exposure is averaged--days)
BW	=	Body weight (kg)

Variable values:

CA: Values estimated using dispersion modeling

IR: 2.5 m^3/hr (20 m^3 per 8 hr workday) for the adult worker and recreational visitors (both children and adults) and
0.83 m^3/hr (20 m^3 per 24 hour day) for residents

ET: RME and Average values as shown in Table 6.1-14 (values selected based on estimated area of PAH-contaminated hot spot and human activity patterns)

EF: 350 days/year for resident
250 days/year for worker
104 days/year for the recreational visitor (2 day/week for each week of the year) based on current land use
155 days/year (3 day/week for each week of the year) for the future recreational visitor

ED: 25 years for the on site worker
24 years for an adult resident
6 years for a child resident

BW: 70 kg (average adult body weight)
15 kg (average weight of individual between 0 and 6 years of age) (EPA, 1990)

AT: Pathway-specific period of exposure for non-carcinogenic effects (*i.e.*, ED x 365 days/year), and 70 year lifetime for carcinogenic effects (*i.e.*, 70 years x 365 days/year = 25,550 days)

Intakes for the outdoor air dust inhalation pathway are summarized on Tables 6.1-26 and 6.1-27 for the off site resident, on site worker, and recreational visitor for current and future scenarios.

6.1.2.6 Exposure Assessment Summary

The results of the exposure assessment for chemicals are presented as intake rates in milligram of chemical per kilogram of body weight per day (mg/kg-day) for two different averaging periods:

1) Intakes averaged over 70 years were used to assess lifetime cancer risks; and

2) Intake rates averaged over the exposure duration (ED) were used to assess non-cancer effects.

The intake rates for chemicals from the various exposure pathways are presented in Tables 6.1-15 through 6.1-27.

6.1.2.7 Uncertainties in Exposure Assessment

There are several uncertainties associated with the data and assumptions used in the exposure assessment:

- The exposure assessment identifies direct contact exposure pathways with ground water (via ingestion, dermal contact with water during showering, and inhalation of VOCs volatilized during showering) as complete pathways under future land use. In fact, there is a very low probability that there will be actual exposure to ground water due to the use of municipal water in the vicinity of the PVLF.

- Exposure concentrations in ground water for direct contact scenarios of off site residents are based on modeled concentrations which are extremely

TABLE 6.1-26

OUTDOOR AIR DUST INHALATION PATHWAY INTAKES FOR OFF SITE RESIDENTS, ON SITE WORKERS, AND RECREATIONAL VISITORS - CURRENT AND FUTURE RME CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Air Concentrations (mg/m3)		Current and Future Intakes (mg/kg-day)				
			Downwind Off Site Resident			On Site Worker	
	Off Site Residence	On Site	Adult ADI	Child ADI	LADI	ADI	LADI
Benzo(a)anthracene	1.65E-07	2.12E-06	4.49E-08	2.10E-07	3.34E-08	2.59E-08	9.26E-09
Benzo(a)pyrene	1.52E-07	1.95E-06	4.14E-08	1.93E-07	3.08E-08	2.39E-08	8.53E-09
Benzo(b)fluoranthene	1.61E-07	2.07E-06	4.40E-08	2.05E-07	3.26E-08	2.54E-08	9.06E-09
Benzo(k)fluoranthene	1.38E-07	1.78E-06	3.78E-08	1.76E-07	2.81E-08	2.18E-08	7.78E-09
Chrysene	1.79E-07	2.31E-06	4.89E-08	2.28E-07	3.63E-08	2.82E-08	1.01E-08
Dibenzo(a,h)anthracene	4.17E-08	5.36E-07	1.14E-08	5.31E-08	8.45E-09	6.56E-09	2.34E-09
Indeno(1,2,3-cd)pyrene	5.41E-08	6.96E-07	1.48E-08	6.89E-08	1.10E-08	8.52E-09	3.04E-09
Acenaphthene	1.48E-07	1.90E-06	4.03E-08	1.88E-07	3.00E-08	2.33E-08	8.31E-09
Anthracene	1.17E-07	1.51E-06	3.21E-08	1.50E-07	2.38E-08	1.85E-08	6.60E-09
Benzo(g,h,i)perylene	4.24E-08	5.46E-07	1.16E-08	5.40E-08	8.60E-09	6.68E-09	2.39E-09
Fluoranthene	4.48E-07	5.77E-06	1.22E-07	5.71E-07	9.09E-08	7.06E-08	2.52E-08
Fluorene	1.10E-07	1.42E-06	3.01E-08	1.41E-07	2.24E-08	1.74E-08	6.20E-09
Naphthalene	5.61E-08	7.21E-07	1.53E-08	7.14E-08	1.14E-08	8.82E-09	3.15E-09
Phenanthrene	5.42E-07	6.98E-06	1.48E-07	6.91E-07	1.10E-07	8.54E-08	3.05E-08
Pyrene	4.27E-07	5.49E-06	1.17E-07	5.44E-07	8.65E-08	6.72E-08	2.40E-08

RME = Reasonable Maximum Exposure
ADI = Average Daily Intake
= Lifetime Average Daily Intake

TABLE 6.1-26 (CONTINUED)

OUTDOOR AIR DUST INHALATION PATHWAY INTAKES FOR OFF SITE RESIDENTS, ON SITE WORKERS, AND RECREATIONAL VISITORS - CURRENT AND FUTURE RME CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Air Concentrations (mg/m3)		Current and Future Intakes (mg/kg-day)					
			Current Recreational Visitor			Future Recreational Visitor		
	Off Site Residence	On Site	Adult ADI	Child ADI	LADI	Adult ADI	Child ADI	LADI
Benzo(a)anthracene	1.65E-07	2.12E-06	1.08E-08	5.03E-08	8.01E-09	1.61E-08	7.50E-08	1.19E-08
Benzo(a)pyrene	1.52E-07	1.95E-06	9.94E-09	4.64E-08	7.38E-09	1.48E-08	6.91E-08	1.10E-08
Benzo(b)fluoranthene	1.61E-07	2.07E-06	1.05E-08	4.92E-08	7.84E-09	1.57E-08	7.34E-08	1.17E-08
Benzo(k)fluoranthene	1.38E-07	1.78E-06	9.07E-09	4.23E-08	6.74E-09	1.35E-08	6.31E-08	1.00E-08
Chrysene	1.79E-07	2.31E-06	1.17E-08	5.47E-08	8.72E-09	1.75E-08	8.16E-08	1.30E-08
Dibenzo(a,h)anthracene	4.17E-08	5.36E-07	2.73E-09	1.27E-08	2.03E-09	4.07E-09	1.90E-08	3.02E-09
Indeno(1,2,3-cd)pyrene	5.41E-08	6.96E-07	3.54E-09	1.65E-08	2.63E-09	5.28E-09	2.46E-08	3.92E-09
Acenaphthene	1.48E-07	1.90E-06	9.68E-09	4.52E-08	7.19E-09	1.44E-08	6.73E-08	1.07E-08
Anthracene	1.17E-07	1.51E-06	7.69E-09	3.59E-08	5.71E-09	1.15E-08	5.35E-08	8.52E-09
Benzo(g,h,i)perylene	4.24E-08	5.46E-07	2.78E-09	1.30E-08	2.06E-09	4.14E-09	1.93E-08	3.08E-09
Fluoranthene	4.48E-07	5.77E-06	2.94E-08	1.37E-07	2.18E-08	4.38E-08	2.04E-07	3.25E-08
Fluorene	1.10E-07	1.42E-06	7.23E-09	3.37E-08	5.37E-09	1.08E-08	5.03E-08	8.00E-09
Naphthalene	5.61E-08	7.21E-07	3.67E-09	1.71E-08	2.73E-09	5.47E-09	2.55E-08	4.06E-09
Phenanthrene	5.42E-07	6.98E-06	3.55E-08	1.66E-07	2.64E-08	5.29E-08	2.47E-07	3.93E-08
Pyrene	4.27E-07	5.49E-06	2.80E-08	1.30E-07	2.08E-08	4.17E-08	1.94E-07	3.10E-08

RME = Reasonable Maximum Exposure
ADI = Average Daily Intake
LADI = Lifetime Average Daily Intake

TABLE 6.1-27

OUTDOOR AIR DUST INHALATION PATHWAY INTAKES FOR OFF SITE RESIDENTS, ON SITE WORKERS, AND RECREATIONAL VISITORS - CURRENT AND FUTURE AVERAGE EXPOSURE CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Air Concentrations (mg/m3)		Current and Future Intakes (mg/kg-day)				
			Downwind Off Site Resident			On Site Worker	
	Off Site Residence	On Site	Adult ADI	Child ADI	LADI	ADI	LADI
Benzo(a)anthracene	9.68E-08	1.25E-06	1.76E-08	8.22E-08	9.31E-09	1.52E-08	2.18E-09
Benzo(a)pyrene	9.34E-08	1.20E-06	1.70E-08	7.93E-08	8.98E-09	1.47E-08	2.10E-09
Benzo(b)fluoranthene	9.57E-08	1.23E-06	1.74E-08	8.12E-08	9.20E-09	1.51E-08	2.15E-09
Benzo(k)fluoranthene	7.65E-08	9.85E-07	1.39E-08	6.50E-08	7.36E-09	1.20E-08	1.72E-09
Chrysene	1.01E-07	1.30E-06	1.84E-08	8.60E-08	9.74E-09	1.59E-08	2.28E-09
Dibenzo(a,h)anthracene	3.94E-08	5.07E-07	7.17E-09	3.34E-08	3.79E-09	6.20E-09	8.86E-10
Indeno(1,2,3-cd)pyrene	4.50E-08	5.79E-07	8.19E-09	3.82E-08	4.33E-09	7.09E-09	1.01E-09
Acenaphthene	8.67E-08	1.12E-06	1.58E-08	7.36E-08	8.33E-09	1.36E-08	1.95E-09
Anthracene	6.75E-08	8.69E-07	1.23E-08	5.73E-08	6.49E-09	1.06E-08	1.52E-09
Benzo(g,h,i)perylene	3.04E-08	3.91E-07	5.53E-09	2.58E-08	2.92E-09	4.78E-09	6.83E-10
Fluoranthene	2.60E-07	3.35E-06	4.73E-08	2.21E-07	2.50E-08	4.09E-08	5.85E-09
Fluorene	6.53E-08	8.40E-07	1.19E-08	5.54E-08	6.28E-09	1.03E-08	1.47E-09
Naphthalene	3.26E-08	4.20E-07	5.94E-09	2.77E-08	3.14E-09	5.14E-09	7.34E-10
Phenanthrene	3.13E-07	4.03E-06	5.69E-08	2.66E-07	3.01E-08	4.93E-08	7.04E-09
Pyrene	2.36E-07	3.04E-06	4.30E-08	2.01E-07	2.27E-08	3.72E-08	5.32E-09

ADI = Average Daily Intake
= Lifetime Average Daily Intake

TABLE 6.1-27 (CONTINUED)

OUTDOOR AIR DUST INHALATION PATHWAY INTAKES FOR OFF SITE RESIDENTS, ON SITE WORKERS, AND RECREATIONAL VISITORS - CURRENT AND FUTURE AVERAGE EXPOSURE CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Air Concentrations (mg/m3)		Current and Future Intakes (mg/kg-day)					
			Current Recreational Visitor			Future Recreational Visitor		
	Off Site Residence	On Site	Adult ADI	Child ADI	LADI	Adult ADI	Child ADI	LADI
Benzo(a)anthracene	9.68E-08	1.25E-06	3.17E-09	1.48E-08	1.68E-09	3.17E-09	1.48E-08	1.68E-09
Benzo(a)pyrene	9.34E-08	1.20E-06	3.06E-09	1.43E-08	1.62E-09	3.06E-09	1.43E-08	1.62E-09
Benzo(b)fluoranthene	9.57E-08	1.23E-06	3.13E-09	1.46E-08	1.66E-09	3.13E-09	1.46E-08	1.66E-09
Benzo(k)fluoranthene	7.65E-08	9.85E-07	2.51E-09	1.17E-08	1.32E-09	2.51E-09	1.17E-08	1.32E-09
Chrysene	1.01E-07	1.30E-06	3.32E-09	1.55E-08	1.75E-09	3.32E-09	1.55E-08	1.75E-09
Dibenzo(a,h)anthracene	3.94E-08	5.07E-07	1.29E-09	6.02E-09	6.82E-10	1.29E-09	6.02E-09	6.82E-10
Indeno(1,2,3-cd)pyrene	4.50E-08	5.79E-07	1.47E-09	6.88E-09	7.79E-10	1.47E-09	6.88E-09	7.79E-10
Acenaphthene	8.67E-08	1.12E-06	2.84E-09	1.32E-08	1.50E-09	2.84E-09	1.32E-08	1.50E-09
Anthracene	6.75E-08	8.69E-07	2.21E-09	1.03E-08	1.17E-09	2.21E-09	1.03E-08	1.17E-09
Benzo(g,h,i)perylene	3.04E-08	3.91E-07	9.95E-10	4.64E-09	5.26E-10	9.95E-10	4.64E-09	5.26E-10
Fluoranthene	2.60E-07	3.35E-06	8.51E-09	3.97E-08	4.50E-09	8.51E-09	3.97E-08	4.50E-09
Fluorene	6.53E-08	8.40E-07	2.14E-09	9.97E-09	1.13E-09	2.14E-09	9.97E-09	1.13E-09
Naphthalene	3.26E-08	4.20E-07	1.07E-09	4.99E-09	5.65E-10	1.07E-09	4.99E-09	5.65E-10
Phenanthrene	3.13E-07	4.03E-06	1.02E-08	4.78E-08	5.42E-09	1.02E-08	4.78E-08	5.42E-09
Pyrene	2.36E-07	3.04E-06	7.74E-09	3.61E-08	4.09E-09	7.74E-09	3.61E-08	4.09E-09

ADI = Average Daily Intake
LADI = Lifetime Average Daily Intake

conservative due to the assumptions made in the model and the complex hydrogeology in the vicinity of the PVLF. Furthermore, it is unlikely that any future well drilled very close to the PVLF could produce enough water to make it cost effective.

- Several of the ground water modeling parameters were conservatively chosen in order to account for the uncertainties inherent in the ground water modeling exercise. For example, source area concentrations were based upon the highest measured chemical concentrations found on site. As noted earlier, predicted ground water exposure point concentrations could be overestimated by at least 1.5 orders of magnitude;

- Conservative exposure assumptions were used to estimate the duration and magnitude of exposure. The assumptions on contact rates are typically used by risk assessors to reflect upper-bound estimates for these activities to avoid underestimation of risk. Average case exposure assumptions were also calculated to provide a less conservative, more plausible estimate of risks.

- For the outdoor air pathway calculations, assumed landfill gas collection efficiencies of 75 to 95 percent were used to calculate potential emissions, although the actual capture rate for the PVLF gas collection system is estimated to exceed 98 percent. Therefore, the predicted air vapor concentrations could be overestimated by a factor ranging from two to more than ten. The particulate emissions estimates were based upon highest measured concentrations in soils and are thus likely to be conservative. Emissions were also calculated using a conservative screening methodology. Finally, the dispersion model used was a conservative screening model.

6.1.3 Toxicity Assessment

The toxicity assessment determines how much exposure to a particular chemical can produce a particular health effect. This assessment provides, where possible, a numerical estimate

of the increased likelihood and/or severity of adverse effects associated with chemical exposure (EPA, 1989a). The potential for chemicals to elicit adverse health effects will be interpreted through the use of toxicity criteria derived by the EPA and in some instances by DTSC.

For purposes of the toxicity assessment, the COCs have been classified into two broad categories: noncarcinogens and carcinogens. This classification is used because health risks are calculated quite differently for carcinogenic and non-carcinogenic effects. Toxicity studies with laboratory animals or epidemiological studies of human populations provide the data used to develop these toxicity criteria. The toxicity criteria are combined with the exposure estimates (developed in Section 6.1.2) in the risk characterization process (Section 6.1.4) to quantify adverse health effects from chemicals potentially originating from the PVLF.

The toxicity criteria used in the risk assessment were obtained from these sources:

- California Cancer Potency Factors, a compilation of cancer potency factors developed or approved by the California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, the Department of Pesticide Regulation, and DTSC.
- The Integrated Risk Information System (IRIS), a database available through the EPA Environmental Criteria and Assessments Office (ECAO) in Cincinnati, Ohio. IRIS, prepared and maintained by EPA, contains health risk and EPA regulatory information on specific chemicals.
- The Health Effects Assessment Summary (HEAST), provided by the EPA Office of Solid Waste and Emergency Response (OSWER) (EPA, 1991a). HEAST is a compilation of toxicity criteria published in health effects documents issued by the EPA.

California Cancer Potency Factors dated November 1, 1994, were used as the primary source of carcinogenic criteria. In accordance with EPA guidance for risk assessment (endorsed by DTSC), criteria from IRIS were given higher priority than those from HEAST.

The toxicity assessment is presented in these sections: Section 6.1.3.1 discusses toxicity criteria for non-carcinogenic effects; Section 6.1.3.2 discusses toxicity criteria for carcinogenic effects; and Section 6.1.3.3 discusses uncertainties associated with the toxicity assessment.

In addition, brief toxicity profiles of the COCs are presented in Appendix D.10.

6.1.3.1 Non-Carcinogenic Effects

Non-carcinogenic effects were evaluated using either *reference doses* (RfDs) or *reference concentrations* (RfCs) developed by EPA. These are defined and discussed below.

The RfD is a health-based criterion used in evaluating non-carcinogenic effects. It is based on the assumption that thresholds exist for non-carcinogenic toxic effects (*i.e.*, liver or kidney damage), but do not exist for carcinogenic effects. In general, the RfD is an estimate (with uncertainty spanning perhaps an order of magnitude, or more for certain compounds) of a daily exposure to the human population (including sensitive subgroups such as children or the elderly) that is likely to be without an appreciable risk of deleterious effects during a lifetime of exposure (EPA, 1989a). RfDs are expressed in units of mg/kg/day (intake) for oral routes of exposure, while RfCs are expressed in units of mg/m^3 air (concentration) for inhalation exposure.

The terms *oral RfD* and *inhalation RfD* will be used to refer to RfDs and to RfCs converted to intake rates. The toxicity constants selected for this risk assessment are presented in Tables 6.1-28 and 6.1-29.

Potential health effects associated with exposure to each non-carcinogenic compound were evaluated by calculating a *hazard quotient* (HQ). The HQ is calculated as the ratio of the intake to the oral or inhalation RfD for a particular chemical. If the estimated average daily dose (ADD) or intake for any single chemical is greater than its oral or inhalation RfD, the HQ will exceed one (unity), indicating that there exists the potential for adverse health effects associated with exposure to that chemical. A HQ of less than one indicates that the predicted exposure to a chemical should not result in adverse health effects.

TABLE 6.1-28

TOXICITY CONSTANTS FOR THE GROUND WATER PATHWAYS

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	RfD (mg/kg-day)			Slope Factor (per mg/kg-day)		
	Oral	Inhalation	Dermal	Oral	Inhalation	Dermal
Acetone	1.00E-01	1.00E-01	1.00E-01	NA	NA	NA
Benzene	1.71E-03	1.71E-03	1.71E-03	1.00E-01	1.00E-01	1.00E-01
Bis-(2-chloroethyl)ether	NA	NA	NA	2.50E+00	2.50E+00	2.50E+00
Bromodichloromethane	2.00E-02	2.00E-02	2.00E-02	1.30E-01	1.30E-01	1.30E-01
Bromoform	2.00E-02	2.00E-02	2.00E-02	7.90E-03	3.90E-03	7.90E-03
Bromomethane	1.40E-03	1.43E-03	1.40E-03	NA	NA	NA
Butanone, 2-	6.00E-01	2.90E-01	6.00E-01	NA	NA	NA
Carbon tetrachloride	7.00E-04	5.71E-04	7.00E-04	1.50E-01	1.50E-01	1.50E-01
Chlordane	6.00E-05	6.00E-05	6.00E-05	1.20E+00	1.20E+00	1.20E+00
Chlorobenzene	2.00E-02	5.71E-03	2.00E-02	NA	NA	NA
Chloroethane	4.00E-01	2.90E+00	4.00E-01	NA	NA	NA
Chloroform	1.00E-02	1.00E-02	1.00E-02	3.10E-02	1.90E-02	3.10E-02
Chloromethane	NA	NA	NA	1.30E-02	6.30E-03	1.30E-02
Chlorophenol, 2-	5.00E-03	5.00E-03	5.00E-03	NA	NA	NA
DDD	NA	NA	NA	2.40E-01	2.40E-01	2.40E-01
DDE	NA	NA	NA	3.40E-01	3.40E-01	3.40E-01
DDT	5.00E-04	5.00E-04	5.00E-04	3.40E-01	3.40E-01	3.40E-01
Di-n-butylphthalate	1.00E-01	1.00E-01	1.00E-01	NA	NA	NA
Dibromochloromethane	2.00E-02	2.00E-02	2.00E-02	9.40E-02	9.40E-02	9.40E-02
Dichlorobenzene, 1,2-	9.00E-02	5.70E-02	9.00E-02	NA	NA	NA
Dichlorobenzene, 1,4-	2.29E-01	2.29E-01	2.29E-01	4.00E-02	4.00E-02	4.00E-02
Dichloroethane, 1,1-	1.00E-01	1.43E-01	1.00E-01	5.70E-03	5.70E-03	5.70E-03
Dichloroethane,1,2-	2.86E-03	2.86E-03	2.86E-03	7.00E-02	7.00E-02	7.00E-02
Dichloroethene, 1,1-	9.00E-03	9.00E-03	9.00E-03	6.00E-01	1.80E-01	6.00E-01
Dichloroethene, cis-1,2-	1.00E-02	1.00E-02	1.00E-02	NA	NA	NA
Dichloroethene, trans-1,2-	2.00E-02	2.00E-02	2.00E-02	NA	NA	NA

RfD = Reference Dose
NA = Not Available

TABLE 6.1-28 (CONTINUED)
TOXICITY CONSTANTS FOR THE GROUND WATER PATHWAYS
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	RfD (mg/kg-day)			Slope Factor (per mg/kg-day)		
	Oral	Inhalation	Dermal	Oral	Inhalation	Dermal
Dichloropropane, 1,2-	1.40E-03	1.40E-03	1.40E-03	6.30E-02	6.30E-02	6.30E-02
Dichloropropene, 1,3-	3.00E-04	5.71E-03	3.00E-04	1.80E-01	4.30E-02	1.80E-01
Dieldrin	1.60E+01	1.60E+01	1.60E+01	1.60E+00	1.60E+00	1.60E+00
Diethylphthalate	8.00E-01	8.00E-01	8.00E-01	NA	NA	NA
Ethylbenzene	1.00E-01	2.90E-01	1.00E-01	NA	NA	NA
Freon 11 (CCL3F)	3.00E-01	2.00E-01	3.00E-01	NA	NA	NA
Isophorone	2.00E-01	2.00E-01	2.00E-01	9.50E-04	9.50E-04	9.50E-04
Lindane	3.00E-04	3.00E-04	3.00E-04	1.10E+00	1.10E+00	1.10E+00
Methylene chloride	6.00E-02	8.57E-01	6.00E-02	1.40E-02	3.50E-03	1.40E-02
N-nitrosodi-n-propylamine	NA	NA	NA	7.00E+00	7.00E+00	7.00E+00
N-nitrosodiphenylamine	NA	NA	NA	9.00E-03	9.00E-03	9.00E-03
Pentachlorophenol	3.00E-02	3.00E-02	3.00E-02	1.80E-02	1.80E-02	1.80E-02
Phenol	6.00E-01	6.00E-01	6.00E-01	NA	NA	NA
Tetrachloroethene	1.00E-02	1.00E-02	1.00E-02	5.10E-02	2.10E-02	5.10E-02
Tetrahydrofuran	NA	NA	NA	NA	NA	NA
Toluene	2.00E-01	1.14E-01	2.00E-01	NA	NA	NA
Trichlorobenzene, 1,2,4-	1.00E-02	5.70E-02	1.00E-02	NA	NA	NA
Trichloroethane, 1,1,1-	9.00E-02	2.86E-01	9.00E-02	NA	NA	NA
Trichloroethane, 1,1,2-	4.00E-03	4.00E-03	4.00E-03	5.70E-02	5.60E-02	5.70E-02
Trichloroethene	6.00E-03	6.00E-03	6.00E-03	1.50E-02	1.00E-02	1.50E-02
Vinyl Chloride	NA	NA	NA	2.70E-01	2.70E-01	2.70E-01
Xylenes	2.00E+00	2.00E+00	2.00E+00	NA	NA	NA
Cyanide	2.00E-02	2.00E-02	2.00E-02	NA	NA	NA
Nitrate	1.60E+00	1.60E+00	1.60E+00	NA	NA	NA
Arsenic	3.00E-04	3.00E-04	3.00E-04	1.80E+00	1.20E+01	1.80E+00

RfD = Reference Dose
NA = Not Available

TABLE 6.1-29

TOXICITY CONSTANTS FOR THE DIRECT CONTACT AND DUST INHALATION PATHWAYS

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	RfD (mg/kg-day)			Slope Factor (per mg/kg-day)		
	Oral	Inhalation	Dermal	Oral	Inhalation	Dermal
Benzo(a)anthracene	NA	NA	NA	1.2	0.39	1.2
Benzo(a)pyrene	NA	NA	NA	12	3.9	12
Benzo(b)fluoranthene	NA	NA	NA	1.2	0.39	1.2
Benzo(k)fluoranthene	NA	NA	NA	1.2	0.39	1.2
Chrysene	NA	NA	NA	0.12	0.039	0.12
Dibenzo(a,h)anthracene	NA	NA	NA	4.1	4.1	4.1
Indeno(1,2,3-cd)pyrene	NA	NA	NA	1.2	0.39	1.2
Acenaphthene	6.0E-02	6.0E-02	6.0E-02	NA	NA	NA
Anthracene	3.0E-01	3.0E-01	3.0E-01	NA	NA	NA
Benzo(g,h,i)perylene	NA	NA	NA	NA	NA	NA
Fluoranthene	4.0E-02	4.0E-02	4.0E-02	NA	NA	NA
Fluorene	4.0E-02	4.0E-02	4.0E-02	NA	NA	NA
Naphthalene	4.0E-02	4.0E-02	4.0E-02	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA
Pyrene	3.0E-02	3.0E-02	3.0E-02	NA	NA	NA

RfD = Reference Dose
NA = Not Available

RfDs are derived from critical health effects (target organs). HQs may be grouped by critical effect and summed to yield a *hazard index* (HI) in order to assess the potential for non-carcinogenic effects posed by more than one chemical. The HI can exceed unity even if no single chemical exposure exceeds its allowable exposure level. For most of the chemicals found at the PVLF, critical effects are associated with the liver and/or kidney damage; other critical effects or target organs include the blood and nervous system. Critical effects or target organs were not available for some compounds. All HQs were summed to yield HIs for each scenario rather than each effect.

6.1.3.2 Carcinogenic Effects

Evidence of the carcinogenicity of a chemical comes from lifetime studies with laboratory animals and/or human epidemiological studies. Unless evidence to the contrary exists, carcinogenic responses occurring at the exposure levels studied (typically high doses) are assumed to occur at all lower doses (a linear extrapolation). Thus, exposure to any level of a carcinogen is assumed to have a finite risk of inducing cancer.

Because of the difficulties in quantifying risks at low levels of exposure in either animal or epidemiological studies, mathematical models are used to extrapolate from high to low doses. The linearized multi-stage model for low dose extrapolation is recommended by regulatory agencies (EPA, 1986). Use of the linearized multi-stage model leads to a conservative, upper-bound estimate of risk. The linearized multi-stage model incorporates a procedure for estimating the largest possible slope at low doses that is consistent with experimental dose-response data (use of a large slope tends to produce a higher estimate of cancer risk). The most sensitive species of animal tested is used for extrapolation to humans on the assumption that humans are as sensitive as the most sensitive animal species. The true risk is not likely to be higher than the estimate and is most likely lower (and could even be zero).

Numerical estimates of cancer potency are presented as *slope factors* (SFs). Under an assumption of dose-response linearity at low doses, the SF defines the cancer risk due to continuous lifetime exposure to one unit of carcinogen (in units of risk per mg/kg/day). Individual cancer risk was calculated as the product of exposure to a chemical (in mg/kg/day) and the SF for that chemical (in $(mg/kg/day)^{-1}$). Cancer risks from inhalation exposure to certain chemicals are characterized using

unit risk values (URVs). The URV defines the cancer risk due to continuous constant lifetime exposure to one unit of carcinogen (in units of risk per $\mu g/m^3$ of air). URVs were converted to units of risk per mg/kg/day using the assumption of a 20-m^3/day inhalation rate and a 70-kg body weight as recommended by guidance (EPA, 1989a). The terms *oral SF* and *inhalation SF* will be used to refer to SFs and to URVs converted to SF units. Cancer risks from exposure to multiple carcinogens and multiple pathways were assumed to be additive, based on the EPA carcinogen risk assessment guidelines (EPA, 1986).

Carcinogens are classified according to the strength of the scientific evidence regarding their ability to produce cancer in humans. The weight-of-evidence classifications are as follows:

(A)	Human carcinogen;
(B1) or (B2)	Probable human carcinogen. (B1) indicates that limited data indicating carcinogenicity in humans are available. (B2) indicates sufficient evidence for carcinogenicity in animals is available and inadequate or no evidence of carcinogenicity in humans is available;
(C)	Possible human carcinogen based on limited data for carcinogenicity in animals;
(D)	Not classifiable as to human carcinogenicity; and
(E)	Evidence of non-carcinogenicity in humans.

It should be noted that intake rates for the ingestion and inhalation routes of exposure do not account for absorption into the body and are therefore consistent with the toxicity values, which are based on the intake of chemicals by laboratory animals in food, drinking water, test solutions, or air. Chemical intake by dermal contact can only occur following absorption, so toxicity values from oral or inhalation exposures must be converted to units of absorbed dose to avoid underestimation of health risks from the dermal exposure pathways.

Each published SF or URV is accompanied by a weight-of-evidence classification, which considers the available data for a chemical to evaluate the likelihood that the chemical is a potential human carcinogen.

The toxicity assessment presents relevant information concerning the toxic effects and dose-response relationships for the COCs. This information includes toxicity constants developed by the EPA and used for the purposes of quantitative risk calculations. They were obtained from the three sources discussed previously.

Toxicity profiles for the major COCs are provided in Appendix D.10. The toxicity profiles are derived largely from information provided by the Agency for Toxic Substances and Disease Registry (ATSDR, 1988-1991), and provide descriptive information regarding the toxic effects of each chemical.

As with non-carcinogenic risks, carcinogenic risks should be estimated on a route specific basis, utilizing route specific SFs. Since SFs are not available for the dermal exposure route, oral SFs are usually converted to dermal SFs utilizing an assumed gastrointestinal (GI) absorption factor. As in the case of RfDs, the GI absorption factors used to convert from the oral SF to the dermal SF were 0.5 and 0.1, respectively, for organics and metals.

Chemicals Without Existing Toxicity Constants

4.3.1 Non-carcinogenic Effects

A number of the COCs do not have established RfDs. Typically, the quality of the available toxicity data for these chemicals has been deemed inadequate for the derivation of RfDs. This section describes the derivation of provisional constants for use in the non-carcinogenic risk assessment. It should be emphasized that the values derived here contain increased levels of uncertainty as compared with the officially defined RfDs.

The COCs lacking established RfDs are as follows:

- The known or suspected carcinogens: Benzene, *bis*(2-chloroethyl)ether, DDD, DDE, Dichloroethane, Vinyl Chloride, and the carcinogenic PAHs; and
- Tetrahydrofuran, Acenaphthalene, Phenanthrene, Benzo[g,h,i]perylene.

The approach used to derive the provisional values was as follows:

- If Drinking Water Equivalent Levels (DWELs), defined by the EPA Office of Drinking Water were available, the oral criterion was based upon these values;

- For chemicals not having DWELs, an appropriate surrogate chemical having a defined RfD was utilized to obtain a first order approximation of toxicity for the chemical in question. Surrogates were chosen based upon expected similar chemical and toxicologic properties. Surrogate oral and inhalation RfDs were utilized when available. Otherwise, the oral RfD was used to define the oral, inhalation and dermal toxicity criteria for the chemical in question as long as no sensitive localized respiratory effects were suspected;

- If a reasonable surrogate could not be identified for a chemical in question, then the available oral toxicological data for the chemical was utilized to develop an oral toxicity value. The inhalation criterion was assumed to be equivalent to the oral value, as long as the available toxicological data did not indicate that the chemical caused sensitive localized respiratory effects; and

- Dermal criteria were based upon the derived oral values.

Bis(2-chloroethyl)ether

The oral criterion for *bis*(2-chloroethyl)ether was based upon a surrogate chemical, *bis*(2-chloroisopropyl)ether. Both these chemicals are structurally similar and likely to have similar toxicological properties. The critical toxic effect of *bis*(2-chloroisopropyl)ether via the oral route of exposure is upon the hematologic system; the oral RfD is 0.004 mg/kg-day. The inhalation criterion for *bis*(2-chloroethyl)ether was assumed to be equivalent to the oral criterion.

1,2-Dichloroethane

The inhalation toxicity of 1,2-dichloroethane is expected to be similar to that of the analogous 1,2-dichloropropane. Thus, the inhalation RfD for 1,2-dichloropropane was used as a surrogate for 1,2-dichloroethane (0.004 mg/m^3 or 0.001 mg/kg-day). The oral toxicity of 1,2-dichloroethane was assumed to be the same as that of 1,2-dichloropropane whose toxicity value is derived below.

DDD and DDE

DDT (1,1,1-trichloro-2,2-(4-chlorophenol)ethane) was chosen as a surrogate for both DDD(1,1-dichloro-2,2-(4-chlorophenol)ethane)and DDE(1,1-dichloro-2,2-(4-chlorophenol)ethene). The latter chemicals are primary metabolites of DDT having similar chemical structures. The oral RfD for DDT is 0.0005 mg/kg-day; The inhalation criteria for these chemicals were assumed to be equivalent to the oral criteria.

PAHs

The oral and inhalation toxicity constants of the carcinogenic PAHs and acenaphthalene, phenanthrene, benzo[g,h,i]perylene were based upon the oral RfD for pyrene of 0.03 mg/kg-day.

Trichloroethene

An oral toxicity criterion of 0.0074 mg/kg-day for trichloroethene was based upon the DWEL assuming an intake of 2 L/day for a 70 kg adult. The inhalation criterion was assumed equivalent to the oral value.

Criteria Defined from Toxicological Data

The ATSDR Toxicity Profiles for benzene, 1,2-dichloropropane, and vinyl chloride were reviewed and available oral NOAELs or LOAELs were identified for either chronic or

subchronic studies. A review of tetrahydrofuran toxicology (Moody, 1991) was utilized to obtain recent information on this chemical. The calculation of oral criteria for these chemicals is presented in Table 4-3. With the exception of 1,2-dichloropropane which has an inhalation RfD, the inhalation toxicity criteria were based upon the calculated oral values since there was no clear indication of sensitive local respiratory effects.

4.3.2 Carcinogenic Effects

Of the carcinogenic PAHs, only benzo(a)pyrene has a defined carcinogenic slope factor. However, the carcinogenic potency for other carcinogenic PAHs can be derived using the Toxicity Equivalency Factor approach. The carcinogenic potency for other PAHs that are suspected carcinogens may be calculated from that of benzo(a)pyrene by using the following toxicity equivalency factors: benzo(a)anthracene (0.1), benzo(b)fluoranthene (0.1), benzo(k)fluoranthene (0.1), chrysene (0.01), dibenzo(a,h)anthracene (1.0), and indeno(1,2,3-c,d)pyrene (0.1).

6.1.3.3 Uncertainties Associated with the Toxicity Assessment

Often, the emphasis in analyzing uncertainties in health risk estimates has been with the exposure assessment (*i.e.*, how much water an individual ingests, how much of a VOC volatilizes from water, how frequently an individual can come in contact with ground water from a site, how long an individual may live near a site, *et cetera*). However, the uncertainty associated with the exposure assumptions typically ranges from one to two orders of magnitude (10- to 100-fold), whereas the assumptions used to evaluate the toxicity of chemicals may provide the greatest sources of uncertainty. The extrapolation of cancer potency from laboratory animals to humans, which forms the basis for the cancer risk estimates presented in the risk assessment, may be associated with uncertainties ranging from three to five orders of magnitude (1,000- to 100,000-fold) for selected chemicals. Health-protective assumptions related to the toxicity of chemicals associated with the PVLF and used in this risk assessment systematically overstate the magnitude of health risks and include:

- Assumption that cancer risks are linearly related to exposure (*i.e.*, that carcinogenic effects have no thresholds);

- Assumption that exposure variables, and toxicity constants formulated for lifetime exposures are applicable for less than lifetime exposures; and
- Calculating inhalation RfDs from the corresponding oral RfDs. This may either underestimate or overestimate risks for the relevant COCs. For organics the uncertainty is probably less than one order of magnitude.

Evaluation of 1,1-Dichloroethene (1,1-DCE) as a Carcinogen

Several animal studies with 1,1-DCE have been negative for carcinogenicity. The EPA has judged these studies to be inadequate for detecting a carcinogenic effect (according to the IRIS profile for 1,1-DCE, dated January 20, 1992). However, the single positive study judged adequate by EPA did not unequivocally show a carcinogenic dose-response relationship (one important factor in judging whether or not a chemical causes cancer). 1,1-DCE is mutagenic and is structurally similar to vinyl chloride, a known human carcinogen. Based on this information, EPA classified 1,1-DCE as a group C, or possible human, carcinogen. Since the weight of evidence for carcinogenicity is less for 1,1-DCE than for vinyl chloride, it is less certain that this chemical is carcinogenic in humans. Including risks from 1,1-DCE may therefore overestimate total cancer risks associated with chemicals at the Site.

EPA Region IX recommends evaluation of the risks associated with 1,1-DCE using a *modified-RfD approach* (as opposed to using the SFs for this chemical). This approach is not endorsed by the DTSC and was, therefore, not applied to the PVLF risk assessment and is discussed here to present the uncertainties associated with quantifying risks from exposure to this chemical. The EPA Region IX approach involves including an additional 10-fold safety factor to the published RfD for this chemical (*i.e.*, multiplying by 0.1) to account for potential carcinogenicity of this chemical. EPA Region IX has stated that the number of negative cancer studies for 1,1-DCE is "notable." Five oral carcinogenicity studies have been conducted on 1,1-DCE including a lifetime joint study by the National Cancer Institute and National Toxicology Program. All of these oral cancer studies produced negative results. Eleven studies on 1,1-DCE evaluated carcinogenic potential via inhalation; ten of these studies produced negative results. One study, by Maltoni, did produce evidence of carcinogenic potential in mice, although this interpretation is blurred by the lack of a clear dose-response relationship. A similar study by the same group of investigators did not produce cancer in rats, even

though doses up to six-fold greater were administered. Thus, the evidence supporting the classification of 1,1-DCE as a "carcinogen" is especially weak.

6.1.4 Risk Characterization

The risk characterization combines the results of the exposure assessment with the toxicity constants (RfDs and SFs) to provide numerical indicators of potential non-carcinogenic effects, or upper-bound estimates of the risk of carcinogenic effects. Risk characterization also considers the possible magnitude of uncertainty surrounding the risk estimates.

Health risks associated with exposure to non-carcinogenic compounds were evaluated by calculating *hazard quotients* and *hazard indices*. The hazard quotient was calculated as the ratio of the intake rate to the RfD for a particular chemical:

$$HQ = \frac{E}{RfD}$$

where,

HQ	=	Hazard quotient
E	=	Exposure level (*i.e.*, intake) for a chemical (mg/kg-day)
RfD	=	Reference dose (mg/kg-day)

If the estimated daily intake for any single chemical is greater than its RfD, its hazard quotient will exceed unity indicating increased concern that non-carcinogenic effects could be manifested.

The hazard index characterizes the non-carcinogenic risk due to exposure to multiple chemicals and is calculated as follows:

$$HI = \frac{E_1}{RfD_1} + \frac{E_2}{RfD_2} + \cdots + \frac{E_i}{RfD_i}$$

where,

HI	=	Hazard index
E_i	=	Exposure level (or intake) for the i^{th} chemical (mg/kg-day)
RfD_i	=	Reference Dose for the i^{th} chemical (mg/kg-day)

The hazard index can exceed unity even when individual hazard quotients do not. Initially, a screening procedure is carried out by summing the hazard quotients of all the potential chemicals of concern. If the hazard index calculated in this way does not exceed unity, then the risk of non-carcinogenic effects of a mixture of chemicals is generally low. If the hazard index obtained by summing all chemicals exceeds unity, potential non-carcinogenic risks should be characterized by *segregating hazard* quotients according to the specific toxicity of the chemicals being evaluated. A segregated hazard index is obtained by summing the hazard quotients of chemicals acting on the same target organ or producing similar toxic action. Segregated hazard indices greater than unity indicate an increased risk of adverse non-carcinogenic effects.

Cancer risks from exposure to potential carcinogens are calculated utilizing SFs in the following way:

$$Risk = CDI \times SF$$

where,

Risk	=	Age-averaged, upper-bound, probability (in excess of the background risk) of an individual developing cancer over a 70-year lifetime (unitless)
CDI	=	Chronic daily intake averaged over 70 years (mg/kg-day)
SF	=	Slope factor $(mg/kg\text{-}day)^{-1}$

The total risk from all carcinogenic potential chemicals of concern is calculated by summing risks for all carcinogens and for all pathways.

6.1.4.1 Total Receptor Risks

Once the pathway specific risks have been calculated at the RME receptor locations, overall risks for each receptor should then be calculated. As previously discussed in Section 6.1.2.3, receptors were defined for the landfill in order to evaluate reasonable maximum exposures for each of the three complete pathways, *i.e.*, the outdoor air pathway (vapor and dust), ground water, and the direct contact pathways. These receptors include off site residents, on site workers, and recreational visitors. Each of the receptors is assumed to be exposed via the outdoor air pathway. Calculation of overall site risks at each of the receptors thus involved adding one of the pathway RME risks together. The off site residential receptor at Crenshaw Boulevard represents the RME for the outdoor air pathway; the overall risks for this receptor consist of the outdoor air pathway risks only. However, nearby residents may also use the recreational areas at the PVLF. The risks to a receptor who is both a nearby resident and recreational visitor can be calculated by adding the risks for these two receptors. Such a summation of risks, based on the assumption that nearby residents might also be exposed as recreational visitors, could result in an overestimation of risks for some off site residents who may not be recreational visitors to the PVLF. In addition, such a summation would tend to overcount potential intakes and risks, since residential intakes were calculated under the assumption that residents are exposed to outdoor air concentrations at the residential locations 24 hours per day.

6.1.4.2 Discussion of Health Risk Calculation Results

This section discusses the results of the risk calculations for the scenarios evaluated. Carcinogenic and non-carcinogenic results are summarized in Tables 6.1-30 through 6.1-33. These table are also included as Tables ES-1 through ES-4 in the Executive Summary.

6.1.4.2.1 Current Off Site Resident

This receptor was defined in order to characterize the RME for the outdoor air pathway (*i.e.*, the Crenshaw Boulevard resident was the nearest downwind resident identified in the AB 2588 modeling exercise). The scenario under consideration is that of a resident who currently lives near to the PVLF. The outdoor air pathway was identified as the only complete pathway by which residents near the PVLF could be exposed under current conditions. Other potential pathways

TABLE 6.1-30
SUMMARY OF EXCESS CANCER RISKS BY EXPOSURE SCENARIO FOR CURRENT LAND USE
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Exposure Scenario	RME	Average
Off Site Resident[1]		
Groundwater	Pathways Incomplete	Pathways Incomplete
Soil -		
Ingestion	Pathways Incomplete	Pathways Incomplete
Outdoor Dust Inhalation	2.0×10^{-7}	6.3×10^{-8}
Outdoor Vapor Inhalation[2]	2.7×10^{-6} (1.3×10^{-5})	1.3×10^{-6} (6.3×10^{-6})
Total Risk	**2.9×10^{-6} (1.3×10^{-5})**	**1.4×10^{-6} (6.4×10^{-6})**
On Site Worker		
Groundwater	Pathways Incomplete	Pathways Incomplete
Soil -		
Ingestion	2.1×10^{-6}	5.4×10^{-7}
Dermal Contact	7.4×10^{-6}	1.6×10^{-6}
Outdoor Dust Inhalation	5.5×10^{-8}	1.5×10^{-8}
Outdoor Vapor Inhalation	1.1×10^{-6} (5.5×10^{-6})	4.4×10^{-7} (2.2×10^{-6})
Total Risk	**1.1×10^{-5} (1.5×10^{-5})**	**2.5×10^{-6} (4.3×10^{-6})**
Recreational Visitor		
Groundwater	Pathways Incomplete	Pathways Incomplete
Soil -		
Ingestion	5.7×10^{-6}	7.1×10^{-7}
Dermal Contact	4.8×10^{-6}	6.8×10^{-7}
Outdoor Dust Inhalation	4.7×10^{-8}	1.1×10^{-8}
Outdoor Vapor Inhalation	2.4×10^{-7} (1.2×10^{-6})	4.0×10^{-8} (2.1×10^{-7})
Total Risk	**1.1×10^{-5} (1.2×10^{-5})**	**1.4×10^{-6} (1.6×10^{-6})**

(1) Values based on nearest downwind location.
(2) Values represent landfill gas collection system achieving 95% (75%) efficiency.

TABLE 6.1-31
SUMMARY OF EXCESS CANCER RISKS BY EXPOSURE SCENARIO FOR FUTURE LAND USE
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Exposure Scenario	RME	Average
Off Site Adult Resident		
Receptor Well 2 -		
Groundwater	3.3×10^{-5}	1.8×10^{-5}
Soil -		
Outdoor Dust Inhalation	1.0×10^{-8}	3.2×10^{-9}
Outdoor Vapor Inhalation[1]	1.3×10^{-7} (6.7×10^{-7})	6.0×10^{-8} (3.1×10^{-7})
Total Risk	**3.3×10^{-5} (3.4×10^{-5})**	**1.8×10^{-5} (1.8×10^{-5})**
	1.4×10^{-7} (6.8×10^{-7})	6.32×10^{-6} (3.132×10^{-7})
Receptor Well 5 -		
Groundwater	$\frac{1.4}{10,000,000}$ 1.8×10^{-5}	$\frac{6.32}{100,000,000}$ 9.8×10^{-6}
Soil -		
Outdoor Dust Inhalation	2.0×10^{-8}	6.3×10^{-9}
Outdoor Vapor Inhalation	2.7×10^{-7} (1.3×10^{-6})	1.3×10^{-7} (6.3×10^{-7})
Total Risk	**1.8×10^{-5} (1.9×10^{-5})**	**9.8×10^{-6} (9.9×10^{-6})**
	2.9×10^{-8} (1.32×10^{-6})	1.363×10^{-7} (6.363×10^{-7})
On Site Worker		
Groundwater	Pathways Incomplete	Pathways Incomplete
Soil -		
Ingestion	2.1×10^{-6}	5.4×10^{-7}
Dermal Contact	7.4×10^{-6}	1.6×10^{-6}
Outdoor Dust Inhalation	5.5×10^{-8}	1.5×10^{-8}
Outdoor Vapor Inhalation	1.1×10^{-6} (5.5×10^{-6})	4.4×10^{-7} (2.2×10^{-6})
Total Risk	**1.1×10^{-5} (1.5×10^{-5})**	**2.5×10^{-6} (4.3×10^{-6})**
Recreational Visitor		
Groundwater	Pathways Incomplete	Pathways Incomplete
Soil -		
Ingestion	8.5×10^{-6}	7.1×10^{-7}
Dermal Contact	7.2×10^{-6}	6.8×10^{-7}
Dust Inhalation	7.0×10^{-8}	1.1×10^{-8}
Outdoor Vapor Inhalation	3.6×10^{-7} (1.8×10^{-6})	4.0×10^{-8} (2.1×10^{-7})
Total Risk	**1.6×10^{-5} (1.7×10^{-5})**	**1.4×10^{-6} (1.6×10^{-6})**

(1) Values represent landfill gas collection system achieving 95% (75%) efficiency.

TABLE 6.1-32
SUMMARY OF NONCARCINOGENIC EFFECTS BY EXPOSURE SCENARIO FOR CURRENT LAND USE
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Pathway Scenario	RME	Average
Offsite Resident		
Adult		
Groundwater	Pathways Incomplete	Pathways Incomplete
Soil -		
Ingestion	Pathways Incomplete	Pathways Incomplete
Outdoor Dust Inhalation	<0.001	<0.001
Outdoor Vapor Inhalation[1]	0.02 (0.10)	0.01 (0.07)
Total	**0.02 (0.10)**	**0.01 (0.07)**
Child		
Groundwater	Pathways Incomplete	Pathways Incomplete
Soil -		
Ingestion	Pathways Incomplete	Pathways Incomplete
Outdoor Dust Inhalation	<0.001	<0.001
Outdoor Vapor Inhalation	0.09 (0.46)	0.06 (0.30)
Total	**0.09 (0.46)**	**0.06 (0.30)**
Onsite Worker		
Groundwater	Pathways Incomplete	Pathways Incomplete
Soil -		
Ingestion	<0.001	<0.001
Dermal Contact	<0.001	<0.001
Outdoor Dust Inhalation	<0.001	<0.001
Outdoor Vapor Inhalation	0.02 (0.09)	0.02 (0.09)
Total	**0.02 (0.09)**	**0.02 (0.09)**

TABLE 6.1-32 (CONTINUED)
SUMMARY OF NON-CARCINOGENIC EFFECTS BY EXPOSURE SCENARIO FOR CURRENT LAND USE
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Exposure Scenario	RME	Average
Recreational Visitor		
Groundwater	Pathways Incomplete	Pathways Incomplete
Adult		
Soil -		
Ingestion	<0.001	<0.001
Dermal Contact	<0.001	<0.001
Outdoor Dust Inhalation	<0.001	<0.001
Outdoor Vapor Inhalation	0.002 (0.009)	<0.001 (0.002)
Total	**0.002 (0.009)**	**<0.001 (0.002)**
Child		
Soil		
Ingestion	<0.001	<0.001
Dermal Contact	<0.001	<0.001
Outdoor Dust Inhalation	<0.001	<0.001
Outdoor Vapor Inhalation	0.008 (0.04)	0.002 (0.01)
Total	**0.008 (0.04)**	**0.002 (0.01)**

(1) Values represent landfill gas collection system achieving 95% (75%) efficiency.

TABLE 6.1-33
SUMMARY OF NON-CARCINOGENIC EFFECTS BY EXPOSURE SCENARIO FOR FUTURE LAND USE
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Exposure Scenario	RME	Average
Off Site Adult Resident		
Receptor Well 2 -		
Groundwater	0.12	0.082
Soil -		
Outdoor Dust Inhalation	<0.001	<0.001
Outdoor Vapor Inhalation[1]	0.001 (0.005)	<0.001 (0.004)
Total	**0.12 (0.12)** .001 (.005)	**0.082 (0.086)** .082 (.086)
Receptor Well 5 -		
Groundwater	0.08	0.056
Soil -		
Outdoor Dust Inhalation	<0.001	<0.001
Outdoor Vapor Inhalation	0.002 (0.01)	0.001 (0.007)
Total	**0.082 (0.09)** 0.002 (0.01)	**0.057 (0.063)** .001 (0.007)
Off Site Child Resident		
Receptor Well 2 -		
Groundwater	0.27	0.27
Soil -		
Outdoor Dust Inhalation	<0.001	<0.001
Outdoor Vapor Inhalation	0.005 (0.02)	0.003 (0.02)
Total	**0.28 (0.29)** (.005) (0.02)	**0.28 (0.29)** .003 (.002)
Receptor Well 5 -		
Groundwater	0.19	0.19
Soil -		
Outdoor Dust Inhalation	<0.001	<0.001
Outdoor Vapor Inhalation	0.009 (0.05)	0.006 (0.03)
Total	**0.20 (0.24)** 0.009 (0.05)	0.19 (0.22) .006 (.03)

(1) Values represent landfill gas collection system achieving 95% (75%) efficiency.

TABLE 6.1-33 (CONTINUED)
SUMMARY OF NON-CARCINOGENIC EFFECTS BY EXPOSURE SCENARIO FOR FUTURE LAND USE
PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Exposure Scenario	RME	Average
On Site Worker		
Groundwater	Pathways Incomplete	Pathways Incomplete
Soil -		
Ingestion	<0.001	<0.001
Dermal Contact	<0.001	<0.001
Outdoor Dust Inhalation	<0.001	<0.001
Outdoor Vapor Inhalation	0.02 (0.09)	0.02 (0.09)
Total	**0.02 (0.09)**	**0.02 (0.09)**
Recreational Visitor		
Adult		
Soil -		
Ingestion	<0.001	<0.001
Dermal Contact	<0.001	<0.001
Outdoor Dust Inhalation	<0.001	<0.001
Outdoor Vapor Inhalation	0.003 (0.01)	<0.001 (0.002)
Total	**0.003 (0.01)**	**<0.001 (0.002)**
Child		
Soil -		
Ingestion	<0.001	<0.001
Dermal Contact	<0.001	<0.001
Outdoor Dust Inhalation	<0.001	<0.001
Outdoor Vapor Inhalation	0.01 (0.06)	0.002 (0.10)
Total	**0.01 (0.06)**	**0.002 (0.01)**

(1) Values represent landfill gas collection system achieving 95% (75%) efficiency.

that were investigated for the off site resident are subsurface migration of landfill gas, and vapor emissions from contaminated ground water. These pathways were tested through a vapor emission flux survey and found not to exceed background concentrations for ambient air.

Potential outdoor air exposures to off site residents can result to the extent that chemicals from the landfill are released to ambient air. Two kinds of air releases are possible. Volatile compounds can be released along with any landfill gas that is not captured by the landfill gas collection system. In addition, PAHs can be released in any airborne dust from maintenance access roads where PAHs have been detected.

Ambient air monitoring for VOCs at the PVLF, and testing for gas at the landfill surface, have not detected any releases of volatile compounds to air. Potential releases of landfill gas from the PVLF were modeled assuming that some of the gas that is generated by the landfill is not captured by the landfill gas collection system. Landfill gas that is not captured was assumed to be emitted through the landfill surface to ambient air.

Concentrations of VOCs that could be released with the landfill gas were calculated from the analytical test results for landfill gas collected from the main gas collection system pipeline at the PVLF, which is known as Header 2. The gas sampling port for Header 2 is located near the terminus of this pipeline; therefore the landfill gas collected from Header 2 constitutes an integrated sample of landfill gas extracted from the landfill. Landfill gas samples were also collected from Header 1, which is a peripheral gas collection pipeline that serves boundary gas migration control wells. The gas samples from Header 1 showed consistently lower concentrations of all of the VOCs, approximately ten times less than the Header 2 values.

The entire list of priority pollutant VOCs that have been tested in landfill gas was included in the risk calculations, even though some of the compounds have never been detected in landfill gas or in ground water at the PVLF. The non-detected compounds were included in the risk calculations so that the risk significance of any potential concentrations below analytical detection limits could be evaluated. As shown in Table 6.1-5, either the 95 percent upper confidence limit of the arithmetic average concentration in the landfill gas testing data, or the July 1994 detection limit for non-detected compounds, was selected to represent the long-term average landfill concentration

for each compound over a 30-year exposure period. This assumption is conservative, since experience with landfill gas at other sites indicates that the volatile compound concentrations are likely to decrease from current levels.

The volume of gas that could be released from the landfill depends on the total volume that is generated, and the fraction that escapes the gas collection system. A CARB model was used to calculate the expected volume of landfill gas that could be generated by the PVLF. The CARB model calculates a 70-year average annual volume of gas that could be generated, based on the mass of the landfill contents. This estimated 70-year average volume was used to represent the long-term average gas generation rate from the PVLF for a 30-year exposure period. The CARB model estimate is very close to the current measured volume of landfill gas extracted from the landfill. Use of this volume to represent the long term average volume during the next 30 years is conservative, since the volume of gas that can be generated is expected to decrease with time.

The fraction of gas that could escape the landfill gas collection system at the PVLF is estimated at less than two percent, based on model calculations for the PVLF and the measured efficiency of a similar landfill gas collection system at the Puente Hills landfill. However, for the purpose of this risk assessment, landfill gas collection efficiencies of 75 percent and 95 percent were used to calculate a range of potential risks. One-fourth (25 percent) of all of the gas generated was assumed to be released to ambient air for the 75 percent gas collection efficiency. At 95 percent gas collection efficiency, one-twentieth (five percent) of the gas was assumed to be released. Estimated landfill gas emissions are therefore assumed to be five times higher at 75 percent gas collection efficiency than at 95 percent gas collection efficiency.

While residents at any of the downwind locations are potentially exposed, the nearest downwind resident would receive the highest ambient air concentrations. Air dispersion calculations were used to find the specific off site residential location where the highest ambient air concentrations would be expected from any air releases from the landfill. As part of the modeling exercise, a receptor grid (shown in Figure 6.1-2) was defined to evaluate potential ambient air concentrations at off site locations surrounding the PVLF. The highest modeled ambient air concentration at any location where a residence is possible (i.e., not in the middle of a major highway) was used to calculate potential risks from the landfill to current off site residents.

Table 6.1-12 shows the predicted ambient air concentration for the most exposed residential location, assuming 95 percent gas collection efficiency. The landfill gas emissions and ambient air concentrations are five times higher if the landfill gas collection efficiency is 75 percent.

Potential airborne dust from maintenance access roads where PAHs were detected was modeled using an EPA model for dust generated by vehicle traffic. The model is conservative since it assumes much more vehicle traffic on the roads than is likely to occur. In addition, the model assumes an unpaved surface which serves as an unlimited source of erodible particles; in fact, the road is covered by a layer of gravel which tends to limit erosion and dust. The EPA dust model predicts on site airborne dust concentrations in the immediate area of the maintenance road. Off site ambient air concentrations of PAHs in dust particles were calculated using the air dispersion model results developed to evaluate volatile compounds.

Measured PAH concentrations in soil samples from the maintenance road were used to estimate the average concentration in soil that could serve as a source of PAHs in airborne dust. The 95 percent upper confidence limit of the arithmetic average concentration was calculated from six soil samples in the area of the third bench access road to serve as an upper bound estimate of the PAH concentrations in soil. The arithmetic average of the six samples was selected as the best estimate of the PAH concentrations.

Both reasonable maximum exposure (RME) and average case assumptions were used to calculate potential intakes of chemicals in ambient air. The reasonable maximum exposure assumptions represent an upper bound estimate that is still within the range of plausible exposures. The average assumptions represent more typical exposures. For PAHs, the 95 percent UCL concentrations were used in the RME exposure calculations, and the arithmetic average concentrations were used in the average case. For volatile compounds in landfill gas, the 95 percent UCL concentrations were used in both the RME and average exposure cases.

As shown on Table 6.1-14, the off site resident was assumed to live adjacent to the PVLF during six years of early childhood and 24 years as an adult for the reasonable maximum exposure scenario. In addition, in the RME case, the resident was assumed to be at home 24 hours per day 350 days per year during the 30-year exposure period. In the average case, the off site

resident was assumed to live adjacent to the PVLF during six years of early childhood and for nine years as an adult, and to be at home sixteen hours per day, 350 days per year during the fifteen-year exposure period. A bodyweight of fifteen kg for the child and 70 kg for the adult, and a breathing rate of 0.83 m^3/hr (the EPA recommended values) were assumed for both the average and RME scenarios.

Potential health risks for off site residents were evaluated using standard EPA procedures which are also recommended and endorsed by DTSC. These procedures involve calculating the lifetime average daily intake (LADI) for a 70-year lifetime to calculate potential excess cancer risk. The LADI expresses exposure in units of mg/kg/day. Cancer potency values have been derived by DTSC and EPA which express excess cancer risk per unit of lifetime intake, i.e., in units of $(mg/kg/day)^{-1}$.

In accordance with EPA and DTSC procedures, potential non-cancer health risks were evaluated by calculating the average daily intake over one year (ADI). The ADI for each compound was compared to the reference dose published by EPA, which is an exposure level that is considered unlikely to cause adverse health effects. Therefore, as long as the ADI is less than the reference dose (i.e., the ratio of the ADI divided by the reference dose is less than one) adverse health effects are not expected to occur. Moreover, to account for potential additive effects from simultaneous exposure to several compounds, a hazard index was calculated by adding the ratio of the ADI to the reference dose for all of the compounds. This assumption of additive health effects to calculate a single hazard index is a screening level procedure, since all of the chemicals involved do not have the same type of health effects and therefore the risks from these chemicals are not additive.

Potential health effects for off site residents from PAHs in dust and volatile compounds released in landfill gas are shown on Tables 6.1-34 through 6.1-41. Table 6.1-42 shows the percent contribution to excess cancer risk and the non-cancer hazard index by chemical.

Current day upper-bound excess cancer risk for residents at this receptor location was less than 3.0×10^{-6} under RME intake assumptions based on 95 percent gas collection efficiency. The overall range of risks calculated for the off site resident is 1.4×10^{-6} (for average exposure assumptions and 95 percent gas collection efficiency) to 1.3×10^{-5} (for RME assumptions and 75 percent gas

TABLE 6.1-34

OUTDOOR AIR-DUST INHALATION PATHWAY LIFETIME EXCESS CANCER RISK FOR THE OFF SITE RESIDENT, ONSITE WORKER, AND RECREATIONAL VISITOR - CURRENT AND FUTURE RME CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Downwind Off Site Resident Current and Future	On Site Worker Current and Future	Recreational Visitor Current	Recreational Visitor Future
Benzo(a)anthracene	1.3E-08	3.6E-09	3.1E-09	4.7E-09
Benzo(a)pyrene	1.2E-07	3.3E-08	2.9E-08	4.3E-08
Benzo(b)fluoranthene	1.3E-08	3.5E-09	3.1E-09	4.6E-09
Benzo(k)fluoranthene	1.1E-08	3.0E-09	2.6E-09	3.9E-09
Chrysene	1.4E-09	3.9E-10	3.4E-10	5.1E-10
Dibenzo(a,h)anthracene	3.5E-08	9.6E-09	8.3E-09	1.2E-08
Indeno(1,2,3-cd)pyrene	4.3E-09	1.2E-09	1.0E-09	1.5E-09
Acenaphthene				
Anthracene				
Benzo(g,h,i)perylene				
Fluoranthene				
Fluorene				
Naphthalene				
Phenanthrene				
Pyrene				
PATHWAY-SPECIFIC CANCER RISK	2.0E-07	5.5E-08	4.7E-08	7.0E-08

= Reasonable Maximum Exposure

TABLE 6.1-35

OUTDOOR AIR-VAPOR INHALATION PATHWAY LIFETIME EXCESS CANCER RISK FOR THE OFF SITE RESIDENT, ON SITE WORKER, AND RECREATIONAL VISITOR - CURRENT AND FUTURE RME CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

ANALYTE	CANCER POTENCY SLOPE FACTOR (MG/KG-DAY)-1	LIFETIME EXCESS CANCER RISK			
		ON SITE WORKER (Current and Future)	ON SITE VISITOR Current	ON SITE VISITOR (Future)	OFF SITE RESIDENT (Current and Future)
Benzene	1.00E-01	7.8E-07	1.7E-07	2.5E-07	1.9E-06
Carbon Tetrachloride	1.50E-01	1.3E-09	2.9E-10	4.3E-10	3.2E-09
Chlorobenzene	NA				
Dichlorobenzene, 1,4-	4.00E-02	4.1E-08	8.8E-09	1.3E-08	9.8E-08
Dichloroethane, 1,1-	5.70E-03	6.3E-10	1.4E-10	2.0E-10	1.5E-09
Dichloroethane, 1,2-	7.00E-02	5.1E-09	1.1E-09	1.6E-09	1.2E-08
Dichloroethene, 1,1-	1.80E-01	1.3E-08	2.8E-09	4.1E-09	3.1E-08
Methylene Chloride	3.50E-03	5.1E-10	1.1E-10	1.7E-10	1.2E-09
Tetrachloroethene	2.10E-02	1.1E-08	2.3E-09	3.4E-09	2.6E-08
Toluene	NA				
Trichloroethane, 1,1,1-	NA				
Trichloroethene	1.00E-02	3.1E-09	6.7E-10	1.0E-09	7.4E-09
Vinyl Chloride	2.70E-01	2.1E-07	4.6E-08	6.8E-08	5.1E-07
Xylenes	NA				
Acetone	NA				
Bromodichloromethane	1.30E-01	1.2E-09	2.5E-10	3.7E-10	2.8E-09
Bromoform	3.90E-03	3.5E-11	7.5E-12	1.1E-11	8.4E-11
Bromomethane	NA				
Butanone, 2-	NA				
Carbon Disulfide	NA				
Chloroethane	NA				
Chloroform	1.90E-02	1.7E-10	3.7E-11	5.5E-11	4.1E-10
Chloromethane	6.30E-03	5.6E-11	1.2E-11	1.8E-11	1.4E-10
Dibromochloromethane	9.40E-02	8.4E-10	1.8E-10	2.7E-10	2.0E-09
Dibromoethane, 1,2-	3.60E+00	3.2E-08	7.0E-09	1.0E-08	7.7E-08
Dichlorobenzene, 1,2-	NA				
Dichlorobenzene, 1,3-	NA				
Dichloroethene, cis-1,2-	NA				
Dichloroethene, trans-1,2-	NA				
Dichloropropane, 1,2-	6.30E-02	5.6E-10	1.2E-10	1.8E-10	1.4E-09
Dichloropropene, cis-1,3-	4.30E-02	3.8E-10	8.3E-11	1.2E-10	9.2E-10
Dichloropropene, trans-1,3-	4.30E-02	3.8E-10	8.3E-11	1.2E-10	9.2E-10
Ethylbenzene	NA				
Hexanone, 2-	NA				
Methane	NA				
Methyl tert-butyl Ether	NA				
Pentanone, 4-Methyl-2-	NA				
Styrene	NA				
Tetrachloroethane, 1,1,2,2-	2.70E-01	2.4E-09	5.2E-10	7.8E-10	5.8E-09
Trichloroethane, 1,1,2-	5.60E-02	5.0E-10	1.1E-10	1.6E-10	1.2E-09
Trichlorofluoromethane	NA				
Trichlorotrifluoroethane	NA				
Vinyl Acetate	NA				
PATHWAY-SPECIFIC CANCER RISK		1.1E-06	2.4E-07	3.6E-07	2.7E-06

RME = Reasonable Maximum Exposure

TBL61-35.XLS

TABLE 6.1-36

OUTDOOR AIR-DUST INHALATION PATHWAY LIFETIME EXCESS CANCER RISK FOR THE OFF SITE RESIDENT, ON SITE WORKER, AND RECREATIONAL VISITOR - CURRENT AND FUTURE AVERAGE EXPOSURE CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Downwind Off Site Resident (Current and Future)	On Site Worker (Current and Future)	Recreational Visitor Current	Recreational Visitor Future
Benzo(a)anthracene	3.6E-09	8.5E-10	6.5E-10	6.5E-10
Benzo(a)pyrene	3.5E-08	8.2E-09	6.3E-09	6.3E-09
Benzo(b)fluoranthene	3.6E-09	8.4E-10	6.5E-10	6.5E-10
Benzo(k)fluoranthene	2.9E-09	6.7E-10	5.2E-10	5.2E-10
Chrysene	3.8E-10	8.9E-11	6.8E-11	6.8E-11
Dibenzo(a,h)anthracene	1.6E-08	3.6E-09	2.8E-09	2.8E-09
Indeno(1,2,3-cd)pyrene	1.7E-09	3.9E-10	3.0E-10	3.0E-10
Acenaphthene				
Anthracene				
Benzo(g,h,i)perylene				
Fluoranthene				
Fluorene				
Naphthalene				
Phenanthrene				
Pyrene				
PATHWAY-SPECIFIC CANCER RISK	6.3E-08	1.5E-08	1.1E-08	1.1E-08

TABLE 6.1-37

OUTDOOR AIR-VAPOR INHALATION PATHWAY LIFETIME EXCESS CANCER RISK FOR THE OFF SITE RESIDENT, ON SITE WORKER, AND RECREATIONAL VISITOR - CURRENT AND FUTURE AVERAGE EXPOSURE CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

ANALYTE	CANCER POTENCY SLOPE FACTOR (MG/KG-DAY)-1	LIFETIME EXCESS CANCER RISK			
		ON SITE WORKER (Current and Future)	ON SITE VISITOR (Current)	ON SITE VISITOR (Future)	OFF SITE RESIDENT (Current and Future)
Benzene	1.00E-01	3.1E-07	3.0E-08	3.0E-08	8.9E-07
Carbon Tetrachloride	1.50E-01	5.4E-10	5.2E-11	5.2E-11	1.5E-09
Chlorobenzene	NA				
Dichlorobenzene, 1,4-	4.00E-02	1.6E-08	1.6E-09	1.6E-09	4.6E-08
Dichloroethane, 1,1-	5.70E-03	2.5E-10	2.4E-11	2.4E-11	7.1E-10
Dichloroethane, 1,2-	7.00E-02	2.0E-09	1.9E-10	1.9E-10	5.7E-09
Dichloroethene, 1,1-	1.80E-01	5.1E-09	5.0E-10	5.0E-10	1.5E-08
Methylene Chloride	3.50E-03	2.1E-10	2.0E-11	2.0E-11	5.8E-10
Tetrachloroethene	2.10E-02	4.2E-09	4.1E-10	4.1E-10	1.2E-08
Toluene	NA				
Trichloroethane, 1,1,1-	NA				
Trichloroethene	1.00E-02	1.2E-09	1.2E-10	1.2E-10	3.5E-09
Vinyl Chloride	2.70E-01	8.4E-08	8.1E-09	8.1E-09	2.4E-07
Xylenes	NA				
Acetone	NA				
Bromodichloromethane	1.30E-01	4.6E-10	4.5E-11	4.5E-11	1.3E-09
Bromoform	3.90E-03	1.4E-11	1.3E-12	1.3E-12	4.0E-11
Bromomethane	NA				
Butanone, 2-	NA				
Carbon Disulfide	NA				
Chloroethane	NA				
Chloroform	1.90E-02	6.8E-11	6.5E-12	6.5E-12	1.9E-10
Chloromethane	6.30E-03	2.3E-11	2.2E-12	2.2E-12	6.4E-11
Dibromochloromethane	9.40E-02	3.4E-10	3.2E-11	3.2E-11	9.5E-10
Dibromoethane, 1,2-	3.60E+00	1.3E-08	1.2E-09	1.2E-09	3.7E-08
Dichlorobenzene, 1,2-	NA				
Dichlorobenzene, 1,3-	NA				
Dichloroethene, cis-1,2-	NA				
Dichloroethene, trans-1,2-	NA				
Dichloropropane, 1,2-	6.30E-02	2.3E-10	2.2E-11	2.2E-11	6.4E-10
Dichloropropene, cis-1,3-	4.30E-02	1.5E-10	1.5E-11	1.5E-11	4.4E-10
Dichloropropene, trans-1,3-	4.30E-02	1.5E-10	1.5E-11	1.5E-11	4.4E-10
Ethylbenzene	NA				
Hexanone, 2-	NA				
Methane	NA				
Methyl tert-butyl Ether	NA				
Pentanone, 4-Methyl-2-	NA				
Styrene	NA				
Tetrachloroethane, 1,1,2,2-	2.70E-01	9.7E-10	9.3E-11	9.3E-11	2.7E-09
Trichloroethane, 1,1,2-	5.60E-02	2.0E-10	1.9E-11	1.9E-11	5.7E-10
Trichlorofluoromethane	NA				
Trichlorotrifluoroethane	NA				
Vinyl Acetate	NA				
PATHWAY-SPECIFIC CANCER RISK		4.4E-07	4.3E-08	4.3E-08	1.3E-06

TBL61-37.XLS

TABLE 6.1-38

OUTDOOR AIR-DUST INHALATION PATHWAY HAZARD QUOTIENTS FOR THE OFF SITE RESIDENT, ON SITE WORKER, AND RECREATIONAL VISITOR - CURRENT AND FUTURE RME CASES

Current and Future

Chemical	Current and Future Downwind Off Site Resident		Current and Future On Site Worker	Current Recreational Visitor		Future Recreational Visitor	
	Adult	Child		Adult	Child	Adult	Child
Benzo(a)anthracene							
Benzo(a)pyrene							
Benzo(b)fluoranthene							
Benzo(k)fluoranthene							
Chrysene							
Dibenzo(a,h)anthracene							
Indeno(1,2,3-cd)pyrene							
Acenaphthene	6.7E-07	3.1E-06	3.9E-07	1.6E-07	7.5E-07	2.4E-07	1.1E-06
Anthracene	1.1E-07	5.0E-07	6.2E-08	2.6E-08	1.2E-07	3.8E-08	1.8E-07
Benzo(g,h,i)perylene							
Fluoranthene	3.1E-06	1.4E-05	1.8E-06	7.3E-07	3.4E-06	1.1E-06	5.1E-06
Fluorene	7.5E-07	3.5E-06	4.3E-07	1.8E-07	8.4E-07	2.7E-07	1.3E-06
Naphthalene	3.8E-07	1.8E-06	2.2E-07	9.2E-08	4.3E-07	1.4E-07	6.4E-07
Phenanthrene							
Pyrene	3.9E-06	1.8E-05	2.2E-06	9.3E-07	4.3E-06	1.4E-06	6.5E-06
PATHWAY-SPECIFIC HAZARD INDEX	7.8E-07	3.6E-06	4.5E-07	1.9E-07	8.7E-07	2.8E-07	1.3E-06

E = Reasonable Maximum Exposure

TABLE 6.1-39

OUTDOOR AIR-VAPOR INHALATION PATHWAY HAZARD QUOTIENTS FOR THE OFF SITE RESIDENT, ON SITE WORKER, AND RECREATIONAL VISITOR - CURRENT AND FUTURE RME CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

ANALYTE	INHALATION REFERENCE DOSE (MG/KG-DAY)	NON-CANCER HAZARD			
		ONSITE WORKER (Current and Future)	ADULT ONSITE VISITOR (Current)	ADULT ONSITE VISITOR (Future)	ADULT OFFSITE RESIDENT (Current and Future)
Benzene	1.71E-03	1.3E-02	1.3E-03	2.0E-03	1.5E-02
Carbon Tetrachloride	5.71E-04	4.4E-05	4.6E-06	6.8E-06	5.1E-05
Chlorobenzene	5.71E-03	1.5E-03	1.6E-04	2.3E-04	1.7E-03
Dichlorobenzene, 1,4-	2.29E-01	1.2E-05	1.3E-06	1.9E-06	1.4E-05
Dichloroethane, 1,1-	1.43E-01	2.2E-06	2.2E-07	3.3E-07	2.5E-06
Dichloroethane, 1,2-	2.86E-03	7.1E-05	7.3E-06	1.1E-05	8.2E-05
Dichloroethene, 1,1-	9.00E-03	2.2E-05	2.3E-06	3.4E-06	2.6E-05
Methylene Chloride	8.57E-01	4.8E-07	5.0E-08	7.4E-08	5.5E-07
Tetrachloroethene	1.00E-02	1.4E-04	1.5E-05	2.2E-05	1.6E-04
Toluene	1.14E-01	4.3E-04	4.4E-05	6.6E-05	4.9E-04
Trichloroethane, 1,1,1-	2.86E-01	8.8E-08	9.1E-09	1.4E-08	1.0E-07
Trichloroethene	6.00E-03	1.4E-04	1.5E-05	2.2E-05	1.7E-04
Vinyl Chloride	NA				
Xylenes	2.00E+00	4.0E-05	4.2E-06	6.2E-06	4.6E-05
Acetone	1.00E-01	1.1E-04	1.2E-05	1.7E-05	1.3E-04
Bromodichloromethane	2.00E-02	1.3E-06	1.3E-07	1.9E-07	1.4E-06
Bromoform	2.00E-02	1.3E-06	1.3E-07	1.9E-07	1.4E-06
Bromomethane	1.43E-03	1.8E-05	1.8E-06	2.7E-06	2.0E-05
Butanone, 2-	2.90E-01	1.5E-05	1.5E-06	2.3E-06	1.7E-05
Carbon Disulfide	2.90E-03	1.5E-05	1.5E-06	2.3E-06	1.7E-05
Chloroethane	2.90E+00	1.3E-08	1.3E-09	2.0E-09	1.5E-08
Chloroform	1.00E-02	2.5E-06	2.6E-07	3.9E-07	2.9E-06
Chloromethane	NA				
Dibromochloromethane	2.00E-02	1.3E-06	1.3E-07	1.9E-07	1.4E-06
Dibromoethane, 1,2-	5.70E-05	4.4E-04	4.6E-05	6.8E-05	5.1E-04
Dichlorobenzene, 1,2-	5.70E-02	3.6E-05	3.7E-06	5.6E-06	4.2E-05
Dichlorobenzene, 1,3-	8.90E-02	2.8E-07	2.9E-08	4.4E-08	3.3E-07
Dichloroethene, cis-1,2-	1.00E-02	7.2E-04	7.5E-05	1.1E-04	8.4E-04
Dichloroethene, trans-1,2-	2.00E-02	1.8E-05	1.8E-06	2.7E-06	2.0E-05
Dichloropropane, 1,2-	1.40E-03	1.8E-05	1.9E-06	2.8E-06	2.1E-05
Dichloropropene, cis-1,3-	5.71E-03	4.4E-06	4.6E-07	6.8E-07	5.1E-06
Dichloropropene, trans-1,3-	5.71E-03	4.4E-06	4.6E-07	6.8E-07	5.1E-06
Ethylbenzene	2.90E-01	2.0E-04	2.0E-05	3.0E-05	2.3E-04
Hexanone, 2-	NA				
Methane	NA				
Methyl tert-butyl Ether	8.60E-01	2.9E-08	3.0E-09	4.5E-09	3.4E-08
Pentanone, 4-Methyl-2-	2.30E-02	1.5E-04	1.6E-05	2.4E-05	1.8E-04
Styrene	2.90E-01	1.1E-05	1.1E-06	1.7E-06	1.2E-05
Tetrachloroethane, 1,1,2,2-	NA				
Trichloroethane, 1,1,2-	4.00E-03	6.3E-06	6.5E-07	9.7E-07	7.2E-06
Trichlorofluoromethane	2.00E-01	1.3E-07	1.3E-08	1.9E-08	1.4E-07
Trichlorotrifluoroethane	8.60E+00	2.9E-09	3.0E-10	4.5E-10	3.4E-09
Vinyl Acetate	5.71E-02	8.8E-07	9.1E-08	1.4E-07	1.0E-06
PATHWAY SPECIFIC HAZARD INDEX		1.7E-02	1.8E-03	2.6E-03	2.0E-02

RME = Reasonable Maximum Exposure

TABLE 6.1-39 (CONTINUED)

OUTDOOR AIR-VAPOR INHALATION PATHWAY HAZARD QUOTIENTS FOR THE OFF SITE RESIDENT, ON SITE WORKER, AND RECREATIONAL VISITOR - CURRENT AND FUTURE RME CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

ANALYTE	INHALATION REFERENCE DOSE (MG/KG-DAY)	NON-CANCER HAZARD		
		CHILD ONSITE VISITOR (Current)	CHILD ONSITE VISITOR (Future)	CHILD OFFSITE RESIDENT (Current and Future)
Benzene	1.71E-03	6.2E-03	9.3E-03	6.9E-02
Carbon Tetrachloride	5.71E-04	2.1E-05	3.2E-05	2.4E-04
Chlorobenzene	5.71E-03	7.3E-04	1.1E-03	8.1E-03
Dichlorobenzene, 1,4-	2.29E-01	6.0E-06	9.0E-06	6.7E-05
Dichloroethane, 1,1-	1.43E-01	1.0E-06	1.6E-06	1.2E-05
Dichloroethane, 1,2-	2.86E-03	3.4E-05	5.1E-05	3.8E-04
Dichloroethene, 1,1-	9.00E-03	1.1E-05	1.6E-05	1.2E-04
Methylene Chloride	8.57E-01	2.3E-07	3.5E-07	2.6E-06
Tetrachloroethene	1.00E-02	6.9E-05	1.0E-04	7.6E-04
Toluene	1.14E-01	2.1E-04	3.1E-04	2.3E-03
Trichloroethane, 1,1,1-	2.86E-01	4.2E-08	6.3E-08	4.7E-07
Trichloroethene	6.00E-03	7.0E-05	1.0E-04	7.8E-04
Vinyl Chloride	NA			
Xylenes	2.00E+00	1.9E-05	2.9E-05	2.2E-04
Acetone	1.00E-01	5.4E-05	8.0E-05	6.0E-04
Bromodichloromethane	2.00E-02	6.1E-07	9.1E-07	6.8E-06
Bromoform	2.00E-02	6.1E-07	9.1E-07	6.8E-06
Bromomethane	1.43E-03	8.5E-06	1.3E-05	9.4E-05
Butanone, 2-	2.90E-01	7.1E-06	1.1E-05	7.9E-05
Carbon Disulfide	2.90E-03	7.1E-06	1.1E-05	7.9E-05
Chloroethane	2.90E+00	6.3E-09	9.4E-09	7.0E-08
Chloroform	1.00E-02	1.2E-06	1.8E-06	1.4E-05
Chloromethane	NA			
Dibromochloromethane	2.00E-02	6.1E-07	9.1E-07	6.8E-06
Dibromoethane, 1,2-	5.70E-05	2.1E-04	3.2E-04	2.4E-03
Dichlorobenzene, 1,2-	5.70E-02	1.7E-05	2.6E-05	1.9E-04
Dichlorobenzene, 1,3-	8.90E-02	1.4E-07	2.0E-07	1.5E-06
Dichloroethene, cis-1,2-	1.00E-02	3.5E-04	5.2E-04	3.9E-03
Dichloroethene, trans-1,2-	2.00E-02	8.5E-06	1.3E-05	9.5E-05
Dichloropropane, 1,2-	1.40E-03	8.7E-06	1.3E-05	9.6E-05
Dichloropropene, cis-1,3-	5.71E-03	2.1E-06	3.2E-06	2.4E-05
Dichloropropene, trans-1,3-	5.71E-03	2.1E-06	3.2E-06	2.4E-05
Ethylbenzene	2.90E-01	9.5E-05	1.4E-04	1.1E-03
Hexanone, 2-	NA			
Methane	NA			
Methyl tert-butyl Ether	8.60E-01	1.4E-08	2.1E-08	1.6E-07
Pentanone, 4-Methyl-2-	2.30E-02	7.4E-05	1.1E-04	8.2E-04
Styrene	2.90E-01	5.2E-06	7.7E-06	5.8E-05
Tetrachloroethane, 1,1,2,2-	NA			
Trichloroethane, 1,1,2-	4.00E-03	3.0E-06	4.5E-06	3.4E-05
Trichlorofluoromethane	2.00E-01	6.1E-08	9.1E-08	6.8E-07
Trichlorotrifluoroethane	8.60E+00	1.4E-09	2.1E-09	1.6E-08
Vinyl Acetate	5.71E-02	4.3E-07	6.3E-07	4.7E-06
PATHWAY SPECIFIC HAZARD INDEX		8.3E-03	1.2E-02	9.2E-02

RME = Reasonable Maximum Exposure

TABLE 6.1-40

OUTDOOR AIR-DUST INHALATION PATHWAY HAZARD QUOTIENTS FOR THE OFF SITE RESIDENT, ON SITE WORKER, AND RECREATIONAL VISITOR - CURRENT AND FUTURE AVERAGE EXPOSURE CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Downwind Off Site Resident (Current and Future)		On Site Worker (Current and Future)	Current Recreational Visitor		Future Recreational Visitor	
	Adult	Child		Adult	Child	Adult	Child
Benzo(a)anthracene							
Benzo(a)pyrene							
Benzo(b)fluoranthene							
Benzo(k)fluoranthene							
Chrysene							
Dibenzo(a,h)anthracene							
Indeno(1,2,3-cd)pyrene							
Acenaphthene	2.6E-07	1.2E-06	2.3E-07	4.7E-08	2.2E-07	4.7E-08	2.2E-07
Anthracene	4.1E-08	1.9E-07	3.5E-08	7.4E-09	3.4E-08	7.4E-09	3.4E-08
Benzo(g,h,i)perylene							
Fluoranthene	1.2E-06	5.5E-06	1.0E-06	2.1E-07	9.9E-07	2.1E-07	9.9E-07
Fluorene	3.0E-07	1.4E-06	2.6E-07	5.3E-08	2.5E-07	5.3E-08	2.5E-07
Naphthalene	1.5E-07	6.9E-07	1.3E-07	2.7E-08	1.2E-07	2.7E-08	1.2E-07
Phenanthrene							
Pyrene	1.4E-06	6.7E-06	1.2E-06	2.6E-07	1.2E-06	2.6E-07	1.2E-06
PATHWAY-SPECIFIC HAZARD INDEX	3.0E-07	1.4E-06	2.6E-07	5.5E-08	2.6E-07	5.5E-08	2.6E-07

TABLE 6.1-41

OUTDOOR AIR-VAPOR INHALATION PATHWAY HAZARD QUOTIENTS FOR THE OFF SITE RESIDENT, ON SITE WORKER, AND RECREATIONAL VISITOR - CURRENT AND FUTURE AVERAGE EXPOSURE CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

ANALYTE	INHALATION REFERENCE DOSE (MG/KG-DAY)	NON-CANCER HAZARD			
		ON SITE WORKER (Current and Future)	ADULT ON SITE VISITOR (Current)	ADULT ON SITE VISITOR (Future)	ADULT OFF SITE RESIDENT (Current and Future)
Benzene	1.71E-03	1.3E-02	3.3E-04	3.3E-04	9.8E-03
Carbon Tetrachloride	5.71E-04	4.4E-05	1.1E-06	1.1E-06	3.4E-05
Chlorobenzene	5.71E-03	1.5E-03	3.9E-05	3.9E-05	1.2E-03
Dichlorobenzene, 1,4-	2.29E-01	1.2E-05	3.2E-07	3.2E-07	9.6E-06
Dichloroethane, 1,1-	1.43E-01	2.2E-06	5.6E-08	5.6E-08	1.7E-06
Dichloroethane, 1,2-	2.86E-03	7.1E-05	1.8E-06	1.8E-06	5.4E-05
Dichloroethene, 1,1-	9.00E-03	2.2E-05	5.8E-07	5.8E-07	1.7E-05
Methylene Chloride	8.57E-01	4.8E-07	1.2E-08	1.2E-08	3.7E-07
Tetrachloroethene	1.00E-02	1.4E-04	3.7E-06	3.7E-06	1.1E-04
Toluene	1.14E-01	4.3E-04	1.1E-05	1.1E-05	3.3E-04
Trichloroethane, 1,1,1-	2.86E-01	8.8E-08	2.3E-09	2.3E-09	6.7E-08
Trichloroethene	6.00E-03	1.4E-04	3.8E-06	3.8E-06	1.1E-04
Vinyl Chloride	NA				
Xylenes	2.00E+00	4.0E-05	1.0E-06	1.0E-06	3.1E-05
Acetone	1.00E-01	1.1E-04	2.9E-06	2.9E-06	8.5E-05
Bromodichloromethane	2.00E-02	1.3E-06	3.3E-08	3.3E-08	9.6E-07
Bromoform	2.00E-02	1.3E-06	3.3E-08	3.3E-08	9.6E-07
Bromomethane	1.43E-03	1.8E-05	4.6E-07	4.6E-07	1.3E-05
Butanone, 2-	2.90E-01	1.5E-05	3.8E-07	3.8E-07	1.1E-05
Carbon Disulfide	2.90E-03	1.5E-05	3.8E-07	3.8E-07	1.1E-05
Chloroethane	2.90E+00	1.3E-08	3.4E-10	3.4E-10	9.9E-09
Chloroform	1.00E-02	2.5E-06	6.5E-08	6.5E-08	1.9E-06
Chloromethane	NA				
Dibromochloromethane	2.00E-02	1.3E-06	3.3E-08	3.3E-08	9.6E-07
Dibromoethane, 1,2-	5.70E-05	4.4E-04	1.1E-05	1.1E-05	3.4E-04
Dichlorobenzene, 1,2-	5.70E-02	3.6E-05	9.4E-07	9.4E-07	2.8E-05
Dichlorobenzene, 1,3-	8.90E-02	2.8E-07	7.3E-09	7.3E-09	2.2E-07
Dichloroethene, cis-1,2-	1.00E-02	7.2E-04	1.9E-05	1.9E-05	5.6E-04
Dichloroethene, trans-1,2-	2.00E-02	1.8E-05	4.6E-07	4.6E-07	1.3E-05
Dichloropropane, 1,2-	1.40E-03	1.8E-05	4.6E-07	4.6E-07	1.4E-05
Dichloropropene, cis-1,3-	5.71E-03	4.4E-06	1.1E-07	1.1E-07	3.4E-06
Dichloropropene, trans-1,3-	5.71E-03	4.4E-06	1.1E-07	1.1E-07	3.4E-06
Ethylbenzene	2.90E-01	2.0E-04	5.1E-06	5.1E-06	1.5E-04
Hexanone, 2-	NA				
Methane	NA				
Methyl tert-butyl Ether	8.60E-01	2.9E-08	7.6E-10	7.6E-10	2.2E-08
Pentanone, 4-Methyl-2-	2.30E-02	1.5E-04	4.0E-06	4.0E-06	1.2E-04
Styrene	2.90E-01	1.1E-05	2.8E-07	2.8E-07	8.2E-06
Tetrachloroethane, 1,1,2,2-	NA				
Trichloroethane, 1,1,2-	4.00E-03	6.3E-06	1.6E-07	1.6E-07	4.8E-06
Trichlorofluoromethane	2.00E-01	1.3E-07	3.3E-09	3.3E-09	9.6E-08
Trichlorotrifluoroethane	8.60E+00	2.9E-09	7.6E-11	7.6E-11	2.2E-09
Vinyl Acetate	5.71E-02	8.8E-07	2.3E-08	2.3E-08	6.7E-07
PATHWAY-SPECIFIC HAZARD INDEX		1.7E-02	4.4E-04	4.4E-04	1.3E-02

TABLE 6.1-41 (CONTINUED)

OUTDOOR AIR-VAPOR INHALATION PATHWAY HAZARD QUOTIENTS FOR THE OFF SITE RESIDENT, ON SITE WORKER, AND RECREATIONAL VISITOR - CURRENT AND FUTURE AVERAGE EXPOSURE CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

ANALYTE	INHALATION REFERENCE DOSE (MG/KG-DAY)	NON-CANCER HAZARD		
		CHILD ON SITE VISITOR (Current)	CHILD ON SITE VISITOR (Future)	CHILD OFF SITE RESIDENT (Current and Future)
Benzene	1.71E-03	1.6E-03	1.6E-03	4.6E-02
Carbon Tetrachloride	5.71E-04	5.3E-06	5.3E-06	1.6E-04
Chlorobenzene	5.71E-03	1.8E-04	1.8E-04	5.4E-03
Dichlorobenzene, 1,4-	2.29E-01	1.5E-06	1.5E-06	4.5E-05
Dichloroethane, 1,1-	1.43E-01	2.6E-07	2.6E-07	7.7E-06
Dichloroethane, 1,2-	2.86E-03	8.6E-06	8.6E-06	2.5E-04
Dichloroethene, 1,1-	9.00E-03	2.7E-06	2.7E-06	8.0E-05
Methylene Chloride	8.57E-01	5.8E-08	5.8E-08	1.7E-06
Tetrachloroethene	1.00E-02	1.7E-05	1.7E-05	5.1E-04
Toluene	1.14E-01	5.2E-05	5.2E-05	1.5E-03
Trichloroethane, 1,1,1-	2.86E-01	1.1E-08	1.1E-08	3.1E-07
Trichloroethene	6.00E-03	1.8E-05	1.8E-05	5.2E-04
Vinyl Chloride	NA			
Xylenes	2.00E+00	4.8E-06	4.8E-06	1.4E-04
Acetone	1.00E-01	1.3E-05	1.3E-05	4.0E-04
Bromodichloromethane	2.00E-02	1.5E-07	1.5E-07	4.5E-06
Bromoform	2.00E-02	1.5E-07	1.5E-07	4.5E-06
Bromomethane	1.43E-03	2.1E-06	2.1E-06	6.3E-05
Butanone, 2-	2.90E-01	1.8E-06	1.8E-06	5.3E-05
Carbon Disulfide	2.90E-03	1.8E-06	1.8E-06	5.3E-05
Chloroethane	2.90E+00	1.6E-09	1.6E-09	4.6E-08
Chloroform	1.00E-02	3.0E-07	3.0E-07	9.0E-06
Chloromethane	NA			
Dibromochloromethane	2.00E-02	1.5E-07	1.5E-07	4.5E-06
Dibromoethane, 1,2-	5.70E-05	5.3E-05	5.3E-05	1.6E-03
Dichlorobenzene, 1,2-	5.70E-02	4.4E-06	4.4E-06	1.3E-04
Dichlorobenzene, 1,3-	8.90E-02	3.4E-08	3.4E-08	1.0E-06
Dichloroethene, cis-1,2-	1.00E-02	8.8E-05	8.8E-05	2.6E-03
Dichloroethene, trans-1,2-	2.00E-02	2.1E-06	2.1E-06	6.3E-05
Dichloropropane, 1,2-	1.40E-03	2.2E-06	2.2E-06	6.4E-05
Dichloropropene, cis-1,3-	5.71E-03	5.3E-07	5.3E-07	1.6E-05
Dichloropropene, trans-1,3-	5.71E-03	5.3E-07	5.3E-07	1.6E-05
Ethylbenzene	2.90E-01	2.4E-05	2.4E-05	7.0E-04
Hexanone, 2-	NA			
Methane	NA			
Methyl tert-butyl Ether	8.60E-01	3.5E-09	3.5E-09	1.0E-07
Pentanone, 4-Methyl-2-	2.30E-02	1.8E-05	1.8E-05	5.5E-04
Styrene	2.90E-01	1.3E-06	1.3E-06	3.8E-05
Tetrachloroethane, 1,1,2,2-	NA			
Trichloroethane, 1,1,2-	4.00E-03	7.6E-07	7.6E-07	2.2E-05
Trichlorofluoromethane	2.00E-01	1.5E-08	1.5E-08	4.5E-07
Trichlorotrifluoroethane	8.60E+00	3.5E-10	3.5E-10	1.0E-08
Vinyl Acetate	5.71E-02	1.1E-07	1.1E-07	3.1E-06
PATHWAY-SPECIFIC HAZARD INDEX		2.1E-03	2.1E-03	6.1E-02

TABLE 6.1-42

RISK PERCENT BY CHEMICAL FOR THE OUTDOOR AIR VAPOR INHALATION PATHWAY - CURRENT OFF SITE RESIDENT

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

CHEMICAL	TARGET ANALYTE GROUP	DETECTED IN LANDFILL GAS AT PVLF	PERCENT OF CANCER RISK	PERCENT OF HAZARD INDEX
Benzene	TAC, TO-14	YES	70.7%	75.4%
Carbon Tetrachloride	TAC, TO-14	NO	0.1%	0.3%
Chlorobenzene	TAC, TO-14	YES	NC	8.9%
Dichlorobenzene, 1,4-	TAC, TO-14	YES	NC	0.1%
Dichloroethane, 1,1-	TAC, TO-14	YES	0.1%	0.0%
Dichloroethane, 1,2-	TAC, TO-14	YES	0.5%	0.4%
Dichloroethene, 1,1-	TAC, TO-14	YES	1.2%	0.1%
Methylene Chloride	TAC, TO-14	YES	0.0%	0.0%
Tetrachloroethene	TAC, TO-14	YES	1.0%	0.8%
Toluene	TAC, TO-14	YES	NC	2.5%
Trichloroethane, 1,1,1-	TAC, TO-14	NO	NC	0.0%
Trichloroethene	TAC, TO-14	YES	0.3%	0.8%
Vinyl Chloride	TAC, TO-14	YES	19.0%	NA
Xylenes	TAC, TO-14	YES	NC	0.2%
Acetone	TO-14	YES	NC	0.7%
Bromodichloromethane	TO-14	NO	0.1%	0.0%
Bromoform	TO-14	NO	0.0%	0.0%
Bromomethane	TO-14	NO	NC	0.1%
Butanone, 2-	TO-14	YES	NC	0.1%
Carbon Disulfide	TO-14	YES	NC	0.1%
Chloroethane	TO-14	YES	NC	0.0%
Chloroform	TO-14	NO	0.0%	0.0%
Chloromethane	TO-14	NO	0.0%	NA
Dibromochloromethane	TO-14	NO	0.1%	0.0%
Dibromoethane, 1,2-	TO-14	NO	2.9%	2.6%
Dichlorobenzene, 1,2-	TO-14	YES	NC	0.2%
Dichlorobenzene, 1,3-	TO-14	NO	NC	0.0%
Dichloroethene, cis-1,2-	TO-14	YES	NC	4.3%
Dichloroethene, trans-1,2-	TO-14	YES	NC	0.1%
Dichloropropane, 1,2-	TO-14	NO	0.1%	0.1%
Dichloropropene, cis-1,3-	TO-14	NO	0.0%	0.0%
Dichloropropene, trans-1,3-	TO-14	NO	0.0%	0.0%
Ethylbenzene	TO-14	YES	NC	1.1%
Hexanone, 2-	TO-14	NO	NC	NA
Methyl tert-butyl Ether	TO-14	NO	NC	0.0%
Pentanone, 4-Methyl-2-	TO-14	YES	NC	0.9%
Styrene	TO-14	YES	NC	0.1%
Tetrachloroethane, 1,1,2,2-	TO-14	NO	0.2%	NA
Trichloroethane, 1,1,2-	TO-14	NO	0.0%	0.0%
Trichlorofluoromethane	TO-14	NO	NC	0.0%
Trichlorotrifluoroethane	TO-14	NO	NC	0.0%
Vinyl Acetate	TO-14	NO	NC	0.0%

Note: "NC" indicates compound is not considered to be a carcinogen. "NA" indicates that no reference dose for non-cancer effects is available for this compound.

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collection efficiency). The excess cancer risks are summarized by exposure scenario in Tables 6.1-30 and 6.1-31. The main contributions to the calculated risks came from benzene and vinyl chloride which were assumed to be emitted through the landfill cover and transported via the outdoor air (vapor) pathway. Risks due to inhalation of dust (containing PAHs detected in the landfill cover) were relatively minor. Current screening level hazard indices for both children and adults at the Crenshaw receptor location were below 0.1 for 95 percent gas collection efficiency and below 0.5 for 75 percent gas collection efficiency indicating that adverse non-carcinogenic effects are unlikely under current exposure conditions at these areas. Non-cancer effects are summarized by exposure scenario in Tables 6.1-32 and 6.1-33. Future exposures and resulting risk values at these receptors are the same as for the current day situation, because air emissions are assumed to remain the same in the future.

The ambient air benzene concentrations predicted by the model from landfill gas emissions account for more than 70 percent of the estimated cancer risk from VOCs in ambient air (a breakdown of risk is shown by chemical on Table 6.1-42). Benzene concentrations measured at upgradient and background locations (shown on Table 6.1-13) are at least ten times higher than the model predictions for benzene that could originate from the landfill. Vinyl chloride concentrations predicted by the model account for nineteen percent of the risk. The predicted vinyl chloride concentrations are approximately ten times less than analytical detection limits for ambient air. Chemicals on the AB 2588 TAC list cumulatively account for over 99 percent of the risk from chemicals that have been detected in landfill gas. A short list of eight chemicals was used to monitor for off site gas migration in the surface emission flux survey. These eight chemicals which are included on the AB 2588 TAC list include all of the chemicals that account for over 99 percent of the risk from chemicals that have been detected in landfill gas. The AB 2588 TAC list is routinely used to monitor for landfill gas migration at boundary probes.

For the purpose of this risk assessment, all of the volatile chemicals on the priority pollutant list were retained in the risk calculations. Approximately three percent of the calculated cancer risk is due to 1,2-dibromoethane (ethylene dibromide, EDB) which was not detected in landfill gas and is not included in the ground water monitoring program for the PVLF.

6.1.4.2.2 Current On Site Worker

The on site worker scenario assumed exposures via the outdoor air and direct contact pathways. The scenario under consideration is that of a full-time maintenance worker at the site. Like the off site resident, the maintenance worker could be exposed to volatile compounds from landfill gas and PAHs in airborne dust. The concentrations of volatile compounds in landfill gas and PAHs in soil were estimated for the worker as described for the current off site resident in Section 6.1.4.2.1. However, for the on site worker, the maximum modeled air concentrations for any location on the site were used to calculate potential outdoor air exposures. The maximum concentrations reflect airborne PAH concentrations directly over the maintenance roads where PAHs were detected, and volatile compound concentrations at the maximum on site exposure location predicted by the air dispersion model.

Current on site workers were also assumed to contact soil on the maintenance access roads in the course of work. The direct contact exposures were assumed to include dermal contact with soil resulting in absorption of PAHs through the skin, and incidental ingestion of soil containing PAHs.

Both RME and average exposures were evaluated for the on site worker. In the RME case, workers were assumed to work at the PVLF full-time (eight hours per day, 250 days per year) for 25 years. In the average case, workers were assumed to work at the PVLF full-time (eight hours per day, 250 days per year) for ten years.

In both the RME and average case, workers were assumed to breath the volatile compound concentrations predicted for the maximum on site location during the entire exposure time. Workers were assumed to be exposed to PAHs in airborne dust for 30 minutes each day. The exposure time for PAHs in airborne dust is 1/16th of the working day. This fraction was selected based on the estimated fraction of the PVLF soil cover that could contain PAHs.

In accordance with EPA guidelines, workers were assumed to ingest 50 mg of soil each day in the course of work. Dermal contact with soil was estimated, based on the worker's exposed skin area (estimated at 5,800 cm^2 in the RME case, and 5,000 cm^2 in the average case), the soil-to-skin

adherence factor (estimated at 0.2 mg/cm^2/day based on the sandy soil type at the PVLF) and the dermal absorption factor for PAHs (0.15, the DTSC-recommended value). One-sixteenth (6.25 percent) of the soil contacted by workers was assumed to contain PAHs, based on the estimated fraction of the soil cover at the PVLF that could contain PAHs.

Standard EPA exposure assumptions for workers included an inhalation rate of 2.5 m^3/hr and 70 kg bodyweight. These exposure assumptions were used for both the RME and average case exposures. The excess cancer risks and hazard quotients for the on site worker are summarized on Tables 6.1-34 through 6.1-41 and 6.1-43 through 6.1-46.

Total screening hazard indices for the on site worker were significantly lower than 0.1. The range of excess cancer risks for the on site worker is 2.5 x 10^{-6} (for the average case and 95 percent gas collection efficiency) to 1.5 x 10^{-5} (for the RME case and 75 percent gas collection efficiency). Direct contact with PAHs in roadway soil accounts for most of the risk; more than 90 percent of the estimated risk is from direct contact with soil if the landfill gas collection efficiency is 95 percent. The excess cancer risks and non-cancer effects by exposure scenario are summarized in Tables 6.1-30 through 6.1-33.

6.1.4.2.3 Current On Site Recreational Visitor

The on site recreational visitor scenario is qualitatively similar to the on site worker scenario, including the outdoor air pathway and direct contact pathways. For adults, exposures and concomitant site risks are lower than for the worker because of less time spent on the site.

The scenario under consideration is that of a visitor who uses the PVLF for recreational purposes (such as horse riding) on a regular basis over a number of years. Both RME and average exposure cases were evaluated for the recreational visitor. In the RME case, the current visitor was assumed to use the PVLF on a regular basis (two hours per day, two days per week, 52 weeks per year) during six years of early childhood and 24 years as an adult. In the average case, the current visitor was assumed to use the PVLF on a less frequent basis (one hour per day, one day per week, 52 weeks per year) during six years of early childhood and nine years as an adult.

TABLE 6.1-43

DIRECT SOIL CONTACT PATHWAY LIFETIME EXCESS CANCER RISK FOR THE ON SITE WORKER AND RECREATIONAL VISITOR - CURRENT AND FUTURE RME CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Current and Future On Site Worker		Current Recreational Visitor		Future Recreational Visitor	
	Soil Ingestion	Dermal	Soil Ingestion	Dermal	Soil Ingestion	Dermal
Benzo(a)anthracene	1.6E-07	5.6E-07	4.3E-07	3.6E-07	6.3E-07	5.4E-07
Benzo(a)pyrene	1.5E-06	5.1E-06	3.9E-06	3.3E-06	5.8E-06	5.0E-06
Benzo(b)fluoranthene	1.6E-07	5.4E-07	4.2E-07	3.6E-07	6.2E-07	5.3E-07
Benzo(k)fluoranthene	1.3E-07	4.7E-07	3.6E-07	3.1E-07	5.3E-07	4.6E-07
Chrysene	1.7E-08	6.0E-08	4.6E-08	4.0E-08	6.9E-08	5.9E-08
Dibenzo(a,h)anthracene	1.4E-07	4.8E-07	3.7E-07	3.1E-07	5.5E-07	4.7E-07
Indeno(1,2,3-cd)pyrene	5.2E-08	1.8E-07	1.4E-07	1.2E-07	2.1E-07	1.8E-07
Acenaphthene						
Anthracene						
Benzo(g,h,i)perylene						
Fluoranthene						
Fluorene						
Naphthalene						
Phenanthrene						
Pyrene						
PATHWAY-SPECIFIC CANCER RISK	2.1E-06	7.4E-06	5.7E-06	4.8E-06	8.5E-06	7.2E-06

= Reasonable Maximum Exposure

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TABLE 6.1-44

DIRECT SOIL CONTACT PATHWAY LIFETIME EXCESS CANCER RISK FOR THE ON SITE WORKER AND RECREATIONAL VISITOR - CURRENT AND FUTURE AVERAGE EXPOSURE CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Current and Future On Site Worker		Current Recreational Visitor		Future Recreational Visitor	
	Soil Ingestion	Dermal	Soil Ingestion	Dermal	Soil Ingestion	Dermal
Benzo(a)anthracene	3.8E-08	1.1E-07	4.9E-08	4.7E-08	4.9E-08	4.7E-08
Benzo(a)pyrene	3.6E-07	1.1E-06	4.8E-07	4.6E-07	4.8E-07	4.6E-07
Benzo(b)fluoranthene	3.7E-08	1.1E-07	4.9E-08	4.7E-08	4.9E-08	4.7E-08
Benzo(k)fluoranthene	3.0E-08	8.9E-08	3.9E-08	3.7E-08	3.9E-08	3.7E-08
Chrysene	3.9E-09	1.2E-08	5.2E-09	5.0E-09	5.2E-09	5.0E-09
Dibenzo(a,h)anthracene	5.2E-08	1.6E-07	6.9E-08	6.6E-08	6.9E-08	6.6E-08
Indeno(1,2,3-cd)pyrene	1.7E-08	5.2E-08	2.3E-08	2.2E-08	2.3E-08	2.2E-08
Acenaphthene						
Anthracene						
Benzo(g,h,i)perylene						
Fluoranthene						
Fluorene						
Naphthalene						
Phenanthrene						
Pyrene						
PATHWAY-SPECIFIC CANCER RISK	5.4E-07	1.6E-06	7.1E-07	6.8E-07	7.1E-07	6.8E-07

TABLE 6.1-45

DIRECT SOIL CONTACT PATHWAY HAZARD QUOTIENTS OF THE ON SITE WORKER AND RECREATIONAL VISITOR - CURRENT AND FUTURE RME CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Current and Future On Site Worker		Current Recreational Visitor				Future Recreational Visitor			
			Adult		Child		Adult		Child	
	Soil Ingestion	Dermal	Soil Ingestion	Dermal	Soil Ingestion	Dermal	Soil Ingestion	Dermal	Soil Ingestion	Dermal
Benzo(a)anthracene										
Benzo(a)pyrene										
Benzo(b)fluoranthene										
Benzo(k)fluoranthene										
Chrysene										
Dibenzo(a,h)anthracene										
Indeno(1,2,3-cd)pyrene										
Acenaphthene	5.6E-06	1.9E-05	4.6E-06	8.1E-06	4.3E-05	2.1E-05	6.9E-06	1.2E-05	6.5E-05	3.1E-05
Anthracene	8.9E-07	3.1E-06	7.4E-07	1.3E-06	6.9E-06	3.3E-06	1.1E-06	1.9E-06	1.0E-05	4.9E-06
Benzo(g,h,i)perylene										
Fluoranthene	2.5E-05	8.8E-05	2.1E-05	3.7E-05	2.0E-04	9.3E-05	3.1E-05	5.5E-05	2.9E-04	1.4E-04
Fluorene	6.2E-06	2.2E-05	5.2E-06	9.0E-06	4.9E-05	2.3E-05	7.7E-06	1.3E-05	7.2E-05	3.4E-05
Naphthalene	3.2E-06	1.1E-05	2.6E-06	4.6E-06	2.5E-05	1.2E-05	3.9E-06	6.8E-06	3.7E-05	1.7E-05
Phenanthrene										
Pyrene	3.2E-05	1.1E-04	2.7E-05	4.7E-05	2.5E-04	1.2E-04	4.0E-05	7.0E-05	3.7E-04	1.8E-04
PATHWAY-SPECIFIC HAZARD INDEX	7.3E-05	2.6E-04	6.1E-05	1.1E-04	5.7E-04	2.7E-04	9.1E-05	1.6E-04	8.5E-04	4.0E-04

= Reasonable Maximum Exposure

TABLE 6.1-46

DIRECT SOIL CONTACT PATHWAY HAZARD QUOTIENTS FOR THE ON SITE WORKER AND RECREATIONAL VISITOR - CURRENT AND FUTURE AVERAGE EXPOSURE CASES

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Current and Future On Site Worker		Current Recreational Visitor				Future Recreational Visitor			
			Adult		Child		Adult		Child	
	Soil Ingestion	Dermal	Soil Ingestion	Dermal	Soil Ingestion	Dermal	Soil Ingestion	Dermal	Soil Ingestion	Dermal
Benzo(a)anthracene										
Benzo(a)pyrene										
Benzo(b)fluoranthene										
Benzo(k)fluoranthene										
Chrysene										
Dibenzo(a,h)anthracene										
Indeno(1,2,3-cd)pyrene										
Acenaphthene	3.3E-06	9.8E-06	5.4E-07	2.0E-06	6.3E-06	3.8E-06	5.4E-07	2.0E-06	6.3E-06	3.8E-06
Anthracene	5.1E-07	1.5E-06	8.5E-08	3.2E-07	9.9E-07	5.9E-07	8.5E-08	3.2E-07	9.9E-07	5.9E-07
Benzo(g,h,i)perylene										
Fluoranthene	1.5E-05	4.4E-05	2.4E-06	9.2E-06	2.9E-05	1.7E-05	2.4E-06	9.2E-06	2.9E-05	1.7E-05
Fluorene	3.7E-06	1.1E-05	6.1E-07	2.3E-06	7.2E-06	4.3E-06	6.1E-07	2.3E-06	7.2E-06	4.3E-06
Naphthalene	1.8E-06	5.5E-06	3.1E-07	1.2E-06	3.6E-06	2.2E-06	3.1E-07	1.2E-06	3.6E-06	2.2E-06
Phenanthrene										
Pyrene	1.8E-05	5.4E-05	3.0E-06	1.1E-05	3.5E-05	2.1E-05	3.0E-06	1.1E-05	3.5E-05	2.1E-05
PATHWAY-SPECIFIC HAZARD INDEX	4.2E-05	1.3E-04	7.0E-06	2.6E-05	8.1E-05	4.9E-05	7.0E-06	2.6E-05	8.1E-05	4.9E-05

In accordance with EPA guidance, the current visitor was assumed to ingest 200 mg/day of soil in the RME case (100 mg/day in the average case) during childhood, and 100 mg/day of soil in the RME case (40 mg/day in the average case) as an adult. As for the on site worker, dermal exposure to PAHs was assumed to occur based on the exposed skin area (3,160 cm^2 RME/2,000 cm^2 average case for the child; 5,800 cm^2 RME/5,000 cm^2 average case as an adult), the soil-to-skin adherence factor, and the dermal absorption factor for PAHs. The fraction of soil contacted by the visitor that was assumed to contain PAHs is one-sixteenth, the estimated fraction of the main site cover that is contaminated. Exposure concentrations for the current visitor were evaluated as described for the off site resident and on site worker in Sections 6.1.4.2.1 and 6.1.4.2.2.

Standard exposure assumptions that were used for both the RME and average exposure scenarios are an inhalation rate of 2.5 m^3/hr and body weights of fifteen kg for the child and 70 kg for the adult. The resulting risks for the recreational visitor are shown on Tables 6.1-34 through 6.1-41 and 6.1-43 through 6.1-46.

The excess cancer risk to current visitors from lifetime (childhood and adult) exposure is in the range of 1.4×10^{-6} (for the average case and 95 percent gas collection efficiency) to 1.2×10^{-5} (for the RME case and 75 percent gas collection efficiency). The hazard index is less than 0.01 for the adult and less than 0.04 for the child. Direct contact with roadway soil on the main site during six years of early childhood accounts for a large portion of the calculated excess cancer risk. For the RME case, more than 95 percent of the estimated risk is from direct contact with roadway soil if the landfill gas collection efficiency is 95 percent; approximately 90 percent of the risk is from direct soil contact if the landfill gas collection efficiency is 75 percent. The overall risks are summarized for the recreational visitor scenario on Tables 6.1-30 through 6.1-33.

6.1.4.2.4 Future Off Site Residents

Future exposures and resulting risk values at the nearest downwind residential location are the same as the current exposures and risk values because air emissions are assumed to remain the same in the future and it is not technically feasible to develop a producing water supply well at this location. Therefore, the risks for the future off site resident are the same as the current off site

resident for the resident where the highest ambient air concentrations would be expected from any air releases from the landfill.

The future residential exposure scenario at Receptor Wells 2 and 5 consisted of combining the RME for the ground water pathway with the calculated local value for outdoor air exposures as discussed previously. Risks at these receptors were largely due to the ground water pathway, with smaller additional risks due to the outdoor air pathway. Maximum predicted future ground water concentrations of COCs were used to calculate exposures at the residential receptors.

The scenario under consideration is that of a resident using ground water from a private water supply well for all domestic purposes (e.g., washing and drinking). This future resident is also assumed to be exposed to outdoor air concentrations from landfill releases of volatile compounds and dust.

The future ground water use scenario is hypothetical since ground water near the site is not currently used. Moreover, the development of private wells in the future is considered unlikely since the area is highly developed, municipal water is generally available, and ground water extraction rights are currently apportioned under the basin adjudication.

Chemicals that were included in the ground water calculations include nitrate, cyanide and all of the organic compounds that were detected in ground water, with the exception of two phthalates (which were detected in both upgradient and downgradient ground water and are likely laboratory artifacts) and PAHs (which were detected in both upgradient and downgradient ground water sporadically and at low concentrations, and are constituents of naturally occurring oil in the Malaga mudstone at the site). In general, metals in ground water were considered to be naturally occurring (and not considered to be landfill related constituents) based on the measured metals concentrations in soil equilibrium studies for geological formations at the site, and review of ground water concentration isopleth maps which did not suggest a pattern of release from the landfill. However, arsenic was evaluated as a potential constituent of concern, because arsenic concentrations in both filtered and unfiltered ground water samples showed an area of consistently higher concentrations (up to about twenty times the MCL) at several locations in the Hawthorne Boulevard area.

The maximum detected concentrations in ground water during the entire historical ground water monitoring period (from 1986 through June 1994) were used to estimate the current releases from the Hawthorne and Crenshaw Boulevard areas. Chemicals were assumed to be potentially present at both areas if they were detected in at least one well from the Hawthorne and Crenshaw Boulevard areas. In accordance with EPA guidance, one-half of the laboratory detection limit was substituted for non-detected chemical concentrations. Some of the detection limits were elevated (due to matrix interference and dilution of the sample by the laboratory). Therefore, to avoid underestimating a chemical that could be masked by higher concentrations of other compounds, the detection limit selected as the proxy for non-detected concentrations was the highest minimum detection limit that had been achieved at least once for all of the ground water monitoring wells in the area.

Ground water modeling was used to predict maximum future chemical concentrations at five downgradient locations where future ground water use was considered possible based on the volume of ground water that could be extracted by a water supply well. These locations are in the West Coast Basin, immediately downgradient of the Palos Verdes fault zone, and were selected to represent maximum ground water concentrations from the landfill for any location with sufficient ground water to support a water supply well. Ground water use immediately adjacent to the landfill is not considered plausible based on the thinness of the aquifer and low productivity of monitoring wells in this area. The two locations that showed the highest future impact from the PVLF in the Hawthorne and Crenshaw Boulevard areas (Receptor Wells 2 and 5 respectively) were selected to represent future risks from residential ground water use.

Ground water modeling was used to predict future off site concentrations resulting from continued, steady-state releases in both the Hawthorne and Crenshaw Boulevard areas. The steady-state assumption is believed to be conservative, since future releases from the Hawthorne Boulevard area are expected to be limited by the construction of the subsurface barrier and ground water extraction system in 1986.

The maximum predicted concentrations at any time in the future were used to represent ground water exposures for the future resident. In addition, the ground water

concentrations that were selected represent the high end of a predicted range (based on uncertainties in the ground water model) which spans 1.5 orders of magnitude (a factor of about 70).

In accordance with EPA guidance, the future resident was assumed to consume one liter of water per day as a child and two liters of water per day as an adult in the RME case. In the average case, the resident was assumed to consume one liter of water per day as a child and 1.4 liters of water per day as an adult. Dermal absorption of chemicals from water was assumed to occur during showering based on the whole body skin surface area exposed (7,280 cm^2 for the child and 19,400 cm^2 for the adult) and the chemical-specific dermal permeability constant (shown in Table 6.1-23). All of the other intake parameters are the same as those defined for the current off site resident. The pathway risks for the future off site resident are shown on Tables 6.1-47 through 6.1-54.

Excess cancer risks for the future resident were calculated to be in the range of 9.8×10^{-6} (for the average case at Receptor Well 5 and 95 percent gas collection efficiency) to 3.4×10^{-5} (for the RME case at Receptor Well 2 and 75 percent gas collection efficiency). The hazard index was less than 0.2 for the adult and less than 0.3 for the child. Approximately 95 percent of the excess cancer risk and non-cancer hazard is attributed to potential exposure to arsenic, which was predicted by ground water modeling at concentrations some one-thousandth of the MCL. Maximum future nitrate concentrations at the receptor wells were in the range of 0.001 mg/L, a value that is well below the 10 mg/L health criterion, set to protect infants from acute toxic effects.

6.1.4.2.5 Future On Site Worker

No changes are expected in the types or levels of potential exposures and risks to full-time maintenance workers at the PVLF. Therefore the estimated risks to future workers at the PVLF are the same as those calculated for the current on site worker.

6.1.4.2.6 Future Recreational Visitor

Future uses for the PVLF main site are being considered which include equestrian areas, a golf course, a park, or other open space alternatives. Since future development could lead to increased site use, more frequent use of the main site at the PVLF was assumed for the future

TABLE 6.1-47

GROUND WATER PATHWAY LIFETIME EXCESS CANCER RISK AND HAZARD QUOTIENTS FOR THE ADULT OFF SITE RESIDENT USING RECEPTOR WELL 2 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients					Lifetime Upper-Bound Excess Cancer Risk				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Acetone	1.25E-05	1.25E-05	1.72E-08	2.49E-05	0.02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Benzene	3.37E-07	3.37E-07	1.71E-08	6.90E-07	0.00	3.12E-11	3.12E-11	1.45E-12	6.39E-11	0.00
Bis-(2-chloroethyl)ether						7.04E-10	7.04E-10	3.26E-12	1.41E-09	0.00
Bromodichloromethane	9.25E-09	9.25E-09	1.30E-10	1.86E-08	0.00	1.31E-11	1.31E-11	1.67E-13	2.63E-11	0.00
Bromoform	1.67E-10	1.67E-10	1.05E-12	3.36E-10	0.00	1.43E-14	7.08E-15	8.21E-17	2.15E-14	0.00
Bromomethane	1.56E-06	1.52E-06	1.32E-08	3.09E-06	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Butanone, 2-	8.65E-07	1.79E-06	2.31E-09	2.66E-06	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Carbon tetrachloride	1.14E-09	1.39E-09	6.07E-11	2.59E-09	0.00	6.49E-14	6.49E-14	3.14E-15	1.33E-13	0.00
Chlordane	9.13E-11	9.13E-11	1.15E-11	1.94E-10	0.00	3.57E-15	3.57E-15	4.09E-16	7.55E-15	0.00
Chlorobenzene	1.12E-07	3.91E-07	1.11E-08	5.13E-07	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Chloroethane	4.67E-09	6.44E-10	9.06E-11	5.40E-09	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Chloroform	1.97E-06	1.97E-06	4.26E-08	3.99E-06	0.00	3.32E-10	2.03E-10	6.50E-12	5.42E-10	0.00
Chloromethane						1.10E-09	5.32E-10	1.02E-11	1.64E-09	0.00
Chlorophenol, 2-	2.70E-06	2.70E-06	7.20E-08	5.47E-06	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
DDD						4.28E-16	4.28E-16	2.64E-16	1.12E-15	0.00
DDE						4.05E-16	4.05E-16	2.14E-16	1.02E-15	0.00
DDT	2.41E-11	2.41E-11	2.51E-11	7.34E-11	0.00	2.22E-15	2.22E-15	2.11E-15	6.56E-15	0.00
Di-n-butylphthalate	2.30E-11	2.30E-11	1.84E-12	4.79E-11	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Dibromochloromethane	1.08E-08	1.08E-08	8.14E-11	2.17E-08	0.00	1.10E-11	1.10E-11	7.54E-14	2.22E-11	0.00
Dichlorobenzene, 1,2-	4.92E-12	7.77E-12	7.28E-13	1.34E-11	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Dichlorobenzene, 1,4-	1.67E-11	1.67E-11	2.51E-12	3.59E-11	0.00	8.31E-14	8.31E-14	1.13E-14	1.77E-13	0.00
Dichloroethane, 1,1-	2.55E-09	1.78E-09	5.49E-11	4.38E-09	0.00	7.88E-13	7.88E-13	1.54E-14	1.59E-12	0.00
Dichloroethane,1,2-	2.14E-04	2.14E-04	2.75E-06	4.31E-04	0.37	2.33E-08	2.33E-08	2.72E-10	4.68E-08	0.14
Dichloroethene, 1,1-	5.66E-09	5.66E-09	2.20E-10	1.15E-08	0.00	1.66E-11	4.98E-12	5.84E-13	2.21E-11	0.00
Dichloroethene, cis-1,2-	6.20E-08	6.20E-08	1.50E-09	1.25E-07	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Dichloroethene, trans-1,2-	7.20E-09	7.20E-09	1.74E-10	1.46E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00

[redacted]tor Well 2 is a *hypothetical* ground water well located as close as technically feasible downgra[redacted]f the PVLF.
[redacted] = Reasonable Maximum Exposure

TABLE 6.1-47 (CONTINUED)

GROUND WATER PATHWAY LIFETIME EXCESS CANCER RISK AND HAZARD QUOTIENTS FOR THE ADULT OFF SITE RESIDENT USING RECEPTOR WELL 2 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients					Lifetime Upper-Bound Excess Cancer Risk				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Dichloropropane, 1,2-	3.64E-08	3.64E-08	8.82E-10	7.36E-08	0.00	1.74E-12	1.74E-12	3.83E-14	3.52E-12	0.00
Dichloropropene, 1,3-	3.65E-08	1.92E-09	4.87E-10	3.89E-08	0.00	1.07E-12	2.56E-13	1.30E-14	1.34E-12	0.00
Dieldrin	1.71E-16	1.71E-16	6.64E-18	3.49E-16	0.00	2.38E-15	2.38E-15	8.38E-17	4.84E-15	0.00
Diethylphthalate	4.15E-11	4.15E-11	4.83E-13	8.35E-11	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Ethylbenzene	5.03E-12	1.74E-12	9.03E-13	7.67E-12	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Freon 11 (CCL3F)	1.84E-10	2.77E-10	7.61E-12	4.69E-10	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Isophorone	3.74E-07	3.74E-07	3.99E-09	7.51E-07	0.00	3.85E-11	3.85E-11	3.73E-13	7.74E-11	0.00
Lindane	8.39E-12	8.39E-12	2.85E-13	1.71E-11	0.00	1.50E-15	1.50E-15	4.63E-17	3.05E-15	0.00
Methylene chloride	1.00E-05	7.02E-07	1.09E-07	1.08E-05	0.00	4.57E-09	1.14E-09	4.53E-11	5.76E-09	0.02
N-nitrosodi-n-propylamine					0.00	3.94E-09	3.94E-09	3.09E-11	7.92E-09	0.02
N-nitrosodiphenylamine					0.00	2.56E-15	2.56E-15	1.15E-16	5.23E-15	0.00
Pentachlorophenol	1.17E-11	1.17E-11	1.85E-11	4.20E-11	0.00	3.44E-15	3.44E-15	4.93E-15	1.18E-14	0.00
Phenol	3.46E-08	3.46E-08	4.61E-10	6.96E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Tetrachloroethene	4.30E-09	4.30E-09	5.01E-10	9.10E-09	0.00	1.19E-12	4.90E-13	1.26E-13	1.81E-12	0.00
Tetrahydrofuran						0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Toluene	4.30E-10	7.55E-10	4.69E-11	1.23E-09	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Trichlorobenzene, 1,2,4-	3.02E-12	5.30E-13	8.06E-13	4.36E-12	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Trichloroethane, 1,1,1-	5.47E-09	1.72E-09	2.25E-10	7.41E-09	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Trichloroethane, 1,1,2-	1.11E-09	1.11E-09	2.25E-11	2.24E-09	0.00	1.37E-13	1.35E-13	2.53E-15	2.74E-13	0.00
Trichloroethene	2.54E-03	2.54E-03	9.86E-05	5.18E-03	4.42	1.24E-07	8.27E-08	4.37E-09	2.11E-07	0.64
Vinyl chloride						2.88E-10	2.88E-10	4.64E-12	5.81E-10	0.00
Xylenes	3.42E-06	3.42E-06	6.64E-07	7.51E-06	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Cyanide	1.59E-09	0.00E+00	3.86E-12	1.60E-09	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Nitrate	1.69E-08	0.00E+00	4.10E-11	1.70E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Arsenic	1.11E-01	0.00E+00	2.70E-04	1.11E-01	95.16	3.26E-05	0.00E+00	7.18E-08	3.27E-05	99.16
				1.17E-01	1.00				3.30E-05	1.00

Receptor Well 2 is a *hypothetical* ground water well located as close as technically feasible downgradient of the PVLF.
RME = Reasonable Maximum Exposure

TABLE 6.1-48

GROUND WATER PATHWAY LIFETIME EXCESS CANCER RISK AND HAZARD QUOTIENTS FOR THE ADULT OFF SITE RESIDENT USING RECEPTOR WELL 5 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients					Lifetime Upper-Bound Excess Cancer Risk				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Acetone	1.64E-05	1.64E-05	2.27E-08	3.29E-05	0.04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Benzene	4.17E-05	4.17E-05	2.12E-06	8.54E-05	0.11	3.87E-09	3.87E-09	1.79E-10	7.91E-09	0.04
Bis-(2-chloroethyl)ether					0.00	2.32E-08	2.32E-08	1.07E-10	4.66E-08	0.25
Bromodichloromethane	7.37E-07	7.37E-07	1.04E-08	1.48E-06	0.00	1.04E-09	1.04E-09	1.33E-11	2.09E-09	0.01
Bromoform	2.01E-08	2.01E-08	1.27E-10	4.04E-08	0.00	1.73E-12	8.53E-13	9.89E-15	2.59E-12	0.00
Bromomethane	6.12E-06	5.99E-06	5.19E-08	1.22E-05	0.02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Butanone, 2-	2.28E-08	4.72E-08	6.09E-11	7.01E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Carbon tetrachloride	5.76E-07	7.06E-07	3.07E-08	1.31E-06	0.00	3.28E-11	3.28E-11	1.59E-12	6.72E-11	0.00
Chlordane	5.94E-11	5.94E-11	7.49E-12	1.26E-10	0.00	2.32E-15	2.32E-15	2.66E-16	4.91E-15	0.00
Chlorobenzene	1.93E-06	6.77E-06	1.92E-07	8.90E-06	0.01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Chloroethane	2.91E-08	4.02E-09	5.65E-10	3.37E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Chloroform	2.95E-06	2.95E-06	6.36E-08	5.95E-06	0.01	4.96E-10	3.04E-10	9.71E-12	8.09E-10	0.00
Chloromethane					0.00	6.04E-11	2.93E-11	5.59E-13	9.03E-11	0.00
Chlorophenol, 2-	5.48E-06	5.48E-06	1.46E-07	1.11E-05	0.01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
DDD					0.00	2.94E-16	2.94E-16	1.82E-16	7.71E-16	0.00
DDE					0.00	2.40E-15	2.40E-15	1.27E-15	6.07E-15	0.00
DDT	1.37E-13	1.37E-13	1.43E-13	4.17E-13	0.00	1.26E-17	1.26E-17	1.20E-17	3.73E-17	0.00
Di-n-butylphthalate	5.48E-14	5.48E-14	4.38E-15	1.14E-13	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Dibromochloromethane	4.78E-07	4.78E-07	3.59E-09	9.60E-07	0.00	4.88E-10	4.88E-10	3.33E-12	9.79E-10	0.01
Dichlorobenzene, 1,2-	1.52E-10	2.40E-10	2.25E-11	4.15E-10	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Dichlorobenzene, 1,4-	6.62E-10	6.62E-10	9.95E-11	1.42E-09	0.00	3.29E-12	3.29E-12	4.49E-13	7.03E-12	0.00
Dichloroethane, 1,1-	1.20E-06	8.41E-07	2.59E-08	2.07E-06	0.00	3.72E-10	3.72E-10	7.29E-12	7.51E-10	0.00
Dichloroethane, 1,2-	2.39E-03	2.39E-03	3.08E-05	4.82E-03	6.01	2.60E-07	2.60E-07	3.04E-09	5.24E-07	2.85
Dichloroethene, 1,1-	1.92E-07	1.92E-07	7.44E-09	3.91E-07	0.00	5.62E-10	1.69E-10	1.98E-11	7.51E-10	0.00
Dichloroethene, cis-1,2-	6.23E-05	6.23E-05	1.51E-06	1.26E-04	0.16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Dichloroethene, trans-1,2-	8.24E-06	8.24E-06	2.00E-07	1.67E-05	0.02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00

Receptor Well 5 is an exiting ground water well used for industrial purposed only.
RME = Reasonable Maximum Exposure

TABLE 6.1-48 (CONTINUED)

GROUND WATER PATHWAY LIFETIME EXCESS CANCER RISK AND HAZARD QUOTIENTS FOR THE ADULT OFF SITE RESIDENT USING RECEPTOR WELL 5 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients					Lifetime Upper-Bound Excess Cancer Risk				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Dichloropropane, 1,2-	1.69E-05	1.69E-05	4.09E-07	3.41E-05	0.04	8.07E-10	8.07E-10	1.78E-11	1.63E-09	0.01
Dichloropropene, 1,3-	3.71E-06	1.95E-07	4.95E-08	3.95E-06	0.00	1.09E-10	2.60E-11	1.32E-12	1.36E-10	0.00
Dieldrin	2.57E-17	2.57E-17	9.97E-19	5.24E-17	0.00	3.57E-16	3.57E-16	1.26E-17	7.26E-16	0.00
Diethylphthalate	1.67E-08	1.67E-08	1.94E-10	3.36E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Ethylbenzene	1.66E-09	5.72E-10	2.98E-10	2.53E-09	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Freon 11 (CCL3F)	2.82E-08	4.23E-08	1.16E-09	7.17E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Isophorone	1.40E-07	1.40E-07	1.50E-09	2.82E-07	0.00	1.45E-11	1.45E-11	1.40E-13	2.91E-11	0.00
Lindane	9.62E-10	9.62E-10	3.27E-11	1.96E-09	0.00	1.72E-13	1.72E-13	5.31E-15	3.50E-13	0.00
Methylene chloride	2.17E-05	1.52E-06	2.37E-07	2.34E-05	0.03	9.89E-09	2.47E-09	9.80E-11	1.25E-08	0.07
N-nitrosodi-n-propylamine					0.00	5.21E-08	5.21E-08	4.08E-10	1.05E-07	0.57
N-nitrosodiphenylamine					0.00	7.05E-14	7.05E-14	3.17E-15	1.44E-13	0.00
Pentachlorophenol	1.92E-09	1.92E-09	3.03E-09	6.88E-09	0.00	5.64E-13	5.64E-13	8.07E-13	1.94E-12	0.00
Phenol	7.99E-08	7.99E-08	1.07E-09	1.61E-07	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Tetrachloroethene	9.02E-06	9.02E-06	1.05E-06	1.91E-05	0.02	2.50E-09	1.03E-09	2.64E-10	3.79E-09	0.02
Tetrahydrofuran						0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Toluene	2.50E-06	4.38E-06	2.73E-07	7.15E-06	0.01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Trichlorobenzene, 1,2,4-	1.08E-09	1.90E-10	2.89E-10	1.56E-09	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Trichloroethane, 1,1,1-	1.55E-08	4.88E-09	6.39E-10	2.10E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Trichloroethane, 1,1,2-	8.01E-05	8.01E-05	1.63E-06	1.62E-04	0.20	9.92E-09	9.74E-09	1.83E-10	1.98E-08	0.11
Trichloroethene	8.42E-03	8.42E-03	3.27E-04	1.72E-02	21.40	4.11E-07	2.74E-07	1.45E-08	7.00E-07	3.81
Vinyl Chloride						3.21E-08	3.21E-08	5.16E-10	6.48E-08	0.35
Xylenes	6.16E-07	6.16E-07	1.20E-07	1.35E-06	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Cyanide	3.79E-06	0.00E+00	9.18E-09	3.80E-06	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Nitrate	1.19E-09	0.00E+00	2.88E-12	1.19E-09	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Arsenic	5.75E-02	0.00E+00	1.40E-04	5.77E-02	71.90	1.69E-05	0.00E+00	3.71E-08	1.69E-05	91.90
				8.02E-02	1.00				1.84E-05	1.00

Receptor Well 5 is an exiting ground water well used for industrial purposed only.
RME = Reasonable Maximum Exposure

TABLE 6.1-49

GROUND WATER PATHWAY LIFETIME EXCESS CANCER RISK AND HAZARD QUOTIENTS FOR THE ADULT OFF SITE RESIDENT USING RECEPTOR WELL 2 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients					Lifetime Upper-Bound Excess Cancer Risk				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Acetone	8.72E-06	8.72E-06	1.72E-08	1.75E-05	0.02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Benzene	2.36E-07	2.36E-07	1.71E-08	4.88E-07	0.00	1.67E-11	1.67E-11	8.17E-13	3.42E-11	0.00
Bis-(2-chloroethyl)ether					0.00	3.76E-10	3.76E-10	1.84E-12	7.54E-10	0.00
Bromodichloromethane	6.47E-09	6.47E-09	1.30E-10	1.31E-08	0.00	6.97E-12	6.97E-12	9.42E-14	1.40E-11	0.00
Bromoform	1.17E-10	1.17E-10	1.05E-12	2.35E-10	0.00	7.66E-15	3.78E-15	4.64E-17	1.15E-14	0.00
Bromomethane	1.09E-06	1.07E-06	1.32E-08	2.17E-06	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Butanone, 2-	6.05E-07	1.25E-06	2.31E-09	1.86E-06	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Carbon tetrachloride	7.96E-10	9.76E-10	6.07E-11	1.83E-09	0.00	3.46E-14	3.46E-14	1.78E-15	7.11E-14	0.00
Chlordane	6.39E-11	6.39E-11	1.15E-11	1.39E-10	0.00	1.91E-15	1.91E-15	2.31E-16	4.04E-15	0.00
Chlorobenzene	7.81E-08	2.73E-07	1.11E-08	3.63E-07	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Chloroethane	3.27E-09	4.51E-10	9.06E-11	3.81E-09	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Chloroform	1.38E-06	1.38E-06	4.26E-08	2.80E-06	0.00	1.77E-10	1.09E-10	3.68E-12	2.90E-10	0.00
Chloromethane					0.00	5.87E-10	2.84E-10	5.74E-12	8.77E-10	0.00
Chlorophenol, 2-	1.89E-06	1.89E-06	7.20E-08	3.85E-06	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
DDD					0.00	2.29E-16	2.29E-16	1.49E-16	6.07E-16	0.00
DDE					0.00	2.16E-16	2.16E-16	1.21E-16	5.53E-16	0.00
DDT	1.69E-11	1.69E-11	2.51E-11	5.89E-11	0.00	1.19E-15	1.19E-15	1.19E-15	3.57E-15	0.00
Di-n-butylphthalate	1.61E-11	1.61E-11	1.84E-12	3.41E-11	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Dibromochloromethane	7.58E-09	7.58E-09	8.14E-11	1.52E-08	0.00	5.90E-12	5.90E-12	4.26E-14	1.18E-11	0.00
Dichlorobenzene, 1,2-	3.45E-12	5.44E-12	7.28E-13	9.61E-12	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Dichlorobenzene, 1,4-	1.17E-11	1.17E-11	2.51E-12	2.59E-11	0.00	4.44E-14	4.44E-14	6.41E-15	9.52E-14	0.00
Dichloroethane, 1,1-	1.78E-09	1.25E-09	5.49E-11	3.08E-09	0.00	4.21E-13	4.21E-13	8.73E-15	8.50E-13	0.00
Dichloroethane,1,2-	1.50E-04	1.50E-04	2.75E-06	3.02E-04	0.37	1.24E-08	1.24E-08	1.54E-10	2.50E-08	0.14
Dichloroethene, 1,1-	3.96E-09	3.96E-09	2.20E-10	8.14E-09	0.00	8.86E-12	2.66E-12	3.30E-13	1.18E-11	0.00
Dichloroethene, cis-1,2-	4.34E-08	4.34E-08	1.50E-09	8.83E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Dichloroethene, trans-1,2-	5.04E-09	5.04E-09	1.74E-10	1.02E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Dichloropropane, 1,2-	2.55E-08	2.55E-08	8.82E-10	5.18E-08	0.00	9.30E-13	9.30E-13	2.17E-14	1.88E-12	0.00
Dichloropropene, 1,3-	2.56E-08	1.34E-09	4.87E-10	2.74E-08	0.00	5.72E-13	1.37E-13	7.33E-15	7.16E-13	0.00

[redacted]tor Well 2 is a *hypothetical* ground water well located as close as technically feasible downgra[redacted]f the PVLF.

TABLE 6.1-49 (CONTINUED)

GROUND WATER PATHWAY LIFETIME EXCESS CANCER RISK AND HAZARD QUOTIENTS FOR THE ADULT OFF SITE RESIDENT USING RECEPTOR WELL 2 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients					Lifetime Upper-Bound Excess Cancer Risk				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Dieldrin	1.20E-16	1.20E-16	6.64E-18	2.46E-16	0.00	1.27E-15	1.27E-15	4.74E-17	2.59E-15	0.00
Diethylphthalate	2.91E-11	2.91E-11	4.83E-13	5.86E-11	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Ethylbenzene	3.52E-12	1.21E-12	9.03E-13	5.64E-12	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Freon 11 (CCL3F)	1.29E-10	1.94E-10	7.61E-12	3.30E-10	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Isophorone	2.62E-07	2.62E-07	3.99E-09	5.27E-07	0.00	2.06E-11	2.06E-11	2.11E-13	4.14E-11	0.00
Lindane	5.87E-12	5.87E-12	2.85E-13	1.20E-11	0.00	8.03E-16	8.03E-16	2.62E-17	1.63E-15	0.00
Methylene chloride	7.02E-06	4.92E-07	1.09E-07	7.62E-06	0.01	2.44E-09	6.11E-10	2.56E-11	3.08E-09	0.00
N-nitrosodi-n-propylamine					0.00	2.11E-09	2.11E-09	1.75E-11	4.23E-09	0.02
N-nitrosodiphenylamine					0.00	1.37E-15	1.37E-15	6.50E-17	2.80E-15	0.00
Pentachlorophenol	8.22E-12	8.22E-12	1.85E-11	3.50E-11	0.00	1.84E-15	1.84E-15	2.79E-15	6.46E-15	0.00
Phenol	2.42E-08	2.42E-08	4.61E-10	4.89E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Tetrachloroethene	3.01E-09	3.01E-09	5.01E-10	6.52E-09	0.00	6.36E-13	2.62E-13	7.11E-14	9.69E-13	0.00
Tetrahydrofuran					0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Toluene	3.01E-10	5.28E-10	4.69E-11	8.76E-10	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Trichlorobenzene, 1,2,4-	2.11E-12	3.71E-13	8.06E-13	3.29E-12	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Trichloroethane, 1,1,1-	3.83E-09	1.20E-09	2.25E-10	5.26E-09	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Trichloroethane, 1,1,2-	7.75E-10	7.75E-10	2.25E-11	1.57E-09	0.00	7.32E-14	7.19E-14	1.43E-15	1.47E-13	0.00
Trichloroethene	1.78E-03	1.78E-03	9.86E-05	3.65E-03	4.45	6.63E-08	4.42E-08	2.47E-09	1.13E-07	0.64
Vinyl Chloride					0.00	1.54E-10	1.54E-10	2.62E-12	3.11E-10	0.00
Xylenes	2.40E-06	2.40E-06	6.64E-07	5.46E-06	0.01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Cyanide	1.12E-09	0.00E+00	3.86E-12	1.12E-09	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Nitrate	1.18E-08	0.00E+00	4.10E-11	1.19E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Arsenic	7.79E-02	0.00E+00	2.70E-04	7.81E-02	95.13	1.74E-05	0.00E+00	4.06E-08	1.75E-05	99.16
				8.21E-02	1.00				1.76E-05	1.00

Receptor Well 2 is a *hypothetical* ground water well located as close as technically feasible downgradient of the PVLF.

TABLE 6.1-50

GROUND WATER PATHWAY LIFETIME EXCESS CANCER RISK AND HAZARD QUOTIENTS FOR THE ADULT OFF SITE RESIDENT USING RECEPTOR WELL 5 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients					Lifetime Upper-Bound Excess Cancer Risk				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Acetone	1.15E-05	1.15E-05	2.27E-08	2.30E-05	0.04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Benzene	2.92E-05	2.92E-05	2.12E-06	6.04E-05	0.11	2.07E-09	2.07E-09	1.01E-10	4.23E-09	0.04
Bis-(2-chloroethyl)ether					0.00	1.24E-08	1.24E-08	6.08E-11	2.49E-08	0.25
Bromodichloromethane	5.16E-07	5.16E-07	1.04E-08	1.04E-06	0.00	5.56E-10	5.56E-10	7.51E-12	1.12E-09	0.01
Bromoform	1.41E-08	1.41E-08	1.27E-10	2.83E-08	0.00	9.23E-13	4.56E-13	5.59E-15	1.38E-12	0.00
Bromomethane	4.28E-06	4.19E-06	5.19E-08	8.52E-06	0.02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Butanone, 2-	1.60E-08	3.31E-08	6.09E-11	4.91E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Carbon tetrachloride	4.03E-07	4.94E-07	3.07E-08	9.28E-07	0.00	1.75E-11	1.75E-11	8.99E-13	3.60E-11	0.00
Chlordane	4.16E-11	4.16E-11	7.49E-12	9.06E-11	0.00	1.24E-15	1.24E-15	1.50E-16	2.63E-15	0.00
Chlorobenzene	1.35E-06	4.74E-06	1.92E-07	6.29E-06	0.01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Chloroethane	2.04E-08	2.81E-09	5.65E-10	2.38E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Chloroform	2.06E-06	2.06E-06	6.36E-08	4.19E-06	0.01	2.65E-10	1.62E-10	5.49E-12	4.33E-10	0.00
Chloromethane					0.00	3.23E-11	1.56E-11	3.16E-13	4.82E-11	0.00
Chlorophenol, 2-	3.84E-06	3.84E-06	1.46E-07	7.82E-06	0.01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
DDD					0.00	1.57E-16	1.57E-16	1.03E-16	4.17E-16	0.00
DDE					0.00	1.28E-15	1.28E-15	7.18E-16	3.28E-15	0.00
DDT	9.59E-14	9.59E-14	1.43E-13	3.35E-13	0.00	6.75E-18	6.75E-18	6.77E-18	2.03E-17	0.00
Di-n-butylphthalate	3.84E-14	3.84E-14	4.38E-15	8.11E-14	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Dibromochloromethane	3.35E-07	3.35E-07	3.59E-09	6.73E-07	0.00	2.61E-10	2.61E-10	1.88E-12	5.23E-10	0.01
Dichlorobenzene, 1,2-	1.07E-10	1.68E-10	2.25E-11	2.97E-10	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Dichlorobenzene, 1,4-	4.63E-10	4.63E-10	9.95E-11	1.03E-09	0.00	1.76E-12	1.76E-12	2.54E-13	3.77E-12	0.00
Dichloroethane, 1,1-	8.41E-07	5.88E-07	2.59E-08	1.46E-06	0.00	1.99E-10	1.99E-10	4.12E-12	4.02E-10	0.00
Dichloroethane,1,2-	1.68E-03	1.68E-03	3.08E-05	3.38E-03	6.01	1.39E-07	1.39E-07	1.72E-09	2.80E-07	2.85
Dichloroethene, 1,1-	1.34E-07	1.34E-07	7.44E-09	2.76E-07	0.00	3.00E-10	9.01E-11	1.12E-11	4.02E-10	0.00
Dichloroethene, cis-1,2-	4.36E-05	4.36E-05	1.51E-06	8.88E-05	0.16	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Dichloroethene, trans-1,2-	5.77E-06	5.77E-06	2.00E-07	1.17E-05	0.02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Dichloropropane, 1,2-	1.18E-05	1.18E-05	4.09E-07	2.40E-05	0.04	4.31E-10	4.31E-10	1.00E-11	8.72E-10	0.01
Dichloropropene, 1,3-	2.60E-06	1.36E-07	4.95E-08	2.78E-06	0.00	5.81E-11	1.39E-11	7.45E-13	7.27E-11	0.00
Dieldrin	1.80E-17	1.80E-17	9.97E-19	3.70E-17	0.00	1.91E-16	1.91E-16	7.11E-18	3.88E-16	0.00

ptor Well 5 is an existing ground water well used for industrial purposes only.

TABLE 6.1-50 (CONTINUED)

GROUND WATER PATHWAY LIFETIME EXCESS CANCER RISK AND HAZARD QUOTIENTS FOR THE ADULT OFF SITE RESIDENT USING RECEPTOR WELL 5 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients					Lifetime Upper-Bound Excess Cancer Risk				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Diethylphthalate	1.17E-08	1.17E-08	1.94E-10	2.36E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Ethylbenzene	1.16E-09	4.01E-10	2.98E-10	1.86E-09	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Freon 11 (CCL3F)	1.97E-08	2.96E-08	1.16E-09	5.05E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Isophorone	9.83E-08	9.83E-08	1.50E-09	1.98E-07	0.00	7.74E-12	7.74E-12	7.93E-14	1.56E-11	0.00
Lindane	6.73E-10	6.73E-10	3.27E-11	1.38E-09	0.00	9.21E-14	9.21E-14	3.00E-15	1.87E-13	0.00
Methylene chloride	1.52E-05	1.06E-06	2.37E-07	1.65E-05	0.03	5.28E-09	1.32E-09	5.54E-11	6.66E-09	0.07
N-nitrosodi-n-propylamine					0.00	2.78E-08	2.78E-08	2.31E-10	5.58E-08	0.57
N-nitrosodiphenylamine					0.00	3.77E-14	3.77E-14	1.79E-15	7.71E-14	0.00
Pentachlorophenol	1.35E-09	1.35E-09	3.03E-09	5.73E-09	0.00	3.01E-13	3.01E-13	4.56E-13	1.06E-12	0.00
Phenol	5.59E-08	5.59E-08	1.07E-09	1.13E-07	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Tetrachloroethene	6.32E-06	6.32E-06	1.05E-06	1.37E-05	0.02	1.33E-09	5.50E-10	1.49E-10	2.03E-09	0.02
Tetrahydrofuran					0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Toluene	1.75E-06	3.07E-06	2.73E-07	5.09E-06	0.01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Trichlorobenzene, 1,2,4-	7.58E-10	1.33E-10	2.89E-10	1.18E-09	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Trichloroethane, 1,1,1-	1.08E-08	3.41E-09	6.39E-10	1.49E-08	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Trichloroethane, 1,1,2-	5.61E-05	5.61E-05	1.63E-06	1.14E-04	0.20	5.30E-09	5.21E-09	1.04E-10	1.06E-08	0.11
Trichloroethene	5.89E-03	5.89E-03	3.27E-04	1.21E-02	21.51	2.20E-07	1.46E-07	8.19E-09	3.74E-07	3.81
Vinyl Chloride					0.00	1.72E-08	1.72E-08	2.92E-10	3.46E-08	0.35
Xylenes	4.32E-07	4.32E-07	1.20E-07	9.83E-07	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Cyanide	2.65E-06	0.00E+00	9.18E-09	2.66E-06	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Nitrate	8.31E-10	0.00E+00	2.88E-12	8.34E-10	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00
Arsenic	4.03E-02	0.00E+00	1.40E-04	4.04E-02	71.78	9.01E-06	0.00E+00	2.10E-08	9.03E-06	91.98
				5.63E-02	1.00				9.83E-06	1.00

Receptor Well 5 is an existing ground water well used for industrial purposes only.

TABLE 6.1-51

GROUND WATER PATHWAY HAZARD QUOTIENTS FOR THE CHILD OFF SITE RESIDENT USING RECEPTOR WELL 2 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Acetone	2.91E-05	2.91E-05	3.01E-08	5.81E-05	0.02
Benzene	7.85E-07	7.85E-07	3.00E-08	1.60E-06	0.00
Bis-(2-chloroethyl)ether					0.00
Bromodichloromethane	2.16E-08	2.16E-08	2.28E-10	4.34E-08	0.00
Bromoform	3.90E-10	3.90E-10	1.85E-12	7.82E-10	0.00
Bromomethane	3.63E-06	3.56E-06	2.31E-08	7.21E-06	0.00
Butanone, 2-	2.02E-06	4.17E-06	4.04E-09	6.20E-06	0.00
Carbon tetrachloride	2.65E-09	3.25E-09	1.06E-10	6.02E-09	0.00
Chlordane	2.13E-10	2.13E-10	2.02E-11	4.46E-10	0.00
Chlorobenzene	2.60E-07	9.11E-07	1.94E-08	1.19E-06	0.00
Chloroethane	1.09E-08	1.50E-09	1.59E-10	1.26E-08	0.00
Chloroform	4.60E-06	4.60E-06	7.45E-08	9.28E-06	0.00
Chloromethane					0.00
Chlorophenol, 2-	6.30E-06	6.30E-06	1.26E-07	1.27E-05	0.00
DDD					0.00
DDE					0.00
DDT	5.63E-11	5.63E-11	4.40E-11	1.57E-10	0.00
Di-n-butylphthalate	5.37E-11	5.37E-11	3.23E-12	1.11E-10	0.00
Dibromochloromethane	2.53E-08	2.53E-08	1.42E-10	5.06E-08	0.00
Dichlorobenzene, 1,2-	1.15E-11	1.81E-11	1.27E-12	3.09E-11	0.00
Dichlorobenzene, 1,4-	3.90E-11	3.90E-11	4.40E-12	8.24E-11	0.00
Dichloroethane, 1,1-	5.94E-09	4.15E-09	9.62E-11	1.02E-08	0.00
Dichloroethane,1,2-	5.00E-04	5.00E-04	4.82E-06	1.00E-03	0.37
Dichloroethene, 1,1-	1.32E-08	1.32E-08	3.84E-10	2.68E-08	0.00
Dichloroethene, cis-1,2-	1.45E-07	1.45E-07	2.63E-09	2.92E-07	0.00
Dichloroethene, trans-1,2-	1.68E-08	1.68E-08	3.06E-10	3.39E-08	0.00
Dichloropropane, 1,2-	8.49E-08	8.49E-08	1.54E-09	1.71E-07	0.00
Dichloropropene, 1,3-	8.52E-08	4.48E-09	8.53E-10	9.06E-08	0.00

tor Well 2 is a *hypothetical* ground water well located as close as technically feasible downgra the PVLF.

TABLE 6.1-51 (CONTINUED)

GROUND WATER PATHWAY HAZARD QUOTIENTS FOR THE CHILD OFF SITE RESIDENT USING RECEPTOR WELL 2 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Dieldrin	4.00E-16	4.00E-16	1.16E-17	8.11E-16	0.00
Diethylphthalate	9.69E-11	9.69E-11	8.46E-13	1.95E-10	0.00
Ethylbenzene	1.17E-11	4.05E-12	1.58E-12	1.74E-11	0.00
Freon 11 (CCL3F)	4.30E-10	6.46E-10	1.33E-11	1.09E-09	0.00
Isophorone	8.72E-07	8.72E-07	6.98E-09	1.75E-06	0.00
Lindane	1.96E-11	1.96E-11	4.99E-13	3.96E-11	0.00
Methylene chloride	2.34E-05	1.64E-06	1.92E-07	2.52E-05	0.01
N-nitrosodi-n-propylamine					0.00
N-nitrosodiphenylamine					0.00
Pentachlorophenol	2.74E-11	2.74E-11	3.24E-11	8.72E-11	0.00
Phenol	8.07E-08	8.07E-08	8.08E-10	1.62E-07	0.00
Tetrachloroethene	1.00E-08	1.00E-08	8.77E-10	2.09E-08	0.00
Tetrahydrofuran					0.00
Toluene	1.00E-09	1.76E-09	8.22E-11	2.85E-09	0.00
Trichlorobenzene, 1,2,4-	7.05E-12	1.24E-12	1.41E-12	9.69E-12	0.00
Trichloroethane, 1,1,1-	1.28E-08	4.01E-09	3.95E-10	1.72E-08	0.00
Trichloroethane, 1,1,2-	2.58E-09	2.58E-09	3.95E-11	5.21E-09	0.00
Trichloroethene	5.93E-03	5.93E-03	1.73E-04	1.20E-02	4.40
Vinyl Chloride					0.00
Xylenes	7.99E-06	7.99E-06	1.16E-06	1.71E-05	1.00
Cyanide	3.72E-09	0.00E+00	6.76E-12	3.72E-09	0.00
Nitrate	3.95E-08	0.00E+00	7.18E-11	3.95E-08	0.00
Arsenic	2.60E-01	0.00E+00	4.72E-04	2.60E-01	95.18
				2.73E-01	100.00%

Receptor Well 2 is a *hypothetical* ground water well located as close as technically feasible downgradient of the PVLF.

TABLE 6.1-52

GROUND WATER PATHWAY HAZARD QUOTIENTS FOR THE CHILD OFF SITE RESIDENT USING RECEPTOR WELL 5 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Acetone	3.84E-05	3.84E-05	3.98E-08	7.68E-05	0.04
Benzene	9.72E-05	9.72E-05	3.71E-06	1.98E-04	0.11
Bis-(2-chloroethyl)ether					0.00
Bromodichloromethane	1.72E-06	1.72E-06	1.82E-08	3.46E-06	0.00
Bromoform	4.70E-08	4.70E-08	2.22E-10	9.42E-08	0.00
Bromomethane	1.43E-05	1.40E-05	9.09E-08	2.83E-05	0.02
Butanone, 2-	5.33E-08	1.10E-07	1.07E-10	1.64E-07	0.00
Carbon tetrachloride	1.34E-06	1.65E-06	5.38E-08	3.04E-06	0.00
Chlordane	1.39E-10	1.39E-10	1.31E-11	2.90E-10	0.00
Chlorobenzene	4.51E-06	1.58E-05	3.37E-07	2.07E-05	0.01
Chloroethane	6.79E-08	9.37E-09	9.89E-10	7.83E-08	0.00
Chloroform	6.87E-06	6.87E-06	1.11E-07	1.39E-05	0.01
Chloromethane					0.00
Chlorophenol, 2-	1.28E-05	1.28E-05	2.56E-07	2.58E-05	0.01
DDD					0.00
DDE					0.00
DDT	3.20E-13	3.20E-13	2.50E-13	8.89E-13	0.00
Di-n-butylphthalate	1.28E-13	1.28E-13	7.68E-15	2.63E-13	0.00
Dibromochloromethane	1.12E-06	1.12E-06	6.30E-09	2.24E-06	0.00
Dichlorobenzene, 1,2-	3.55E-10	5.61E-10	3.95E-11	9.56E-10	0.00
Dichlorobenzene, 1,4-	1.54E-09	1.54E-09	1.74E-10	3.26E-09	0.00
Dichloroethane, 1,1-	2.80E-06	1.96E-06	4.54E-08	4.81E-06	0.00
Dichloroethane,1,2-	5.59E-03	5.59E-03	5.39E-05	1.12E-02	6.01
Dichloroethene, 1,1-	4.47E-07	4.47E-07	1.30E-08	9.08E-07	0.00
Dichloroethene, cis-1,2-	1.45E-04	1.45E-04	2.65E-06	2.94E-04	0.16
Dichloroethene, trans-1,2-	1.92E-05	1.92E-05	3.50E-07	3.88E-05	0.02

Receptor Well 5 is an existing ground water well used for industrial purposes only.

= Reasonable Maximum Exposure

TABLE 6.1-52 (CONTINUED)

GROUND WATER PATHWAY HAZARD QUOTIENTS FOR THE CHILD OFF SITE RESIDENT USING RECEPTOR WELL 5 - FUTURE RME CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Dichloropropane, 1,2-	3.93E-05	3.93E-05	7.16E-07	7.94E-05	0.04
Dichloropropene, 1,3-	8.66E-06	4.55E-07	8.67E-08	9.20E-06	0.00
Dieldrin	5.99E-17	5.99E-17	1.75E-18	1.22E-16	0.00
Diethylphthalate	3.90E-08	3.90E-08	3.40E-10	7.83E-08	0.00
Ethylbenzene	3.87E-09	1.34E-09	5.21E-10	5.73E-09	0.00
Freon 11 (CCL3F)	6.58E-08	9.87E-08	2.04E-09	1.67E-07	0.00
Isophorone	3.28E-07	3.28E-07	2.62E-09	6.58E-07	0.00
Lindane	2.24E-09	2.24E-09	5.72E-11	4.55E-09	0.00
Methylene chloride	5.06E-05	3.54E-06	4.14E-07	5.46E-05	0.03
N-nitrosodi-n-propylamine					0.00
N-nitrosodiphenylamine					0.00
Pentachlorophenol	4.49E-09	4.49E-09	5.31E-09	1.43E-08	0.00
Phenol	1.86E-07	1.86E-07	1.87E-09	3.75E-07	0.00
Tetrachloroethene	2.11E-05	2.11E-05	1.84E-06	4.40E-05	0.02
Tetrahydrofuran					0.00
Toluene	5.83E-06	1.02E-05	4.77E-07	1.65E-05	0.01
Trichlorobenzene, 1,2,4-	2.53E-09	4.43E-10	5.06E-10	3.47E-09	0.00
Trichloroethane, 1,1,1-	3.62E-08	1.14E-08	1.12E-09	4.87E-08	0.00
Trichloroethane, 1,1,2-	1.87E-04	1.87E-04	2.86E-06	3.77E-04	0.20
Trichloroethene	1.96E-02	1.96E-02	5.72E-04	3.99E-02	21.33
Vinyl Chloride					0.00
Xylenes	1.44E-06	1.44E-06	2.09E-07	3.09E-06	0.00
Cyanide	8.84E-06	0.00E+00	1.61E-08	8.85E-06	0.00
Nitrate	2.77E-09	0.00E+00	5.04E-12	2.77E-09	0.00
Arsenic	1.34E-01	0.00E+00	2.44E-04	1.34E-01	71.97
				1.87E-01	1.00

Receptor Well 5 is an existing ground water well used for industrial purposes only.
RME = Reasonable Maximum Exposure

TABLE 6.1-53

GROUND WATER PATHWAY HAZARD QUOTIENTS FOR THE CHILD OFF SITE RESIDENT USING RECEPTOR WELL 2 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Acetone	2.91E-05	2.91E-05	3.01E-08	5.81E-05	0.02
Benzene	7.85E-07	7.85E-07	3.00E-08	1.60E-06	0.00
Bis-(2-chloroethyl)ether					0.00
Bromodichloromethane	2.16E-08	2.16E-08	2.28E-10	4.34E-08	0.00
Bromoform	3.90E-10	3.90E-10	1.85E-12	7.82E-10	0.00
Bromomethane	3.63E-06	3.56E-06	2.31E-08	7.21E-06	0.00
Butanone, 2-	2.02E-06	4.17E-06	4.04E-09	6.20E-06	0.00
Carbon tetrachloride	2.65E-09	3.25E-09	1.06E-10	6.02E-09	0.00
Chlordane	2.13E-10	2.13E-10	2.02E-11	4.46E-10	0.00
Chlorobenzene	2.60E-07	9.11E-07	1.94E-08	1.19E-06	0.00
Chloroethane	1.09E-08	1.50E-09	1.59E-10	1.26E-08	0.00
Chloroform	4.60E-06	4.60E-06	7.45E-08	9.28E-06	0.00
Chloromethane					0.00
Chlorophenol, 2-	6.30E-06	6.30E-06	1.26E-07	1.27E-05	0.00
DDD					0.00
DDE					0.00
DDT	5.63E-11	5.63E-11	4.40E-11	1.57E-10	0.00
Di-n-butylphthalate	5.37E-11	5.37E-11	3.23E-12	1.11E-10	0.00
Dibromochloromethane	2.53E-08	2.53E-08	1.42E-10	5.06E-08	0.00
Dichlorobenzene, 1,2-	1.15E-11	1.81E-11	1.27E-12	3.09E-11	0.00
Dichlorobenzene, 1,4-	3.90E-11	3.90E-11	4.40E-12	8.24E-11	0.00
Dichloroethane, 1,1-	5.94E-09	4.15E-09	9.62E-11	1.02E-08	0.00
Dichloroethane,1,2-	5.00E-04	5.00E-04	4.82E-06	1.00E-03	0.37
Dichloroethene, 1,1-	1.32E-08	1.32E-08	3.84E-10	2.68E-08	0.00
Dichloroethene, cis-1,2-	1.45E-07	1.45E-07	2.63E-09	2.92E-07	0.00
Dichloroethene, trans-1,2-	1.68E-08	1.68E-08	3.06E-10	3.39E-08	0.00
Dichloropropane, 1,2-	8.49E-08	8.49E-08	1.54E-09	1.71E-07	0.00
Dichloropropene, 1,3-	8.52E-08	4.48E-09	8.53E-10	9.06E-08	0.00

[redacted]tor Well 2 is a *hypothetical* ground water well located as close as technically feasible downgra[redacted]f the PVLF.

TABLE 6.1-53 (CONTINUED)

GROUND WATER PATHWAY HAZARD QUOTIENTS FOR THE CHILD OFF SITE RESIDENT USING RECEPTOR WELL 2 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Dieldrin	4.00E-16	4.00E-16	1.16E-17	8.11E-16	0.00
Diethylphthalate	9.69E-11	9.69E-11	8.46E-13	1.95E-10	0.00
Ethylbenzene	1.17E-11	4.05E-12	1.58E-12	1.74E-11	0.00
Freon 11 (CCL3F)	4.30E-10	6.46E-10	1.33E-11	1.09E-09	0.00
Isophorone	8.72E-07	8.72E-07	6.98E-09	1.75E-06	0.00
Lindane	1.96E-11	1.96E-11	4.99E-13	3.96E-11	0.00
Methylene chloride	2.34E-05	1.64E-06	1.92E-07	2.52E-05	0.01
N-nitrosodi-n-propylamine					0.00
N-nitrosodiphenylamine					0.00
Pentachlorophenol	2.74E-11	2.74E-11	3.24E-11	8.72E-11	0.00
Phenol	8.07E-08	8.07E-08	8.08E-10	1.62E-07	0.00
Tetrachloroethene	1.00E-08	1.00E-08	8.77E-10	2.09E-08	0.00
Tetrahydrofuran					0.00
Toluene	1.00E-09	1.76E-09	8.22E-11	2.85E-09	0.00
Trichlorobenzene, 1,2,4-	7.05E-12	1.24E-12	1.41E-12	9.69E-12	0.00
Trichloroethane, 1,1,1-	1.28E-08	4.01E-09	3.95E-10	1.72E-08	0.00
Trichloroethane, 1,1,2-	2.58E-09	2.58E-09	3.95E-11	5.21E-09	0.00
Trichloroethene	5.93E-03	5.93E-03	1.73E-04	1.20E-02	4.40
Vinyl Chloride					0.00
Xylenes	7.99E-06	7.99E-06	1.16E-06	1.71E-05	1.00
Cyanide	3.72E-09	0.00E+00	6.76E-12	3.72E-09	0.00
Nitrate	3.95E-08	0.00E+00	7.18E-11	3.95E-08	0.00
Arsenic	2.60E-01	0.00E+00	4.72E-04	2.60E-01	95.18
				2.73E-01	100.00%

Receptor Well 2 is a *hypothetical* ground water well located as close as technically feasible downgradient of the PVLF.

TABLE 6.1-54

GROUND WATER PATHWAY HAZARD QUOTIENTS FOR THE CHILD OFF SITE RESIDENT USING RECEPTOR WELL 5 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Acetone	3.84E-05	3.84E-05	3.98E-08	7.68E-05	0.04
Benzene	9.72E-05	9.72E-05	3.71E-06	1.98E-04	0.11
Bis-(2-chloroethyl)ether					0.00
Bromodichloromethane	1.72E-06	1.72E-06	1.82E-08	3.46E-06	0.00
Bromoform	4.70E-08	4.70E-08	2.22E-10	9.42E-08	0.00
Bromomethane	1.43E-05	1.40E-05	9.09E-08	2.83E-05	0.02
Butanone, 2-	5.33E-08	1.10E-07	1.07E-10	1.64E-07	0.00
Carbon tetrachloride	1.34E-06	1.65E-06	5.38E-08	3.04E-06	0.00
Chlordane	1.39E-10	1.39E-10	1.31E-11	2.90E-10	0.00
Chlorobenzene	4.51E-06	1.58E-05	3.37E-07	2.07E-05	0.01
Chloroethane	6.79E-08	9.37E-09	9.89E-10	7.83E-08	0.00
Chloroform	6.87E-06	6.87E-06	1.11E-07	1.39E-05	0.01
Chloromethane					0.00
Chlorophenol, 2-	1.28E-05	1.28E-05	2.56E-07	2.58E-05	0.01
DDD					0.00
DDE					0.00
DDT	3.20E-13	3.20E-13	2.50E-13	8.89E-13	0.00
Di-n-butylphthalate	1.28E-13	1.28E-13	7.68E-15	2.63E-13	0.00
Dibromochloromethane	1.12E-06	1.12E-06	6.30E-09	2.24E-06	0.00
Dichlorobenzene, 1,2-	3.55E-10	5.61E-10	3.95E-11	9.56E-10	0.00
Dichlorobenzene, 1,4-	1.54E-09	1.54E-09	1.74E-10	3.26E-09	0.00
Dichloroethane, 1,1-	2.80E-06	1.96E-06	4.54E-08	4.81E-06	0.00
Dichloroethane,1,2-	5.59E-03	5.59E-03	5.39E-05	1.12E-02	6.01
Dichloroethene, 1,1-	4.47E-07	4.47E-07	1.30E-08	9.08E-07	0.00
Dichloroethene, cis-1,2-	1.45E-04	1.45E-04	2.65E-06	2.94E-04	0.16
Dichloroethene, trans-1,2-	1.92E-05	1.92E-05	3.50E-07	3.88E-05	0.02

ptor Well 5 is an existing ground water well used for industrial purposes only.

TABLE 6.1-54 (CONTINUED)

GROUND WATER PATHWAY HAZARD QUOTIENTS FOR THE CHILD OFF SITE RESIDENT USING RECEPTOR WELL 5 - FUTURE AVERAGE EXPOSURE CASE

PALOS VERDES LANDFILL - REMEDIAL INVESTIGATION REPORT

Chemical	Hazard Quotients				
	Oral	Inhalation (Shower)	Dermal	Pathway Total	Percent of Total
Dichloropropane, 1,2-	3.93E-05	3.93E-05	7.16E-07	7.94E-05	0.04
Dichloropropene, 1,3-	8.66E-06	4.55E-07	8.67E-08	9.20E-06	0.00
Dieldrin	5.99E-17	5.99E-17	1.75E-18	1.22E-16	0.00
Diethylphthalate	3.90E-08	3.90E-08	3.40E-10	7.83E-08	0.00
Ethylbenzene	3.87E-09	1.34E-09	5.21E-10	5.73E-09	0.00
Freon 11 (CCL3F)	6.58E-08	9.87E-08	2.04E-09	1.67E-07	0.00
Isophorone	3.28E-07	3.28E-07	2.62E-09	6.58E-07	0.00
Lindane	2.24E-09	2.24E-09	5.72E-11	4.55E-09	0.00
Methylene chloride	5.06E-05	3.54E-06	4.14E-07	5.46E-05	0.03
N-nitrosodi-n-propylamine					0.00
N-nitrosodiphenylamine					0.00
Pentachlorophenol	4.49E-09	4.49E-09	5.31E-09	1.43E-08	0.00
Phenol	1.86E-07	1.86E-07	1.87E-09	3.75E-07	0.00
Tetrachloroethene	2.11E-05	2.11E-05	1.84E-06	4.40E-05	0.02
Tetrahydrofuran					0.00
Toluene	5.83E-06	1.02E-05	4.77E-07	1.65E-05	0.01
Trichlorobenzene, 1,2,4-	2.53E-09	4.43E-10	5.06E-10	3.47E-09	0.00
Trichloroethane, 1,1,1-	3.62E-08	1.14E-08	1.12E-09	4.87E-08	0.00
Trichloroethane, 1,1,2-	1.87E-04	1.87E-04	2.86E-06	3.77E-04	0.20
Trichloroethene	1.96E-02	1.96E-02	5.72E-04	3.99E-02	21.33
Vinyl Chloride					0.00
Xylenes	1.44E-06	1.44E-06	2.09E-07	3.09E-06	0.00
Cyanide	8.84E-06	0.00E+00	1.61E-08	8.85E-06	0.00
Nitrate	2.77E-09	0.00E+00	5.04E-12	2.77E-09	0.00
Arsenic	1.34E-01	0.00E+00	2.44E-04	1.34E-01	71.97
				1.87E-01	1.00

Receptor Well 5 is an existing ground water well used for industrial purposes only.

recreational visitor. Specifically the future recreational visitor was assumed to use the site approximately three days per week, 52 weeks per year (for a total of 155 days per year) in the RME case. This constitutes a 50 percent increase over current site use and exposure for the recreational visitor in the RME case. All other exposure parameters were assumed to be the same as for the current on site visitor.

Hazard indices are less than 0.01 for the adult and 0.06 for the child. Calculated excess cancer risk for the future recreational visitor is in the range of 1.4×10^{-6} (for the average case and 95 percent gas collection efficiency) to 1.7×10^{-5} (for the RME case and 75 percent gas collection efficiency). Direct contact with roadway soil accounts for more than 90 percent of this excess cancer risk.

6.1.4.3 Uncertainty Analysis

The use of multiple conservative assumptions throughout the exposure assessment, and in the derivation of toxicity constants, is likely to result in an overstatement of potential risks due to the facility. Examples of these conservatively chosen assumptions (described in more detail in previous sections) are:

- Use of the highest measured concentrations to define source areas for both ground water and air modeling;
- Use of RME assumptions to estimate chemical intakes; and
- Use of conservatively derived SFs and RfDs.

Another source of uncertainty arises when toxicity data are not available for a compound or group of compounds. This is the case with a subset of PAHs identified at the PVLF. No published reference doses are available for nine of the PAHs which were detected in site soil (namely, the seven carcinogenic PAHs, phenanthrene, and benzo(g,h,i)perylene) and these nine PAHs were not included in the hazard index calculations for PAHs in site soil. For each of the soil pathways (soil ingestion, dermal contact with soil, and dust inhalation) the calculated hazard index for PAHs in soil was less than one in one thousand (<0.001). This value is well below a hazard index of one (the benchmark for non-cancer health effects). The degree to which the potential for non-cancer

effects from PAHs could have been underestimated can be checked by assuming each of the PAHs without a published reference dose has the same reference dose as pyrene, since pyrene is the PAH compound with the lowest published reference dose. Pyrene accounts for approximately 43 percent of the calculated hazard index from PAHs in soil (see Tables 6.5-9, 6.5-11, 6.5-13, and 6.5-15). At the 95 percent UCL concentration, pyrene was found in site soil at 32 mg/kg, while the sum of the 95 percent UCL concentrations for the nine PAHs without published reference doses is 109 mg/kg. Therefore, if the nine PAHs without published reference doses are assumed to have the same reference dose as pyrene, the hazard index for PAHs in soil would be approximately 2.6 times higher, or approximately 2.6 in one thousand (0.0026). This value is still well below the benchmark value of one for non-cancer health effects.

6.2 ENVIRONMENTAL EVALUATION

This section qualitatively characterizes the potential for adverse effects to ecological receptors that inhabit areas on or near the landfill. This evaluation is limited to an analysis of potential exposure pathways and key receptors and includes a qualitative discussion of potential impacts.

6.2.1 Ecological Receptors

As described in Section 6.1.2.1, the PVLF is located within a predominantly residential area. Although the landfill may provide suitable habitat for small birds, insects, plants, and small mammals, establishment of a productive, self-sustaining terrestrial community that would support a diverse wildlife community is not expected to occur over much of the site due to the lack of significant vegetative cover over about half of the landfill. Limited terrestrial populations could become established within the landscaped areas, although these areas are not expected to provide a suitable habitat for a diverse terrestrial community, since most of the landscaped plants present in the South Coast Botanic Garden, Ernie Howlett Park, and along the periphery of the main site area are not indigenous to the area. In addition, land immediately adjacent to, and surrounding the facility, is residential which further limits the establishment of a diverse, permanent, self-sustaining ecological community. Future land use is expected to remain essentially unchanged although a golf course has been proposed for the main site portion of the landfill.

6.2.1.1 Sensitive Habitats and Rare or Endangered Species

Sensitive habitats that may occur at the site include habitats critical for the survival of threatened or endangered (T&E) species and wetlands, both of which are protected by various legislative acts and executive orders. Potential impacts to T&E species must also be evaluated if these species occur within site boundaries or there is reasonable potential for these species to occur in, or use some portion of the site (*i.e.*, critical habitat exists within the site).

A list of T&E species that may occur on or near the landfill was obtained from The Natural Diversity Data Base. For the purposes of this evaluation, the site vicinity was defined as the Torrance Quadrangle, a U.S. Geologic Survey mapping area 1/8 degree latitude by 1/8 degree longitude. The following species could occur in the Torrance Quadrangle:

- Birds: California least tern (Sterna antillarum browni) and California gnatcatcher (*Polioptila californica*);
- Reptiles: San Diego horned lizard (*Phrynosoma coronatum blainvillii*);
- Invertebrates: tiger beetle (*Cicindela hiriticollis gravida*), Palos Verdes blue (*Glaucopsyche lygdamus paloverdesensis*); and
- Plants: Mexican flannelbush (*Fremontodendron mexicanum*)

None of these species are known to occur on or near the landfill with the possible exception of *Glaucopsyche*, which has been seen in the immediate vicinity of the landfill near the intersection of Seacrest Drive, Crenshaw Boulevard, and Crest Road. It has not been seen in this area since 1982. No wetlands are currently located within the landfill boundaries or within a distance that could be impacted by the migration of site-related contaminants from the landfill (Department of Fish and Game, 1992).

6.2.1.2 Horses

Due to the presence of a horse stable at the periphery of the landfill and a horse trail along the main site, horses could be exposed to site-related contaminants. The horses are used for recreational purposes and are not indigenous to the area.

6.2.2 Potential Pathways of Exposure to Ecological Receptors

This section briefly outlines the potential pathways of exposure to ecological receptors at the site, and also discusses whether each exposure pathway is complete, and if so, whether the pathway is likely to be significant.

6.2.2.1 Surface Water Pathways

Surface water related pathways are considered to be incomplete at the landfill based upon the following discussion.

Surface water runoff at the landfill is channeled into municipal storm drains that surround the perimeter of the site. No runoff migrates on the surface significantly beyond site boundaries. Surface drainage at the South Coast Botanic Garden collects in an artificial pond at the center of the garden and then enters the municipal storm system through an underground drain. This pond also receives city tap water, and the available data indicate that concentrations of metals and organics in runoff entering the pond are not elevated above background levels (see Section 6.1.1.2.3). Furthermore, there are no contaminated surface water bodies on site, and the site does not discharge contaminated runoff to off site water bodies. Since the artificial pond within the South Coast Botanic Garden is not contaminated, pathways to aquatic receptors are likely to be incomplete.

6.2.2.2 Ground Water Related Pathways

The landfill, including the South Coast Botanic Garden and Ernie Howlett Park utilize municipal water which is either from imported sources or obtained from West Coast Basin water supply wells which are not impacted by the PVLF. Thus, pathways by which ecological receptors could be exposed to COCs in ground water are incomplete.

6.2.2.3 Surface Soil Related Pathways

The final soil cover at the landfill was imported from both on site and diverse off site sources; hence, the soil represents a variety of different soil types and qualities. Soil cover samples

were taken at 56 locations throughout the landfill and analyzed for 122 organic and metal constituents. Of these constituents, 22 metals, three volatile organics, and fifteen semivolatile chemicals were detected in at least one of the 56 samples (see Section 6.1.1.2.3). While it is unlikely that contaminants present deep within in the landfill where they were deposited would have significantly affected surface cover soils, surface materials could have been contaminated before their use as soil cover for the landfill. Regardless of the source, existing soil contamination was considered as a potential source of biota exposure.

6.2.2.4 Air Pathways

Although air samples collected at the site indicated that ambient VOC concentrations were not measurably elevated above background, relatively low levels of vapor emissions are believed to occur at the site. Inhalation of vapors or resuspended dust is a potential exposure pathway for horses. This pathway is not expected to be significant for vegetation present at the site.

6.2.3 Chemicals of Potential Concern (COCs) for Ecological Effects

COCs for ecological effects were determined from the site characterization data. They are discussed below.

6.2.3.1 COCs for Vegetation

The ecologically important COCs in soil were chosen based upon two criteria. A chemical was determined to be a COC if:

- The chemical was detected in at least five percent of the soil samples collected; and
- The chemical was detected at greater than expected background levels.

Actually detected PAH constituents (which include acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-

c,d)pyrene, naphthalene, phenanthrene, and pyrene) were retained regardless of the detection frequency, since they occurred in a potential hot spot (*i.e.*, an area of the third bench access road on the main site containing elevated concentrations of some constituents) and since background data was unavailable for this class of compounds.

6.2.3.2 COCs for Horses

The COCs for horses were assumed to be the same as those that were defined in Section 6.1.1 for humans. The uncertainties associated with this assumption are unlikely to be greater than the uncertainties associated with utilizing toxicity data from rodents to estimate potential toxicity in humans. At the same time, it is important to recognize that horses, having a ruminant digestive system, may be much more sensitive to certain substances than either humans or rats.

6.2.4 Risk Characterization

Horses present at or near the site could be exposed to COCs via the following pathways:

- Inhalation of vapors and resuspended dust; and
- Occasional ingestion of plants and soils on site.

Horses are not expected to be exposed to contaminated ground water since all residences and other facilities in the site area obtain their water from the Metropolitan Water District. The potential risks associated with the two types of potential exposure are discussed below.

Occasional Ingestion of Plants and Soils

Since there are no grazing lands on or in the vicinity of the site, horses must be sustained with imported feed. It is possible that the horses might occasionally graze when they are out on the trails and ingest small amounts of site soils or vegetation. However, significant exposure through this route is unlikely because: 1) they are not expected to graze frequently during trail rides

in potentially-contaminated areas, as there is little suitable grazing area within site boundaries; and 2) most of the trails are covered by wood chips.

Inhalation

Horses could also be exposed via inhalation of vapors and resuspended particulates while on site (at the main site horse trail) and while housed at the horse stables. Inhalation is not expected to result in significant exposure to a horse based upon the following information:

- The stables are located upwind of the contaminated area (wind monitoring at the site during 1990-1991 indicated that the stable area was upwind of the site area greater than 90 percent of the time);

- Horses have a similar inhalation rate-to-body weight ratio as humans. The average inhalation rate and body weight for a horse is 144 m^3/day and 1000 pounds (454.6 kg) (personal communication, University of Tennessee Veterinary Library Reference Librarian, December 1, 1992). Assuming that the average adult weighs 70 kg and breathes 20 m^3/day, the inhalation rate-to-body weight ratio for both humans and horses is about 0.3.

- Calculations done for the maximally exposed human receptor living downwind of the site and for the maximally exposed on site worker (see Section 6.1.4) showed that exposure via inhalation does not result in elevated non-carcinogenic risks, and results in relatively low carcinogenic risks (*i.e.*, lifetime upper-bound excess risk levels of less than 1×10^{-4}).

These factors collectively suggest that exposure to site-related contaminants by horses residing upwind of the site and used for recreational purposes are expected to be minimal.

6.3 ASSUMPTIONS AND SUMMARY

The assumptions relied upon in performing this Baseline Risk Assessment are noted, followed by a summary of the risk assessment findings.

6.3.1 Assumptions

As noted above, a number of assumptions are made during the risk assessment process. In general, assumptions are made to produce a conservative, or health protective, bias. Therefore, the resulting risk assessment includes many layers of conservatism to insure that risk levels are not understated. This results in risk levels that can be considered upper bound values, where the actual risk is most likely less than the estimated values and could even be zero. The conservative assumptions that were included in the PVLF Baseline Risk Assessment include:

- The exposure assessment identifies direct contact exposure pathways with ground water (via ingestion, dermal contact with water during showering and inhalation of VOCs volatilized during showering) as complete pathways under future land use. In fact, there is a very low probability that there will be actual exposure to ground water due to the use of municipal water in the vicinity of the PVLF.

- Exposure concentrations in ground water for direct contact scenarios of off site residents are based on modeled concentrations which are extremely conservative due to the assumptions made in the model and the complex hydrogeology in the vicinity of the PVLF. Furthermore, it is unlikely that at any time in the future permission would be given for a private domestic well or that a well drilled close to the PVLF could produce enough water to make it cost effective.

- Several of the ground water modeling parameters were conservatively chosen in order to account for the uncertainties inherent in the ground water modeling exercise. For example, source area concentrations were based upon

the highest measured chemical concentrations found on site. As noted earlier, predicted ground water exposure point concentrations could be overestimated by at least 1.5 orders of magnitude;

- Conservative exposure assumptions were used to estimate the duration and magnitude of exposure. The assumptions on contact rates are typically used by risk assessors to reflect upper-bound estimates for these activities to avoid underestimation of risk. Average Case exposure assumptions were also calculated to provide a less conservative, more plausible estimate of risks.

- The emissions estimates for the outdoor air pathway calculations were based upon highest measured concentrations in soils and are thus likely to be conservative. Emissions were also calculated using a conservative screening methodology, and the dispersion model used was a conservative screening model.

- Assumption that cancer risks are linearly related to exposure (i.e., that carcinogenic effects have no thresholds).

- Assumption that exposure variables and toxicity constants formulated for lifetime exposures are applicable for less than lifetime exposures.

- Calculation of inhalation RfDs from the corresponding oral RfDs. This may either underestimate or overestimate risks for the relevant COCs. For organics the uncertainty is probably less than one order of magnitude.

- Use of highest measured concentrations to define source areas for both ground water and air modeling.

- Use of RME assumptions to estimate chemical intakes.

- Use of conservatively derived SFs and RfDs.

- The use of ground water modeling to calculate the concentrations of COCs in ground water.

- The use of current landfill gas values for future scenarios, since gas production decreases over time (see Section 1.3.4.1.1).

- The use of gas collection Header 2 landfill gas values for risk calculations (Header 1, the gas migration control headerline, and the boundary probes have lower concentrations of both methane and trace VOCs).

- Inclusion of PAHs from soil cover sampling location SC6 for on site visitor risk; the area where these compounds are located is downwind from the areas most used by recreational visitors and is not easily accessible to these visitors.

- The use of hypothetical well locations as potential drinking water sources (exposure points) when such wells do not exist, nor, according to information supplied from local water companies, are there any plans to ever install such wells. In addition, the water quality in this area is not generally suitable for drinking water purposes.

- The use of private wells (hypothetical) in the exposure scenarios for ground water exposures, some ground water use is controlled by water masters and drinking water in the area is supplied by municipal water companies.

- The PVLF will act as a continuing, unlimited source of chemicals to air and ground water. In general, the generation of VOCs will decrease over time as the organic materials in the landfill are depleted through microbial degradation.

- The use of conservative screening level models from EPA for outdoor air particulate concentrations of PAHs.

- The use of one-half the detection limit for COCs in the risk calculations in cases where the only detections were an order of magnitude or greater less than some detection limits (for example, due to the use of different analytical methods during different monitoring periods, such as EPA Methods 601 and 602 for quarterly samples and EPA Method 624 for semi-annual samples).

- The use of EPA-recommended linearized multi-stage model for low dose extrapolation for carcinogenic effects. The true risk is not likely to be higher than the estimate and is most likely lower and could even be zero.

- Summing all HQs in the development of HIs rather than summing for each effect (i.e., liver and kidney, lung, etc.).

6.3.2 Summary

The Baseline Risk Assessment was completed as part of the PVLF RI/FS conducted by the Sanitation Districts. The PVLF is located in the residential community of Rolling Hills Estates and unincorporated Los Angeles County, California. The PVLF has been closed since 1980 when it attained its final design capacity. Since closure, portions of the site have been developed for recreational purposes.

A number of investigations have been carried out by the Sanitation Districts in order to identify and characterize potential contamination of environmental media at site. The data from these studies indicated that due to the existing landfill gas collection system and the soil cover on the landfill, there is considerable control over potential exposures to chemicals in or from the landfill. In keeping with the EPA/DTSC-recommended risk assessment guidelines, the following conclusions can be drawn from the Baseline Risk Assessment:

- **Ground Water:** Under current operating conditions, there is no exposure to ground water. However, ground water downgradient of the site contains chemicals of potential concern at concentrations that are elevated above

naturally-occurring background levels. Two plumes of contaminated ground water originating from the site appear to be moving approximately northeast towards the West Coast Basin.

Under a future exposure scenario, use of this ground water by an off site resident was assumed to occur. The risks from such an exposure ranged from about two to three excess cancers per 100,000 exposed individuals as shown in Table 6.1-31. Most of this excess cancer risk (approximately 95 percent) could be attributed to potential exposure to arsenic which was predicted by ground water modeling at concentrations some one-thousandth of the MCL.

- **Soils:** All areas of the landfill containing hazardous wastes are covered by a cap of several feet of clean soil which is regularly inspected and maintained. Thus there is no exposure to chemicals of potential concern contained in the landfill. However, discrete areas of the landfill soil cover (restricted to maintenance access roads on the main site) contain concentrations of polyaromatic hydrocarbons (PAHs) that appear to be above anthropogenic background levels for surface soil. These PAH-containing roadways are covered by gravel thereby minimizing the potential for direct contact. For the purposes of the risk assessment, exposure to these PAHs was assumed for the on site worker and the recreational visitor under both current and future scenarios. As shown in Tables 6.1-30 and 6.1-31, the excess cancer risks from these PAHs ranged from 2.1×10^{-6} to 1.0×10^{-5} for workers and 1.4×10^{-6} to 1.5×10^{-5} for recreational visitors for the Average exposure and RME cases, respectively.

- **Air:** The PVLF has an extensive gas collection system which is regularly monitored. The gas capture efficiency is estimated to be in excess of 98 percent. Ambient air sampling at the PVLF has not shown any statistically discernable impacts in downwind air quality or in integrated surface gas testing at a height of approximately one foot above the landfill surface.

For the purposes of this risk assessment, gas collection efficiencies were estimated to range between 75 percent and 95 percent. For the average and RME scenarios, excess cancer risks were between 1.3×10^{-6} to 1.3×10^{-5} for off site residents, 4.4×10^{-7} to 5.5×10^{-6} for on site workers and 4.0×10^{-8} to 1.8×10^{-6} for recreational visitors to the PVLF, respectively. It should be noted that for the principal contributor (some 70 percent) to excess cancer risk estimates, benzene, the upwind ambient air concentration was approximately ten times higher than releases modeled from the landfill. Analytical detection limits for chlorinated VOCs in ambient air were more than ten times the predicted releases.

Tables 6.1-30 through 6.1-33 summarize the total risks from potential exposures to residents near the site, and to on site workers and visitors. These total risks were calculating by summing risks from all of the potential ground water, air, and soil exposures. Most of the risk is accounted for by one or two potential exposures, however, as indicated in the following paragraphs:

Current Exposure Scenarios

Off site resident: Residents living near the site can be exposed to air releases of volatile compounds in landfill gas, and PAHs in dust from landfill maintenance roadways. More than 90 percent of the estimated risk is from modeled landfill gas releases. The risks from landfill gas vary by a factor of five, depending on the landfill gas collection system capture efficiency assumed (values of 75 percent and 95 percent gas capture were used to calculate a range of risks). The overall range of risks calculated for the off site resident is 1.4×10^{-6} to 1.3×10^{-5}. The total risk to the nearest downwind off site resident is less than three per million (1.0×10^{-6}) for all exposures (i.e., from both landfill gas and PAH dust releases to air), for a 95 percent landfill gas collection efficiency.

On Site Worker: Maintenance workers at the PVLF can be exposed to volatile compounds and dust in air, and through direct contact with PAHs in the maintenance road soil on the main site. Direct contact with roadway soil accounts for a large portion of the calculated risk to workers; for the reasonable maximum exposure scenario more than 90 percent of the estimated risk

is from direct contact with roadway soil, if the landfill gas collection efficiency is 95 percent. The range of calculated risks to workers is 2.5×10^{-6} to 1.5×10^{-5}.

Recreational Visitor: Visitors at the PVLF can potentially be exposed by the same pathways as workers, i.e., to volatile compounds and dust in air, and through direct contact with roadway soils on the main site. The calculated risk to visitors is in the range of 1.4×10^{-6} to 1.2×10^{-5}. Direct contact with roadway soil on the landfill during six years of early childhood accounts for a large portion of the estimated risk to visitors. For the reasonable maximum exposure scenario more than 95 percent of the estimated risk is from direct contact with roadway soil if the landfill gas collection efficiency is 95 percent; approximately 90 percent of the risk is from direct soil contact if the landfill gas collection efficiency is 75 percent.

Future Exposure Scenarios

Future Off Site Resident: Under a future exposure scenario, use of ground water by an off site resident was assumed to occur. The nearest potential locations for a productive water supply well are approximately 300 feet from the landfill. In addition, future residents at a potential well location could be exposed to volatile compounds and dust from the landfill. Total risks to the future resident using ground water are estimated to be in the range of 9.8×10^{-6} to 3.4×10^{-5}. Approximately 95 percent of this excess cancer risk is attributed to potential exposure to arsenic, which was predicted by ground water modeling at concentrations some one-thousandth of the MCL.

Future On Site Worker: Potential exposures and risks to maintenance workers at the landfill are expected to remain the same in the future.

Future Recreational Visitor: Increased recreational use of the main site is likely, since development plans for the site are being considered which include a golf course. Calculated risks for the future recreational visitor are in the range of 1.4×10^{-6} to 1.7×10^{-5}. Direct contact with roadway soil accounts for more than 90 percent of this excess cancer risk.

An environmental evaluation was performed to qualitatively characterize the potential for adverse effects to ecological receptors. This evaluation indicated that exposures to ecological receptors are expected to be minimal.