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Remedial System Results and Risk Assessment for Beacon Gas Station No. 604 at Livermore, California

August 29, 1997

Prepared for:

Ultramar, Inc.

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1.0 SITE DESCRIPTION

Beacon Gas Station No. 604 is located at 1619 West First Street in Livermore, California. The station is bordered on the north by First Street and on the west by P Street. The Beacon Gas Station is in the western portion of downtown Livermore with commercial businesses to the north, east, and west of the site. Residential housing consisting of single-family dwellings, duplexes, and apartments are to the south. The gas station is owned and operated by Ultramar Incorporated.

Livermore is approximately 25 miles east of San Francisco Bay on Interstate Highway 580. A site map of the area is provided as Figure 1. A topological map is given in Figure 2.

1.1 Geology and Soil

The site is located in Township 3 South, Range 1 East, Section 17 of Mt. Diablo Baseline Meridian. Topography maps show the surface elevation at the site to be approximately 475 feet above mean sea level (amsl).

The site is underlain by Tertiary aged Livermore Gravels up to 600 feet deep, according to the geologic cross-sections of the Livermore Valley in the Department of Water Resources (DWR) Bulletin 118.2 (1974). Approximately 100 feet of quaternary alluvial fan deposits overlay the Livermore Gravels in the area. The Livermore Gravels consist of massive beds of rounded gravel cemented by a sandy clay and sandy silt matrix.

The alluvial fan deposits consist of semi-consolidated deposits of clay, silt, sand, and gravel. Soil borings and well drilling operations at the Beacon Gas Station and the shopping center to the northwest of the site by BDM International, Inc. (formerly Geoscience Consultants, Ltd., or GCL) confirms these general soil characteristics down to approximately 70 feet. A soil lithologic map of a well drilled at the site is provided as Figure 3.

1.2 Hydrogeology

The site is located in the Mocha Sub-basin, a division of the Livermore Valley Groundwater Basin. Groundwater ranges from unconfined in near-surface zones to confined in deeper zones. Maps by Alameda County Flood Control and Water Conservation District (1989) shows the elevation of the shallow groundwater at approximately 45 feet below ground surface (bgs). During the drought in the late 1980s and early 1990s and the rains in 1993/1994, water levels at the site show significant fluctuations in the shallow groundwater zone. During the drought, the groundwater was approximately 70 feet bgs, and during the heavy rainy period of 1993/1994, the water was about 25 feet below grade. This upper groundwater is not used locally as a drinking water source.

Drinking water for the City of Livermore is supplied by the California Water Service. Six California Water Service water wells are located near the site, within a 1-mile radius. Well No. 3-01 and 8-01 are closest to the site, located approximately 0.25 mile away. All wells are tested for volatile organic compounds (VOCs) at least once a year. According to the California Water Service, none of these two wells near the site show contamination. These wells are completed in the deeper aquifer and are used during the summer peak demands. A

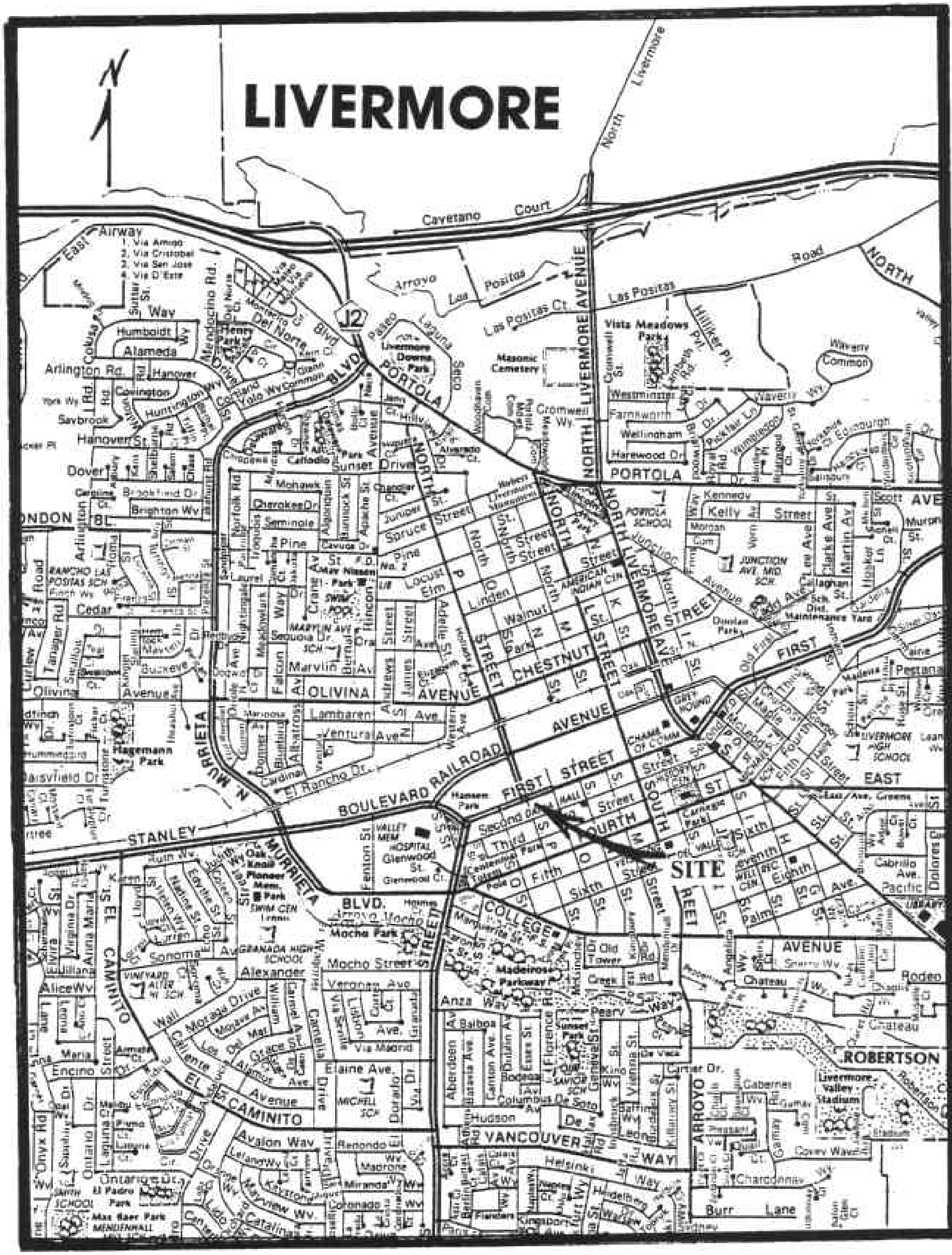

FIGURE 1. SITE MAP OF THE AREA NEAR BEACON GAS STATION

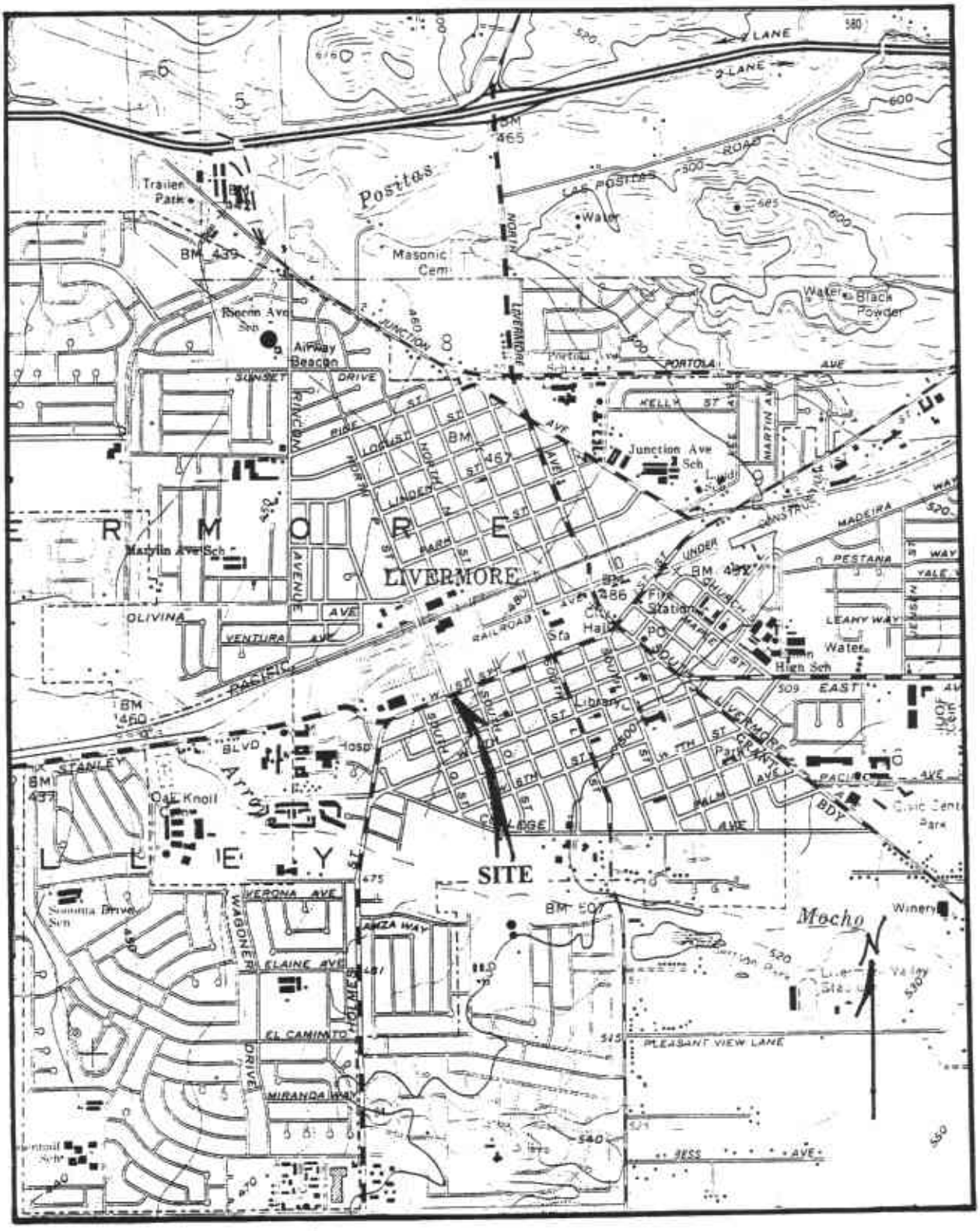

FIGURE 2. TOPOGRAPHICAL MAP OF AREA NEAR BEACON GAS STATION

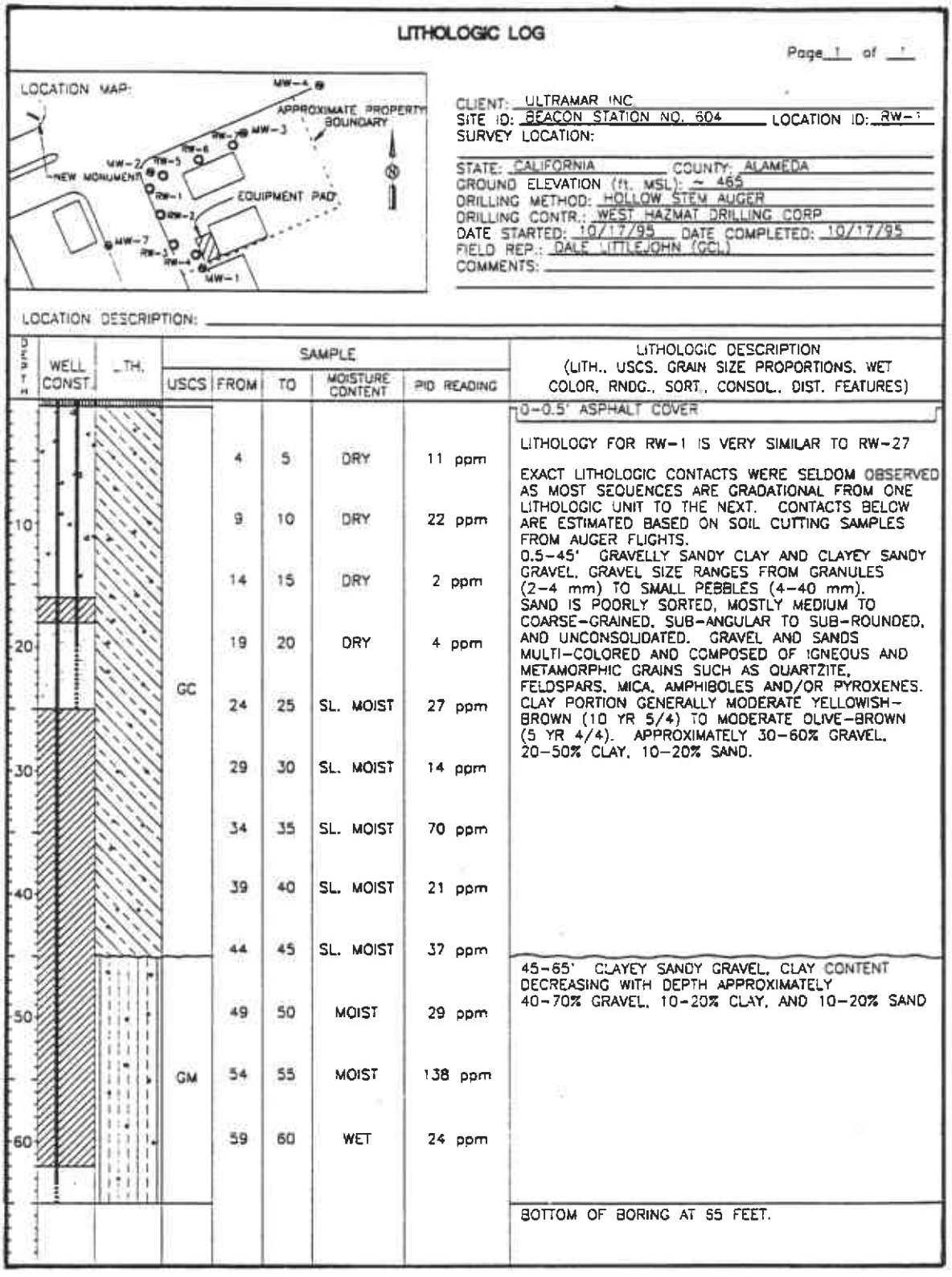

FIGURE 3. SOIL LITHOLOGIC MAP OF WELL DRILLED AT BEACON GAS STATION

thick silty clay layer has been shown to separate the shallow aquifer from the deep aquifer used by the California Water Services (Reference 1). Data from soil borings indicate there is no communications between the deep and shallow aquifers near the site.

Groundwater flow in the region for the shallow and deep aquifers is toward the north-northwest.

2.0 BACKGROUND

2.1 Underground Storage Tank Removal

On November 9, 1992, three underground storage tanks (USTs) and the associated piping systems were excavated and removed from the Beacon Gas Station. The USTs removed included a 10,000-gallon tank used to store regular unleaded gasoline and two 8,000-gallon tanks used to store unleaded plus and unleaded premium gasoline. A 550-gallon waste oil UST was removed from the site in 1990.

The three USTs removed in 1992 were intact with no visible holes. Two soil samples were taken under each tank and a soil sample was taken at each corner of each tank. A total of six soil samples were taken for the USTs. Additionally, five soil samples were taken at the pump islands–one for each product line. A final soil sample was taken at an overexcavated area near the 10,000-gallon tank. The location of these soil samples is provided in Figure 4. Each soil sample was analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX) and total petroleum hydrocarbons as gasoline (TPH-G). Two soil samples taken under the tanks were analyzed for lead.

After sampling, the entire tank basin was excavated to a 19-foot depth for replacement USTs. Approximately 1,200 cubic yards of soil were excavated and stockpiled at the site.

Analytical results were below detectable limits for BTEX and TPH-G at the UST locations. The soil sample taken at the overexcavated area near the 10,000-gallon UST contained 1.4 parts per million (ppm) benzene. The soil samples analyzed for total lead showed 6.5 and 5.6 ppm levels. These low lead results likely reflect background levels. All soil samples taken at the product line locations showed below detectable limits for BTEX. TPH-G was detected in two eastern product line locations at 4.4 and 2.7 ppm concentrations.

Based on analytical results, approximately 1,000 cubic yards of soil were removed to the Ultramar Hanford facility for aeration. About 90 cubic yards of soil were transported to a Class III landfill in Sacramento County with the remaining 110 cubic yards going to the Redwood Landfill in Navato, California.

2.2 Soil Borings and Monitoring Well Installation

On May 27 and 28, and June 1, 1993, a total of seven borings were made at the site. Three of these borings were converted to groundwater monitoring wells (MW-1, MW-2, and MW-3), three borings were completed as vapor extraction wells, and the final boring was abandoned by filling with neat cement pursuant to the Zone 7 Water Agency requirements.

Soil samples collected at the seven borings were analyzed for BTEX and TPH-G. TPH-G was detected in four of the borings at levels ranging from 1.5 to 280 ppm.

On June 1, 1993, groundwater samples were taken from the three monitoring wells and analyzed for BTEX and TPH-G. BTEX and TPH-G were detected in all the wells. The highest concentration was in MW-2 with benzene levels of 20,000 parts per billion (ppb), toluene levels of 21,000 ppb, ethylbenzene levels of 3,300 ppb, xylene levels of 18,000 ppb, and TPH-G levels of 170,000 ppb.

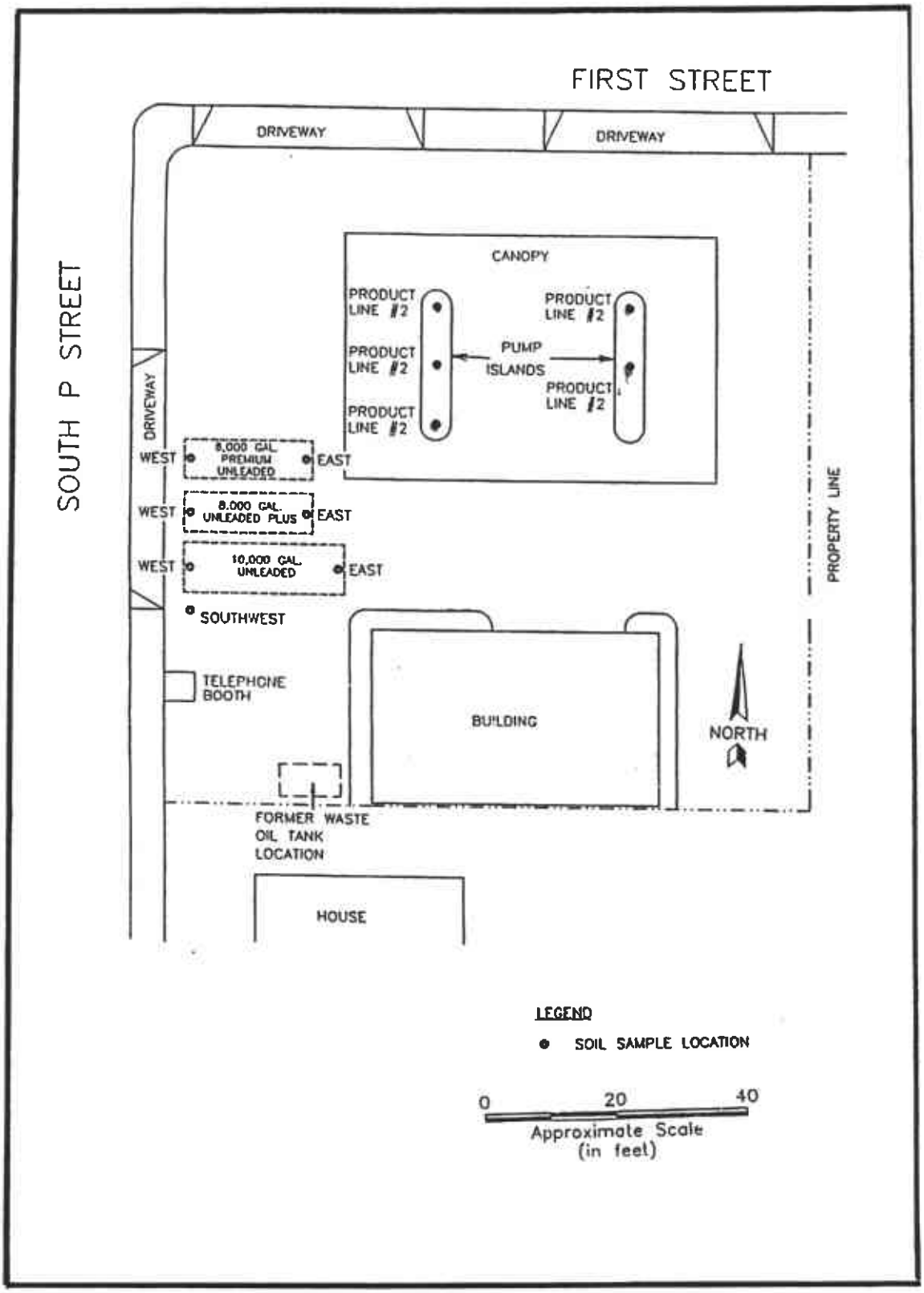

FIGURE 4. SOIL SAMPLING POINTS DURING TANK/PIPE REMOVAL AT BEACON GAS STATION

As a result of these petroleum hydrocarbon levels, four additional monitoring wells (MW-4, MW-5, MW-6, and MW-7) were drilled in March 1994 to further define the levels of impacts to the groundwater. Soil samples were collected during boring of MW-4 through MW-7. Only the boring for MW-6 indicated the presence of petroleum hydrocarbons with benzene at 0.65 ppm, toluene at 1.7 ppm, ethylbenzene at 0.72 ppm, xylene at 0.72 ppm, and TPH-G at 42 ppm. The location of these wells is provided in Figure 5.

Groundwater samples taken from these wells on March 30, 1994, indicated elevated levels of petroleum hydrocarbons in three of the four new wells (MW-5, MW-6, and MW-7) and very low levels in the remaining well (MW-4). In the four wells, benzene varied from 4.2 to 21,000 ppb, toluene varied from 15 to 8,600 ppb, ethylbenzene varied from 2.5 to 1,700 ppb, and xylene varied from 26 to 12,000 ppb. TPH-G varied from 120 to 63,000 ppb. Historical analytical results for all seven wells are provided in Table 1.

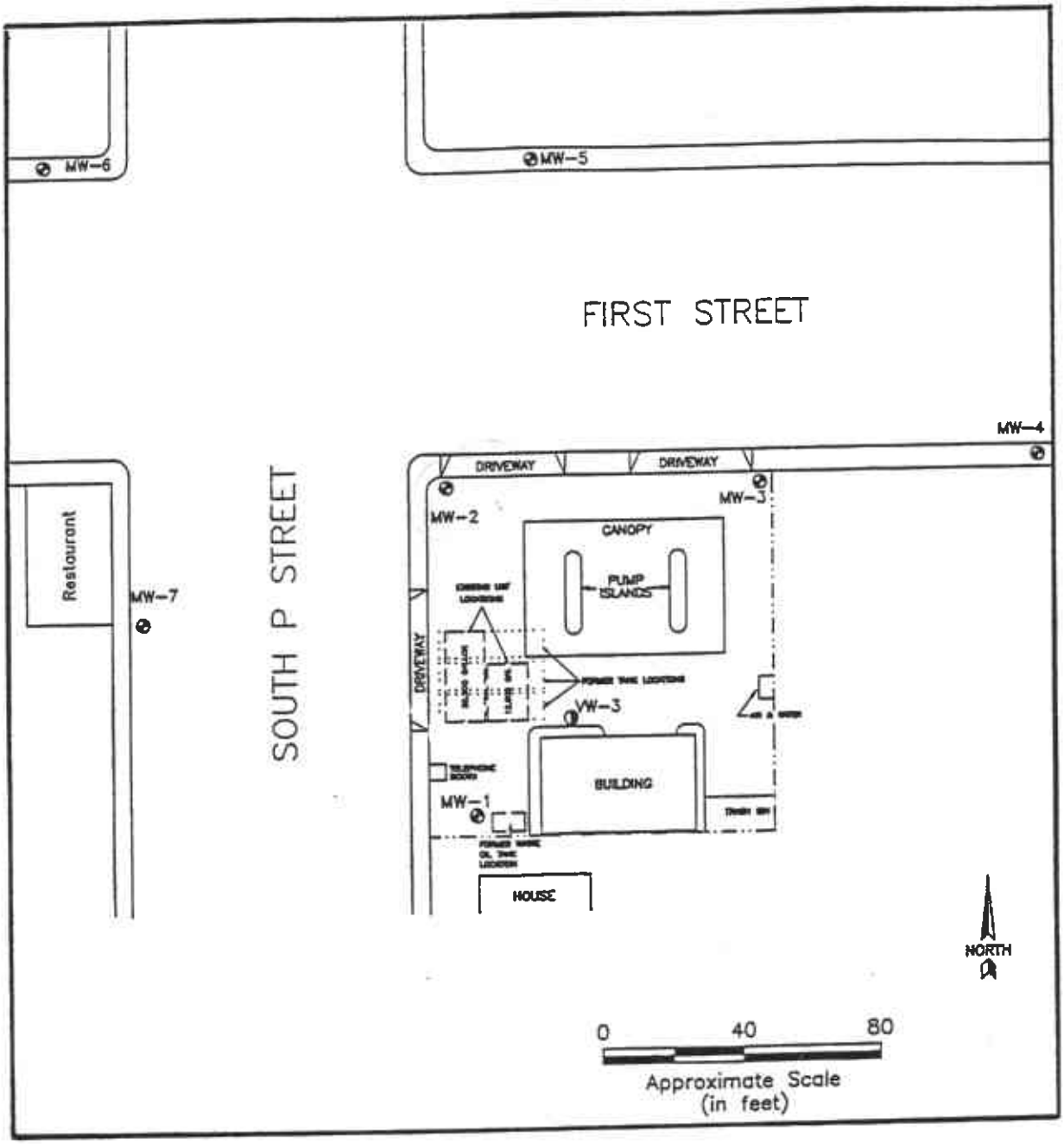

FIGURE 5. MONITORING WELL LOCATION

Table 1. Groundwater Analytical Results (ppb)

Well	Date	Benzene	Toluene	Ethylbenzene	Xylene	TPH-G
MW-1	06/01/93	2200	400	<50	4900	27000
	06/22/93	8000	10000	260	10000	87000
	10/06/93	4700	6500	740	5300	40000
	01/13/94	1300	950	110	850	9400
	04/25/94	1500	1800	290	1700	11000
	08/12/94	550	330	260	1400	11000
	12/14/94	1000	1200	320	1500	11000
	02/10/95	1200	1500	280	1500	9300
	06/15/95	5.6	<0.50	<0.50	<0.50	140
	09/26/95	140	<0.50	<0.50	43	410
	12/15/95	250	<1.3	<1.3	87	740
	03/21/96	0.52	<0.50	<0.50	0.51	<50
	06/13/96	<0.50	<0.50	<0.50	<0.50	240*
	09/16/96	70	<0.50	1.0	5.1	720
	12/02/96	<0.50	<0.50	<0.50	<0.50	<50
	03/07/97	6.7	<0.50	1.2	1.8	600
MW-2	06/01/93	20000	21000	3300	18000	170000
	06/22/93	19000	22000	3500	18000	160000
	10/06/93	17000	17000	3000	15000	110000
	01/13/94	20000	19000	2300	14000	93000
	04/25/94	9600	7300	840	7800	41000
	08/12/94	11000	11000	2300	11000	59000
	12/14/94	13000	13000	2200	12000	63000
	02/10/95	12000	12000	2200	11000	63000
	06/15/95	11000	12000	1900	11000	61000
	09/26/95	9400	11000	2300	12000	61000
	12/15/95	8000	8300	2200	12000	48000
	03/21/96	8000	7700	2400	12000	48000
	06/13/96	7300	8800	1900	12000	33000
	09/16/96	510	640	180	1300	8600
	12/02/96	4400	4000	1300	6100	29000
	03/07/97	1800	1100	270	2000	13000
MW-3	06/01/93	4.6	<0.50	<0.50	1.9	270
	06/22/93	8.2	<0.50	<0.50	0.72	160
	10/06/93	57	110	24	120	740
	01/13/94	2.6	0.67	0.78	4.2	83
	04/25/94	0.72	3.2	0.5	3.6	60
	08/12/94	7.3	14	2.6	13	310
	12/14/94	<0.50	<0.50	<0.50	<0.50	75
	02/10/95	1.4	<0.50	<0.50	1.8	96
	06/15/95	<0.50	<0.50	<0.50	<0.50	<50
	09/26/95	<0.50	<0.50	<0.50	<0.50	<50
	12/15/95	<0.50	<0.50	<0.50	<0.50	<50
	03/21/96	NS	NS	NS	NS	NS
	06/13/96	NS	NS	NS	NS	NS
	09/16/96	NS	NS	NS	NS	NS
	12/02/96	NS	NS	NS	NS	NS
	03/07/97	NS	NS	NS	NS	NS

Table 1. Groundwater Analytical Results (ppb) (concluded)

Well	Date	Benzene	Toluene	Ethylbenzene	Xylene	TPH-G
MW-4	03/30/94	4.2	15	2.5	26	120
	04/25/94	<0.50	1.8	<0.50	2.1	65
	08/12/94	<0.50	<0.50	<0.50	<0.50	<50
	12/14/94	<0.50	<0.50	<0.50	<0.50	<50
	02/10/95	<0.50	<0.50	<0.50	<0.50	<50
	06/15/95	<0.50	<0.50	<0.50	<0.50	<50
	09/26/95	<0.50	<0.50	<0.50	<0.50	<50
	12/15/95	<0.50	<0.50	<0.50	<0.50	<50
	03/21/96	NS	NS	NS	NS	NS
	06/13/96	NS	NS	NS	NS	NS
	09/16/96	NS	NS	NS	NS	NS
	12/02/96	NS	NS	NS	NS	NS
	03/07/97	NS	NS	NS	NS	NS
MW-5	03/30/94	1300	20	<13	160	750
	04/25/94	1100	41	130	740	6500
	08/12/94	420	2.9	41	98	4000
	12/14/94	660	<2.5	33	13	4800
	02/10/95	490	<13	23	19	5200
	06/15/95	<0.50	<0.50	<0.50	<0.50	460
	09/26/95	61	<0.50	3.1	<0.50	1400
	12/15/95	77	1.5	10	1.5	2100
	03/21/96	35	2.0	2.0	18	930
	06/13/96	38	0.72	1.9	2.0	610
	09/16/96	29	<0.50	0.95	<0.50	380
	12/02/96	1.1	0.64	<0.50	<0.50	200
	03/07/97	74	<0.50	0.58	1.5	520
MW-6	03/30/94	21000	8600	1700	12000	63000
	04/25/94	22000	12000	2300	16000	77000
	08/12/94	12000	8100	2200	16000	65000
	12/14/94	18000	9500	2200	14000	65000
	02/10/95	21000	8400	2000	14000	63000
	06/15/95	20000	11000	2100	15000	75000
	09/26/95	15000	9600	1700	12000	62000
	12/15/95	15000	9000	2300	15000	61000
	03/21/96	18000	9800	2400	16000	65000
	06/13/96	8600	3300	2200	12000	29000
	09/16/96	6400	1800	2100	11000	42000
	12/02/96	3000	1100	970	8300	28000
	03/07/97	2000	190	520	2300	12000
MW-7	03/30/94	7200	2400	1600	11000	43000
	04/25/94	3900	1000	940	6900	30000
	08/12/94	3800	1400	1300	7500	30000
	12/14/94	3600	1200	900	6400	31000
	02/10/95	4000	800	890	5100	27000
	06/15/95	920	680	740	4100	17000
	09/26/95	200	150	170	810	7000
	12/15/95	350	170	540	1900	11000
	03/21/96	320	100	730	2500	12000
	06/13/96	98	19	370	620	5900
	09/16/96	140	43	440	590	7800
	12/02/96	87	29	290	430	6300
	03/07/97	35	19	360	470	4500

* Product is not typical gasoline
NS = Well not sampled on this date

3.0 REMEDIATION

3.1 History

Previous reported background data and soil/groundwater chemistry were reviewed to determine the most appropriate remediation system for the Beacon Gas Station site. The objectives of the designed remediation system were to remediate the vadose zone plume and eliminate the threat caused by the dissolved-phase groundwater plume. The remediation system selected to meet these objectives was a soil-vapor extraction (SVE) and air injection system installed at two locations: 1) the Beacon Gas Station and 2) the Livermore Arcade Shopping Center, north-northwest of the site.

A Remedial Action Plan (RAP) was developed and submitted to the Alameda County Health Agency, Division of Environmental Protection, in June 1995. This plan consists of installing two SVE and air injection systems. A description of each of these systems follow:

- System 1: Beacon Gas Station (Source Area Remediation) - The source area remedial system is shown in Figure 6 and includes SVE and air injection in the vicinity of the station. The purpose of this system is to accomplish the following:
  - Remediation of residual hydrocarbon-affected soils and associated subsurface soil vapors in the vicinity of the gas station
  - Remediation of the source area portion of the dissolved-phase groundwater plume
  - Oxygenation of groundwater and subsequent passive remediation of the downgradient, off-site, dissolved-phase hydrocarbon plume

The active air injection and SVE remediation system, enhanced by passive bioremediation, efficiently allowed mechanical in situ stripping, volatilization, subsequent mobilization of the vapor-phase hydrocarbons, and passive bioremediation (hyper-oxygenation) to act together to remediate the dissolved-phase hydrocarbons present in the soil and groundwater. The SVE and air injection treatment system offered a reliable alternative to traditional on-site pump-and-treat technology.

The air injection system consists of seven well locations incorporating the areas of highest dissolved-phase hydrocarbon concentrations. The air injection wells were constructed 10 feet below the historical groundwater low water levels. The air injection wells were manifolded together and connected to a high-capacity, high-pressure air compressor. The compressor was sized to overcome the expected hydrostatic pressure exerted by the column of water over the air injection location.

The SVE wells were located in the same boring (dual-completion wells) as the air injection system. The SVE system created a negative pressure cell within the subsurface soil and ground-

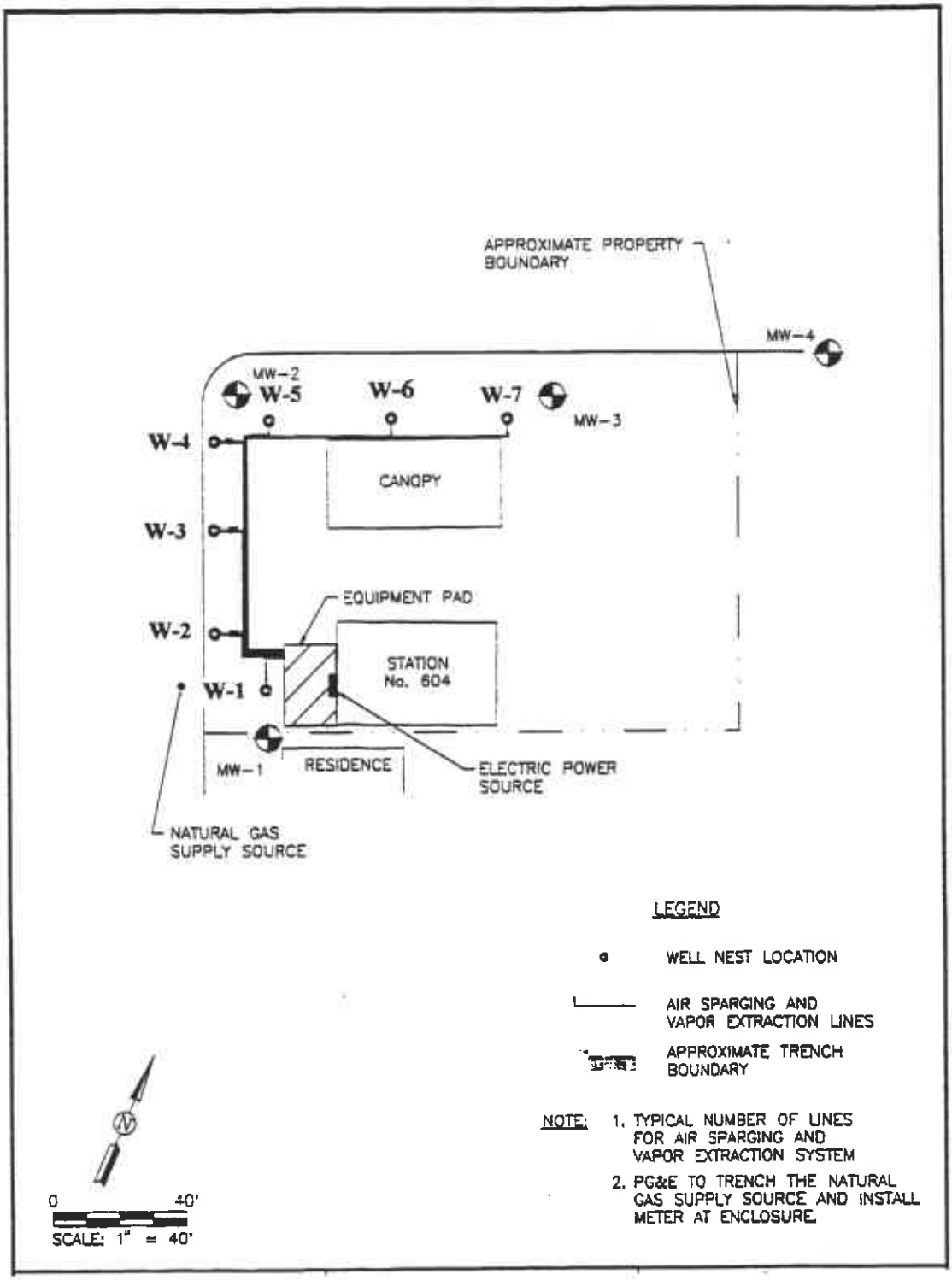

FIGURE 6. SOIL-VAPOR EXTRACTION AND AIR INJECTION WELL LOCATION AT BEACON GAS STATION

water. This negative pressure cell removed hydrocarbon vapors by vacuum displacement from the subsurface material. The SVE wells were manifolded together and connected to a blower. The recovered vapors were removed initially by an oxidizer unit and later by activated carbon canisters.

- System 2: Livermore Arcade Shopping Center (Downgradient Remediation) - The Livermore Arcade Shopping Center remedial system is shown in Figure 7. This system is also an SVE and air injection system. The purpose of this system is generally the same as the source area system. Due to the size of the Livermore Arcade Shipping Center site, a total of 20 SVE and air injection wells were constructed. Otherwise, the operational characteristics described above apply to this system.

The Beacon Gas Station and Livermore Arcade Shopping Center remedial systems were designed to maximize recovery of volatile petroleum hydrocarbons to meet remediation requirement time levels set by the Livermore Arcade Shopping Center owners. Active remediation began in May 1996.

3.2 Remedial System Performance

The remedial systems at the Beacon Gas Station and Livermore Arcade Shopping Center were operated from May 1996 until February 1997. During the operation of the system, periodic petroleum hydrocarbon vapor measurements of the SVE wells were made using a photoionization detector (PID). Additionally, measurements were made at the main line from the manifold to determine total accumulative hydrocarbon levels. These data are provided in Table 2 for the Beacon Gas Station site and Table 3 for the Livermore Arcade Shopping Center. The data sheets are provided in Appendix A.

The SVE data for the seven-well system at the Beacon Gas Station site showed reasonable soil-vapor hydrocarbon recovery rates. However, after operation for approximately four months, the recovery rates dropped, especially in the wells away from the initial source area.

Due to the inefficiency of thermal oxidation to remove the low levels of hydrocarbon vapors that existed after the first four months of operation, it was replaced with activated carbon at the Beacon Gas Station site in November 1996. The system was shut down for approximately three weeks prior to start up with activated carbon. The air injection system was allowed to operate during shut down of the SVE system to allow aeration of the groundwater for bioremediation. Petroleum hydrocarbon vapor measurements using a PID were made daily, over a five-day period after startup with activated carbon, to determine the recovery rate. As shown in the data, the first day of operation showed reasonable recovery rates. However, these rates dropped off over the next four days. The initial recovery rates were likely attributed to the continuous build up of petroleum hydrocarbon vapors as a result of the operation of the air injection system. The SVE system was shut down on two other occasions to determine if recovery rates would improve, but the same results as from the prior operation resulted.

The SVE system at the Beacon Gas Station site was allowed to operate for another two

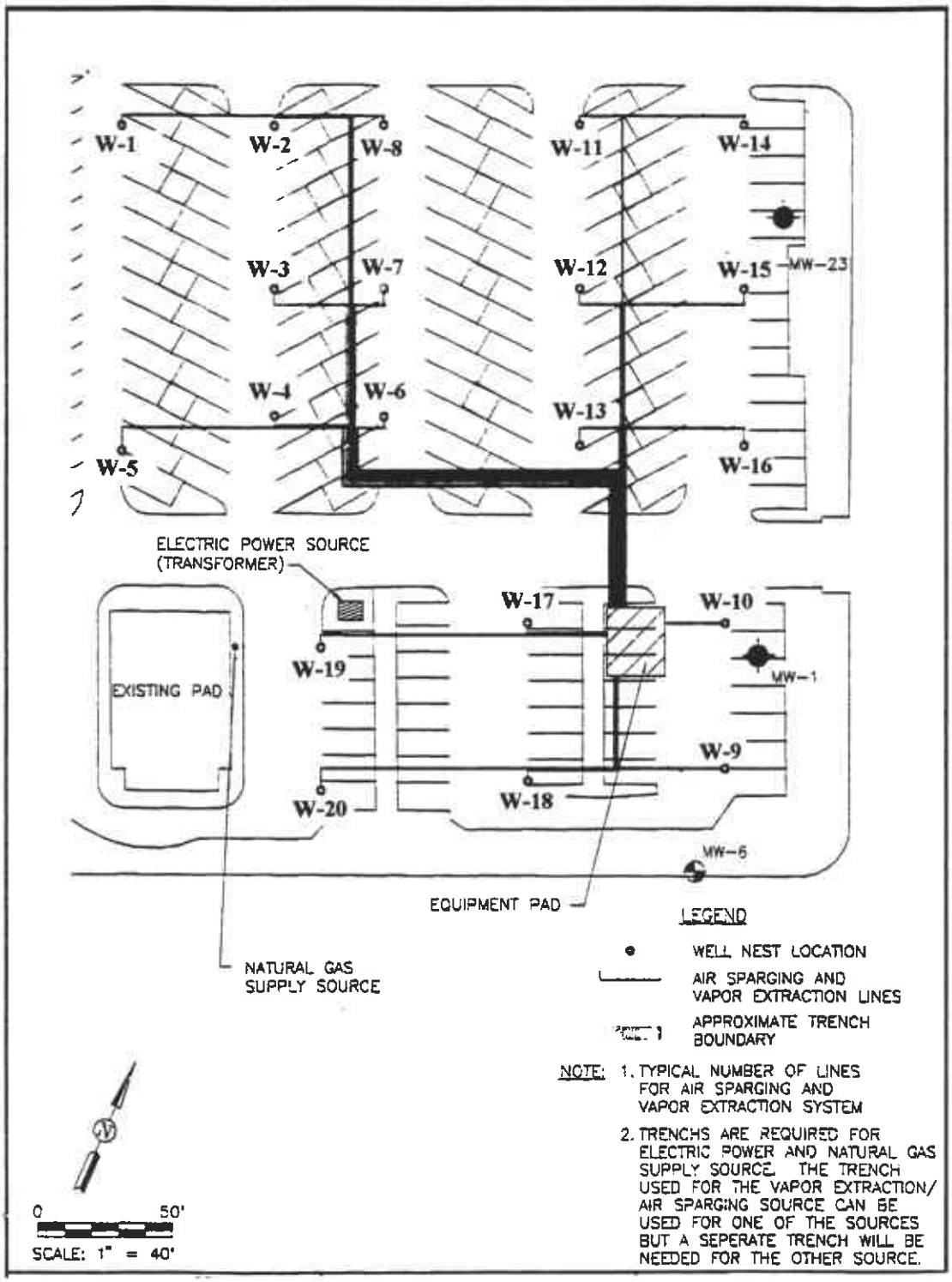

FIGURE 7. SOIL-VAPOR EXTRACTION AND AIR INJECTION WELL LOCATION AT LIVERMORE ARCADE SHOPPING CENTER

Table 2. Soil-Vapor Extraction Data for Beacon Gas Station Site (ppm)

Date	Well Number							Main Line Average
	1	2	3	4	5	6	7	
07/11/96	10	230	510	170	1380	450	<10	470
07/24/96	<10	150	360	110	1370	370	<10	530
08/14/96	<10	10	240	140	2200	2560	80	680
11/18/96*	<10	10	70	10	390	1120	<10	90
11/19/96	<10	20	60	10	70	330	20	20
11/20/96	<10	<10	40	<10	30	50	40	15
11/21/96	<10	<10	30	<10	40	50	30	10
11/22/96	<10	<10	15	<10	40	40	20	<10
12/10/96	<10	<10	30	10	30	130	<10	10
01/10/97	<10	<10	<10	<10	**	230	<10	<10
01/22/97	<10	<10	<10	<10	**	**	<10	<10

* Conversion from thermal oxidation to activated carbon
** Water in line

Table 3. Soil-Vapor Extraction Data for Livermore Arcade Shopping Center Site (ppm)

Date	Well Number																				Main Line
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average
07/11/96	<10	<10	80	<10	<10	<10	150	<10	20	<10	<10	<10	<10	220	<10	<10	<10	30	10	<10	20
07/24/96	<10	<10	30	<10	<10	<10	90	<10	20	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10
08/14/96	<10	<10	10	<10	<10	<10	20	<10	40	<10	<10	<10	<10	10	<10	<10	10	10	20	<10	10
11/18/96*	<10	<10	140	<10	<10	<10	<10	<10	10	10	<10	<10	<10	<10	<10	<10	10	10	<10	<10	<10
11/20/96	<10	<10	30	<10	<10	<10	<10	10	30	<10	<10	<10	<10	10	10	160	30	40	<10	30	10
11/20/96	<10	10	<10	<10	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10	20	<10	<10	<10
11/21/96	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
11/22/96	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
12/10/96	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
12/19/96	<10	<10	<10	<10	**	<10	<10	<10	**	**	<10	**	**	**	**	**	<10	**	**	<10	<10

* Conversion from thermal oxidation to activated carbon
** Water in line

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months to verify that the recoverable volatile petroleum hydrocarbons had been removed. The data shown in Table 2 confirm the success of SVE in recovering hydrocarbon vapors at the Beacon Gas Station location. It is evident the system has reached the limit of its effectiveness and is no longer necessary to continue operation. This system was shut down in early February 1997. The continued drop in recovery rates is likely the result of major source removal in the area of heaviest contamination. This is verified by the unsustained recovery rates after the system was idled during installation of the activated carbon units.

The SVE data for the Livermore Arcade Shopping Center is provided in Table 3 for its seven-month operating period. The recovery wells at the shopping center nearest the Beacon Gas Station (VE-9, VE-10, and VE-18) showed measurable petroleum hydrocarbon vapor levels. The other wells in the main parking lot area of the Livermore Arcade Shopping Center had non-detectable or very low levels of petroleum hydrocarbon vapors. Consistent recovery rates were not shown in any of the SVE wells. It is likely the low recovery rates are attributable to the plume being located mostly within the Beacon Gas Station site and beneath the intersection of South First and P Streets, with only a small portion extending into the southeast corner of the shopping center. Also, the robust vapor extraction system apparently removed all recoverable petroleum hydrocarbon vapors from the area in a very short time. As a result of the low hydrocarbon vapors in the recovery wells, the Livermore Arcade Shopping Center system was turned off in January 1997.

4.0 GROUNDWATER DATA ANALYSES

Historical groundwater analytical results are shown in Table 1. The locations of these wells are provided in Figure 5. These analytical results show significant reductions in BTEX and TPH-G levels in groundwater since the operation of the SVE and air injection system at the Beacon Gas Station site.

Table 4 compares BTEX and TPH-G levels in groundwater monitoring wells prior to the operation of the remedial system in May 1996 to the most recent analytical results of March 1997. These data show fluctuating low levels of BTEX and TPH-G in monitoring wells defining the fringe of the south and eastern portion of the plume (MW-1 and MW-5) and significant reductions in both BTEX and TPH-G in the monitoring well defining the western section of the plume (MW-7).

The two monitoring wells that have historically shown the highest levels of BTEX and TPH-G are MW-2 and MW-6. Since the operation of the remedial system at the Beacon Gas Station site, the petroleum hydrocarbon levels at these two wells have been significantly reduced. As shown in Table 4, MW-2 has shown reductions in benzene (8,000 to 1,800 ppb), toluene (7,700 to 1,100 ppb), ethylbenzene (2,400 to 270 ppb), xylene (12,000 to 2,000 ppb), and TPH-G (48,000 to 13,000 ppb). This well is closest to the original source of the impact area. MW-6 represents the downgradient groundwater monitoring point of the impacted area. This well has also shown reductions of petroleum hydrocarbons with benzene reductions from 8,600 to 2,000 ppb, toluene from 3,300 to 190 ppb, ethylbenzene from 2,200 to 520, xylene from 12,000 to 2,300 ppb, and TPH-G from 29,000 to 12,000 ppb.

In March 1997, groundwater grab samples were taken from selected vapor extraction wells and MW-23 to determine petroleum hydrocarbon levels beyond MW-6 and into the Livermore Arcade Shopping Center. The SVE wells had been shut off for approximately three months prior to sampling, so stable groundwater parameters should have been reached in the area near the wells sampled. The groundwater samples were analyzed for BTEX, TPH-G, and methyl-tertiary-butyl-ether (MTBE). The analytical results are summarized in Table 5 and the analytical data are given in Appendix B.

The wells VE-10 and VE-13 showed detectable levels of petroleum hydrocarbons. VE-10 had benzene (5.1 ppb), ethylbenzene (6.8 ppb), and TPH-G (440 ppb) while VE-13 had only ethylbenzene (0.73 ppb). These two wells are the closest wells to MW-6 and the Beacon Gas Station.

Based on the monitoring well and SVE well data from March 1997, the groundwater plume has been reduced to the Beacon Gas Station site, the South P Street and First intersection, and the southeastern corner of the Livermore Arcade Shopping Center.

In the September 1996 sampling event, nitrate, nitrite, and sulfate groundwater samples were taken from MW-1, MW-2, MW-5, MW-6, and MW-7 to determine microbiological activity upgradient and downgradient of the site. These data are provided in Table 6. The only well considered upgradient from the spill plume is MW-1. This well showed the highest levels of nitrate (3.3 ppm), nitrite (0.26 ppm), and sulfate (64 ppm). The remaining wells showed levels below detectable limits or low levels of sulfate only. These data suggest active microbiological activity in the petroleum hydrocarbon plume.

Table 4. Effectiveness of Remedial System at the Beacon Gas Station Site (ppb)
Contaminant Levles in Groundwater Prior to System Operation Compared to Current Levels

PARAMETERS	MW-1	MW-2	MW-5	MW-6	MW-7
Benzene					
03/21/96	0.52	8000	35	8600	320
03/07/97	6.7	1800	74	2000	35
Toluene					
03/21/96	<0.50	7700	2.0	3300	100
03/07/97	<0.50	1100	<0.50	190	19
Ethylbenzene					
03/21/96	<0.50	2400	2.0	2200	730
03/07/97	1.2	270	0.58	520	360
Xylene					
03/21/96	0.51	12000	18	12000	2500
03/07/97	1.8	2000	1.5	2300	470
TPH-G					
03/21/96	<50	48000	930	29000	12000
03/07/97	600	13000	520	12000	4500

Note: MW-3 and MW-4 were not sampled during 03/21/96 through 03/07/97 due to historically low levels of BTEX and TPH-G.

Table 5. Groundwater Grab Samples from Vapor Extraction Wells and MW-23 at the Livermore Arcade Shopping Center (ppb)

Vapor Extraction Well No.	Benzene	Toluene	Ethylbenzene	Xylenes	TPH-G	MTBE
VE-1	ND	ND	ND	ND	ND	ND
VE-5	ND	ND	ND	ND	ND	ND
VE-7	ND	ND	ND	ND	ND	ND
VE-8	ND	ND	ND	ND	ND	ND
VE-10	5.1	ND	6.8	ND	~~ND~~ 440	~~440~~ ND
VE-13	ND	ND	0.73	ND	ND	ND
MW-23	ND	ND	ND	ND	ND	ND

ND Below detectable limits

* VERIFICATION OF LAB REPORT

Table 6. Nitrate, Nitrite, and Sulfate Levels in Groundwater Samples (ppm)

Monitoring Well No.	Nitrate	Nitrite	Sulfate
MW-1	3.3	0.26	64
MW-2	<0.050	<0.050	20
MW-5	<0.050	<0.050	48
MW-6	<0.050	<0.050	<10
MW-7	<0.050	<0.050	<10

5.0 RISK ASSESSMENT

A risk assessment was performed for the petroleum hydrocarbon impact area associated with the Beacon Gas Station. This risk assessment was performed in accordance with the procedures specified in the American Society for Testing and Materials (ASTM) standard guide "Risk-Based Corrective Action Applied at Petroleum Release Sites," ASTM E-1739-95. The following conditions were considered in this risk assessment:

- Exposure Setting Characterization
  - Site Conditions
  - Chemicals of Concern
  - Current and Future Land Use
  - Current and Future Water Use
- Potential Exposed Population
  - Residential Receptors
  - Commercial Worker Receptors
  - Construction Worker Receptors
- Exposure Pathway Analysis
  - Current Exposure Pathways
  - Future Exposure Pathways

Site-specific assumptions with regard to land use, water use, and future residential or commercial development were used for this assessment. Risks for each potential receptor were calculated for a worst-case exposure scenario using U.S. Environmental Protection Agency (U.S. EPA) default values where site-specific measurements were not available.

5.1 Toxicity Information

Although the toxicity of a substance depends on the intake quantity and the duration of intake, its inherent toxicity is the focus of toxicity assessment. Unfortunately, toxicity information is sparse for effects on humans (epidemiology studies, accidental exposures, and worker exposures). Rather, in most cases, toxicity information comes from controlled animal studies, from which information is published by:

- California EPA, Office of Environmental Health Hazard Assessment (OEHHA)
- California EPA, Department of Toxic Substances Control (DTSC)
- U.S. EPA (including the Integrated Risk Information System [IRIS])
- Department of Health Services (DHS)
- Health Effects Assessment Summary Tables (HEAST)
- U. S. EPA Office of Solid Waste
- American Society for Testing and Materials (ASTM)
- The Cancer Assessment Group (CAG)
- International Agency for Research on Cancer (IARC)
- Office of Technology Assessment (ASTSDR)

There are two main kinds of toxicity: carcinogenic effects (chronic, i.e., long-term) and noncarcinogenic effects (usually acute, i.e., short-term, but also intermediate and chronic). Therefore, this section and the risk estimates are divided into these two classifications.

5.1.1 Carcinogenic Effects

Although there is considerable evidence that an intake greater than some substance-dependent quantity (i.e., a threshold) is necessary to cause some cancers, nevertheless, the U.S. EPA evaluates cancer risk by considering the strength of the evidence (the weight-of-evidence) and dose-response relationships (using a model to extrapolate from the rela-

tively high doses administered to experimental animals to the lower exposure concentrations expected for human contact in the environment).

Acceptable incremental lifetime carcinogenic risk varies considerably depending on the regulatory agency. The following are typical acceptable incremental carcinogenic risk sets for California:

- California AB-2588: 1 in 100,000 (E-05)
- California Proposition 65: 1 in 100,000

5.1.2 *Noncarcinogenic Effects*

For noncarcinogens, the U. S. EPA also uses dose-response data. Generally, the most sensitive animal species are given relatively high doses and the highest No Observable Adverse Effect Level (NOAEL) is selected. Because of uncertainties in these studies (e.g., relating animal data to humans), a safety factor is applied to ensure the protection of human health. Typically, the NOAEL is divided by 1,000 to obtain a U.S. EPA-certified Reference Dose (RfD). Finally, Hazard Quotients (HQ) are calculated from RfD and intake rates (HQ>1 suggests concern for potential noncarcinogenic adverse health effects). HQs are not statistical probabilities but only a qualitative guide of possible hazard. The typical acceptable HQ is given as follows:

- California Dept. of Health Services (1990) HQ<1

5.2 Risk Assessment Parameters

The results of the risk assessment are provided in Table 7 for current conditions and in Table 8 for possible future conditions in the area. Detailed information on the assumptions made in this risk assessment and calculations are provided in Appendix C.

Table 7 shows current risk for on-site and off-site receptors. The only on-site carcinogenic risk is from inhalation. The carcinogenic risk for this condition is 1.24E-06 which is a magnitude below the value of 1.0E-05 (1 in 100,000) set by California AB-2588 and California Proposition 65. The HQ was smaller than 1.0, and falls within the acceptable health risk values set by the California Department of Health Services. Impacted surface soil is not present at the Beacon Gas Station site at depths where construction work would likely be affected. Therefore, this condition was not considered for the current conditions at the site. Additionally, no residential facilities are located on the Beacon Gas Station property, thus no exposure can occur to this type of receptor.

The closest off-site commercial receptor is a Frosty Freeze fast food restaurant located approximately 120 feet northwest of the Beacon Gas Station. The carcinogenic risk for a receptor at this site is 1.26E-05, less than the California values. Construction workers at the restaurant would not be exposed to contaminated soil, thus this condition was not considered in the risk assessment. The carcinogenic risk for the nearest residential receptor downgradient from the site is 1.85E-06 and includes the risks associated with ingestion, inhalation, and dermal contact. This cumulative risk value is a magnitude below the California values, and does not pose a significant health risk. Additionally, the HQ risk for both commercial and residential receptors are below the 1.0 value.

Future cumulative risk associated with impacts at the Beacon Gas Station is provided

indoor or outdoor?

Table 7. Current Cumulative Risk Assessment Results

On-Site						
	Commercial		Construction		Residential	
Parameter	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk
Ingestion	NA	NA	NA	NA	NA	NA
Inhalation	9.82E-02	1.24E-06	NA	NA	NA	NA
Dermal	NA	NA	NA	NA	NA	NA
Total	**9.82E-02**	**1.24E-06**	**NA**	**NA**	**NA**	**NA**

Off-Site						
	Commercial		Construction		Residential	
Parameter	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk
Ingestion	NA	NA	NA	NA	6.81E-04	1.26E-06
Inhalation	7.35E-01	1.26-05	NA	NA	1.56E-02	3.20E-07
Dermal	NA	NA	NA	NA	5.98E-04	2.73E-07
Total	**7.35E-01**	**1.26E-05**	**NA**	**NA**	**1.69E-02**	**1.85E-06**

Table 8. Future Cumulative Risk Assessment Results

On-Site						
	Commercial		Construction		Residential	
Parameter	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk
Ingestion	1.18E-01	1.82E-04	NA	NA	NA	NA
Inhalation	2.26E+01	2.61E-04	NA	NA	NA	NA
Dermal	NA	NA	NA	NA	NA	NA
Total	**2.27E+01**	**4.43E-04**	**NA**	**NA**	**NA**	**NA**

Off-Site						
	Commercial		Construction		Residential	
Parameter	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk
Ingestion	NA	NA	NA	NA	3.64E-04	2.06E-07
Inhalation	NA	NA	NA	NA	NA	NA
Dermal	NA	NA	NA	NA	3.65E-04	1.63-07
Total	**NA**	**NA**	**NA**	**NA**	**7.29E-04**	**3.70E-07**

in Table 8. The cumulative risk for on-site conditions is 4.43E-04 and includes exposure from ingestion and inhalation. This value is greater than the California values. Additionally, the HQ risk for on-site conditions of 22.7 exceeds the California-designated HQ value of 1.0. On-site construction and residential receptors were not considered for the reasons given above. The future carcinogenic risk for off-site conditions is 3.70E-07 with an HQ of 7.29E-04, well within acceptable parameters for carcinogenic and HQ risks.

The most significant potential health risk is associated with the inhalation of volatile organic carbon vapors from the groundwater by commercial workers within the Frosty Freeze building located adjacent to the Beacon Gas Station site. Presently, there is no indication that a health risk has occurred in this area, and the hydrocarbon concentration in the groundwater near this building (MW-7) is below the levels required for a health risk to develop.

5.3 Assumptions

The application of health risk standards to evaluate the potential dangers regarding the release of chemicals to the air, soil, surface water, or groundwater requires many assumptions be made to qualify the character of the release relative to the potential exposed population. A discussion of these assumptions is presented here on the basis of the required application to the site-specific and toxicity assessment parameters.

The site-specific assumptions with regard to land use, water use, and future residential or commercial development are based on an interpretation of the behavior options available to the population in the area surrounding the site. Risk for each of the potential receptors was determined using the following worst-case exposure scenarios:

- The calculated risk to the current on-site commercial receptor (1.24E-06) assumes (using U.S. EPA defaults) that a Beacon Gas Station employee inhales 20 cubic meters of air per day, for 250 days per year (8 hours per day), over a 25-year period. The work activity must be conducted outdoors on the north side of the property (near the pump islands). Additionally, worst-case soil analytical data was used in the model. This scenario is not realistic because the majority of the worker's time is spent inside the facility, southeast of the hydrocarbon impact area. If a more realistic assumption is made that the worker spends only one hour per day outdoors, then both the carcinogenic and noncarcinogenic risks decrease.

- The calculated risk to the "current off-site residential receptor" located 2,700 feet downgradient from the source area assumes that: (1) the water well at this location is both screened in the shallow impacted aquifer and is used for human ingestion, and (2) no biodegradation has occurred in the aquifer between the source area and the water well. The carcinogenic risk calculated for this scenario was determined to be 1.26E-06. Had the data been available to include biodegradation in the natural attenuation model, the calculated risk would be smaller.

- The calculated risks to the "current off-site commercial receptor" (Frosty Freeze fast food restaurant) represents the most significant possible health risk (1.26E-05). The modeling conducted for this scenario assumes the commercial structure is located immediately downgradient from the source area. Based on the groundwater gradient data, this is not the case. The actual groundwater flow is toward the north-northwest and the restaurant is almost due west of the site. In order for a potential health risk to develop in this area, the concentration of dissolved benzene in the groundwater below the Frosty Freeze building must increase from the current level of 0.035 ppm (MW-7) to approximately 0.88 ppm to exceed the values of 1.0E-05 established by California AB-2588 and Proposition 65.

- The calculated risk to the "future on-site commercial receptor" assumes a commercial building will be constructed on the northwest corner of the Beacon Gas Station property. The likelihood this scenario may occur is presently controlled by the property owner, Ultramar Incorporated. If necessary, deed restriction or institutional controls can be incorporated to eliminate this potential health risk.

The health risk assessment does not account for a California Regional Water Quality Control Board "containment zone" in the Livermore Arcade Shopping Center, the Millers Outpost Shopping Center, and portions of a residential area north of the site. This containment zone was established under Site Cleanup Order (SCO) 96-052 and establishes institutional controls through local well permits by the Zone 7 water agency and building/land use permits through the City of Livermore. The containment zone encompasses the downgradient area of the site to a distance of approximately 1,700 feet. A map of this containment zone is shown as Figure 8, and a copy of the SCO is provided in Appendix D.

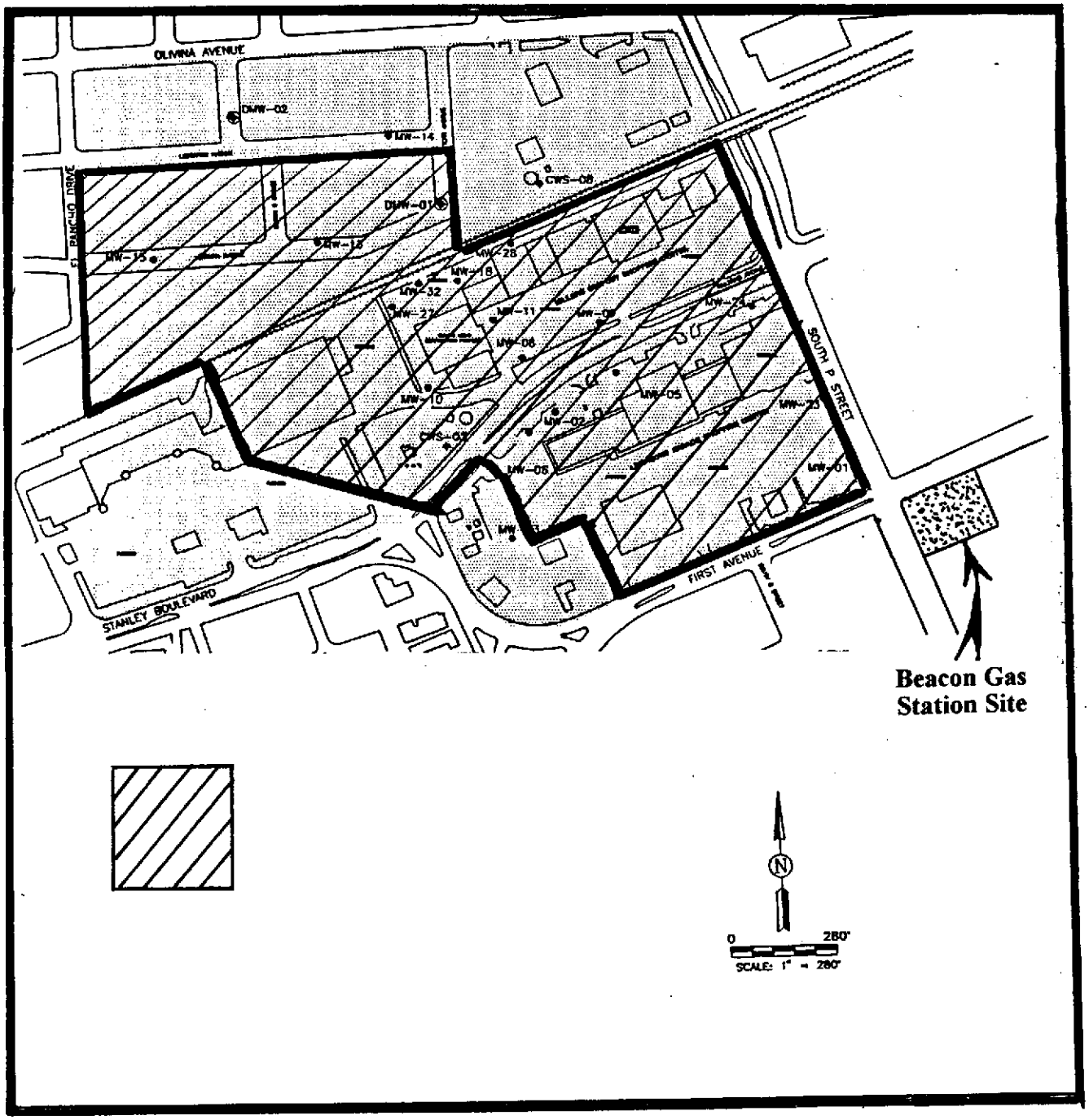

FIGURE 8. CONTAINMENT ZONE AREA DOWN-GRADIENT FROM BEACON GAS STATION

6.0 CONCLUSIONS

Based on information from remediation system operation, groundwater sampling, and risk assessment for the site, the following conclusions can be made:

- A significant drop in petroleum hydrocarbon levels in the groundwater has occurred at the Beacon Gas Station site as a result of operation of the SVE and air injection system.
- Virtually all concentrated vapors in soil have been removed from both sites.
- Due to the decreased petroleum hydrocarbon levels, the SVE and air injection system at the Beacon Gas Station is no longer cost effective in removing the remaining reduced concentrations of petroleum hydrocarbons from the groundwater.
- The SVE and air injection system at the Livermore Arcade Shopping Center is likewise not cost effective in removing the low levels of hydrocarbons remaining in that area.
- The plume has significantly decreased in mass and size since the operation of the treatment systems.
- The petroleum hydrocarbon plume is currently confined to the Beacon Gas Station site, the intersection of First and South P Streets, and the southeastern corner of the Livermore Arcade Shopping Center.
- The nitrate, nitrite, and sulfate levels indicate an active microbiological population in the petroleum hydrocarbon plume.
- Some of the evaluated receptors have calculated risks that could potentially expose receptors to current and future carcinogenic and hazard quotient risks above acceptable levels. However, evaluating these risks for site-specific conditions shows them to be within acceptable limits.
- Most of the area downgradient of the site is a containment zone set by the Regional Water Quality Control Board with institutional controls that provide protection for public health.

7.0 RECOMMENDATIONS

Based on the significant drop in recovery rates of the remedial systems at the Beacon Gas Station and Livermore Arcade Shopping Center and the current groundwater analytical data, the following recommendations are proposed for the site:

- Active mechanical remediation of the Beacon Gas Station and Livermore Arcade Shopping Center be terminated to allow natural microbiological activities to remediate the remaining petroleum hydrocarbons in the groundwater.
- Continue groundwater monitoring of the site on a quarterly basis for one year to confirm continued reduction of petroleum hydrocarbon levels in the plume. If petroleum hydrocarbon levels continue to drop, monitoring of the site should be continued on a semi-annual or annual basis.

8.0 REFERENCES

BDM International, Inc. (BDM). Miscellaneous letters and other correspondence on Ultramar, Inc. Beacon Station No. 604.

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Geoscience Consultants, Ltd. (GCL), 1995. Plan and Specifications for Beacon Station No. 604, 1619 West First Street, Livermore, California: Vapor Extraction and Air Sparging Remediation System, July 26.

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Van Dam, Inc. , 1994. Remedial Action Plan: Former Beacon Station No. 604, 1619 West First Street, Livermore, California, Action * Mickelson *, December 14.

Appendix A

Data Sheets for Soil-Vapor Recovery Rates for Beacon Gas Station and Livermore Arcade Shopping Center

'96 16:05

FAX Transmittal Memo

To	Terry Fox	No. of Pages	Today's Date / Time
Company	Ultramar Inc	From	Chuck Parker
FAX #	209-583-3282	Company	WSES
Comments		Location	Bakersfield, CA

SYSTEMS MONITORING DATA

Date: 7-11-95. Location: Livermore, CA. Field Technician: C. Parker

Station No: 604. Initial System Status: Up/~~Down~~. System Type: Paragon

Tot. Hrs: ——. H_2O K/O: 0 (current) % Full, 0 (stored) # of Full Drums,

Pipe Size I.D.: 3&4 "

BEFORE ANY ADJUSTMENT:

INITIAL Dilution Valve Position: open, ~~closed or cracked~~ 20", Flow Meter: ——— scfm

INITIAL Vac: 3.2 " Hg, Δp: <0.05 (before dilut.) H_2O, Δp: 1.7 (after dilut.) " H_2O, Calc: <17 (before dilut.) scfm, Calc: 255 (after dilut.) scfm

INITIAL: Infl: 470 (before dilut.) ppm, Infl: 10 (after dilut.) ppm, Effl: N.D. ppm, CO_2 ——, H_2O —— %, Motor Amps: ———

~~Initial Recirculation: open or closed~~

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: ——— scfm

FINAL Vac: ——— " Hg, Δp: ——— (before dilut.) " H_2O, Δp: ——— (after dilut.) " H_2O, Calc: ——— (before dilut.) scfm, Calc: ——— (after dilut.) scfm

FINAL: Infl: ——— (before dilut.) ppm, Infl: ——— (after dilut.) ppm, Effl: ——— ppm, CO_2 ——, H_2O —— %, Motor Amps: ———

Final Recirculation: open or closed

Set Pt: 1480°F, Chamber Temp: 1490°F, Exit Temp: ———, Motor Amp Rating: ———

STACK: Temperature: ——— °F, Magnehelic: ——— " ———, Calc: ——— scfm, H_2O: ——— %

Field Instrument: Horiba, Last Monitoring: ———

Well #	Vac.			ppm	Valve
3				510	0
2				230	0
6				450	0
5				1380	0
4				170	0
1				10	0
7				<10	0

Well #	Vac.			ppm	Valve

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene		)				
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

FILENAME: AIRSS
VERSION DATE: 04-09-92

'96 13:44

FAX Transmittal Memo

To	Terry Fox	No. of Pages	1
Company	Ultramar Inc	Today's Date	7-24-96
FAX #	209-583-3282	From	Chuck Parker
Comments		Company	WSES
		Location	Bakersfield, CA

SYSTEMS MONITORING DATA

Date: 7-24-96, Location: Livermore, CA Field Technician: C. Parker

Station No: 604, Initial System Status: Up/Down, System Type: Paragon

Tot. Hrs: ——, H_2O K/O: 0 current % Full, —— stored # of Full Drums, Pipe Size I.D.: 3&4 "

BEFORE ANY ADJUSTMENT:

INITIAL Dilution Valve Position: open, ~~closed or cracked~~, Flow Meter: ____ scfm

INITIAL Vac: 3.9 " Hg, Δp: 0.005 before dilut. " H_2O, Δp: 1.7 after dilut. " H_2O, Calc: 17 before dilut. scfm, Calc: ~250 after dilut. scfm

INITIAL: Infl: 530 before dilut. ppm, Infl: 10 after dilut. ppm, Effl: N.D. ppm, CO_2 ____, H_2O ____ %, Motor Amps: ____

Initial Recirculation: ~~open or closed~~

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: ____ scfm

FINAL Vac: ____ " Hg, Δp: ____ before dilut. " H_2O, Δp: ____ after dilut. " H_2O, Calc: ____ before dilut. scfm, Calc: ____ after dilut. scfm

FINAL: Infl: ____ before dilut. ppm, Infl: ____ after dilut. ppm, Effl: ____ ppm, CO_2 ____, H_2O ____ %, Motor Amps: ____

Final Recirculation: open or closed

Set Pt: 1480°F, Chamber Temp: 1480°F, Exit Temp: ____, Motor Amp Rating: ____

STACK: Temperature: ____ °F, Magnehelic: ____ ", Calc: ____ scfm, H_2O: ____ %

Field Instrument: Horiba, Last Monitoring: 7-11-95

Well #	Vac.			ppm	Valve
3				360	
2				150	
6				370	
5				1370	
4				110	
1				<10	
7				<10	

Well #	Vac.			ppm	Valve

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene						
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

FILENAME: AIRES
VERSION DATE: 04-09-92

FAX Transmittal Memo

To	Terry Fox	No. of Pages	1
Company	Ultramar Inc	Today's Date	8-14-96
FAX #	209-583-3282	From	Chuck Parker
Comments	1) Instrument panel indicated High Temp	Company	WSES
		Location	Bakersfield, CA

SYSTEMS MONITORING DATA

Date: 8-14-96. Location: Livermore, CA. Field Technician: C. Parker
Station No: 604, Initial System Status: Up/Down, System Type: Fargo
Tot. Hrs: —, H_2O K/O: 0 current % Full, — stored # ~~of Full Drums~~, Pipe Size I.D.: 3&4"

BEFORE ANY ADJUSTMENT: ~~4"~~ ~~3"~~
INITIAL Dilution Valve Position: open, ~~closed or cracked~~ Flow Meter: _____ scfm
INITIAL Vac: 5.1 " Hg, Δp: 0.01 before dilut. " H_2O, Δp: 0.5 after dilut. " H_2O, Calc: 35 before dilut. scfm, Calc: 239 after dilut. scfm
INITIAL: Infl: 680 before dilut. ppm, Infl: 10 after dilut. ppm, Effl: N.D ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____
~~Initial Recirculation~~ ~~open or closed~~

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm
FINAL Vac: _____ " Hg, Δp: _____ before dilut. " H_2O, Δp: _____ after dilut. " H_2O, Calc: _____ before dilut. scfm, Calc: _____ after dilut. scfm
FINAL: Infl: _____ before dilut. ppm, Infl: _____ after dilut. ppm, Effl: _____ ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____
Final Recirculation: open or closed

Set Pt: 1480, Chamber Temp: 1480, Exit Temp: _____, Motor Amp Rating: _____
STACK: Temperature: _____ °F, Magnehelic: _____ " _____, Calc: _____ scfm, H_2O: _____ %
Field Instrument: Horiba, Last Monitoring: 7-24-96

Well #	Vac.			ppm	Valve
3				340	O
2				10	
6				2560	
5				2200	
4				140	
1				<10	
7				80	✓

Well #	Vac.			ppm	Valve

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene		)				
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

FILENAME: AWSS
VERSION DATE: 04-09-92

FAX Transmittal Memo

To: Terry Fox		No. of Pages: 1	Today's Date: 11-18-96 Time:
Company: Ultramar Inc		From: Chuck Parker	
FAX #: 209-583-3282		Company: WSES	
Comments:		Location: Bakersfield, CA	

SYSTEMS MONITORING DATA

Date: 11-18-96 Location: Livermore, CA Field Technician: C. Parker

Station No: 66-4, Beeson Station Initial System Status: Up/Down, System Type: Carbon

Tot. Hrs: 1, H_2O K/O: 0 current % Full, ~~stored # of Full Drums~~,

Pipe Size I.D.: 2 "

BEFORE ANY ADJUSTMENT:

INITIAL Dilution Valve Position: ~~open~~, closed ~~or cracked~~, Flow Meter: _____ scfm

INITIAL Vac: 6.0 " Hg, Δp: 0.09 " H_2O before dilut., Δp: ___ " H_2O ~~after dilut.~~, Calc: 26 scfm before dilut., Calc: ___ scfm ~~after dilut.~~

INITIAL: Infl: 90 ppm before dilut., Infl: 1A: N.D. ppm ~~after dilut.~~ 1B: N.D. ppm, Effl: 1B: N.D. ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____

1B = N.D. 1C = N.D.

Initial Recirculation: open or closed

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm

FINAL Vac: _____ " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: _____ scfm before dilut., Calc: _____ scfm after dilut.

FINAL: Infl: _____ ppm before dilut., Infl: _____ ppm after dilut., Effl: _____ ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____

Final Recirculation: open or closed

Set Pt: _____, Chamber Temp: _____, Exit Temp: _____, Motor Amp Rating: _____

STACK: Temperature: _____ °F, Magnehelic: 1B = 0.02 2B = 0.03, Calc: 1B = 12 2B = 14 scfm, H_2O: _____ %

Field Instrument: Horiba Last Monitoring: _____

Well #	Vac.			ppm	Valve
3				70	0
2				10	
6				1120	
5				390	
4				10	
1				<10	
7				80	↓
Flow = Infl → Carbon 1A →					
		Carbon 2A →			

Well #	Vac.			ppm	Valve
Carbon 1B					
Carbon 2B					

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene						
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

FILENAME: AIRSS
VERSION DATE: 04-09-92

FAX Transmittal Memo

To: Terry Fox		No. of Pages: 1	Today's Date: 11-19-96 Time:
Company: Ultramar Inc		From: Chuck Parker	
FAX #: 209-583-3282		Company: WSES	
Comments: N.D. = < 10 ppmv		Location: Bakersfield, CA	

SYSTEMS MONITORING DATA

Date: 11-19-96, Location: Livermore, CA Field Technician: C. Parker
Station No: 604, -Beacon Station Initial System Status: Up ~~Down~~. System Type: Carbon
Tot. Hrs: 20, H_2O K/O: 0 (current) % Full, ~~# of Full Drums~~ (stored),
Pipe Size I.D.: 2 "

BEFORE ANY ADJUSTMENT:
INITIAL Dilution Valve Position: ~~open~~, closed or ~~cracked~~
INITIAL Vac: 6.0 " Hg, Δp: 0.48 (before dilut.) " H_2O, Δp: ___ (after dilut.) " H_2O, Calc: 59 (before dilut.) scfm, Calc: ___ (after dilut.) scfm
Flow Meter: ___ scfm
INITIAL: Infl: ___ (before dilut.) ppm, Infl: ___ (after dilut.) ppm, Effl: ___ ppm, ~~CO_2~~ ___, ~~H_2O~~ ___ %, ~~Motor Amps~~ ___
Initial Recirculation: ~~open or closed~~

FINAL Dilution Valve Position: open, closed or cracked
FINAL Vac: ___ " Hg, Δp: ___ (before dilut.) " H_2O, Δp: ___ (after dilut.) " H_2O, Calc: ___ (before dilut.) scfm, Calc: ___ (after dilut.) scfm
Flow Meter: ___ scfm
FINAL: Infl: ___ (before dilut.) ppm, Infl: ___ (after dilut.) ppm, Effl: ___ ppm, CO_2 ___, H_2O ___ %, Motor Amps: 18
Final Recirculation: open or closed

~~Set Pt~~: ___, ~~Chamber Temp~~: ___, ~~Exit Temp~~: ___, Motor Amp Rating: 22
STACK: Temperature: ___ °F, Magnehelic: ___ " ___, Calc: ___ scfm, H_2O: ___ %
Field Instrument: Horiba, Last Monitoring: 11-18-96

Well #	Vac.			ppm	Valve
3				60	
2				20	
6				330	
5				70	
4				10	
1				<10	
7				20	
N.D. Inf = 20 ppm →				Carbon 1A Effl. =	
				→ Carbon 2A Effl.	

Well #	Vac.			ppm	Valve
—					
Carbon 1B Effl.				26	Scfm
Carbon 2B Effl.				26	Scfm
N.D. ppm →				Carbon 1B Effl. =	N.D.
N.D. ppm →				Carbon 2B Effl.	N.D.

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene						
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

FILENAME: AMSS
VERSION DATE: 04-09-92

Fax Transmittal Memo

To	Terry Tes	TO: 583 3282	P01
Company	Ultramar Inc	No. of Pages 1 / Today's Date	Time
FAX #	209-583-3282	From Chuck Parker	
Comments	N.D = None Detected (Less Than 10 ppmv	Company WSES	
	Note: Heribc measured 10-15 ppmv Methane from all carbon effluents	Location Bakersfield, CA	

SYSTEMS MONITORING DATA

Date: 11-20-96 Location: Livermore CA, Field Technician: C. Parker

Station No: 604, Beacon Station Initial System Status: Up/Down, System Type: Carbon

Tot. Hrs: 47, H_2O K/O: 2 % Full. ~~# of Full Drums~~ stored

Pipe Size I.D.: 2 "

BEFORE ANY ADJUSTMENT:

INITIAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm

INITIAL Vac: 6.0 " Hg, Δp: 0.68 " H_2O (before dilut.), Δp: — " H_2O (after dilut.), Calc: 26 scfm (before dilut.), Calc: — scfm (after dilut.)

INITIAL: Infl: _____ ppm (before dilut.), Infl: _____ ppm (after dilut.), Effl: _____ ppm CO_2 _____, H_2O _____ %, Motor Amps: _____

Initial Recirculation: open or closed

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm

FINAL Vac: _____ " Hg. Δp: _____ " H_2O (before dilut.), Δp: _____ " H_2O (after dilut.), Calc: _____ scfm (before dilut.), Calc: _____ scfm (after dilut.)

FINAL: Infl: _____ ppm (before dilut.), Infl: _____ ppm (after dilut.), Effl: _____ ppm CO_2 _____, H_2O _____ %, Motor Amps: _____

Final Recirculation: open or closed

~~Set Pt:~~ _____, ~~Chamber Temp:~~ _____, ~~Exit Temp:~~ _____, Motor Amp Rating: _____

STACK: Temperature: _____ °F, Magnehelic: _____ " _____, Calc: _____ scfm, H_2O: _____ %

Field Instrument: Heribc Last Monitoring: 11-19-96

Stacks = 2.12" D.T.

Well #	Vac.	ppm	Valve
3		40	O
2		<10	
6		50	
5		30	
4		<10	
1		<10	
7		40	

Inf: 15 ppm → Carbon 1A Effl. = N.D → Carbon 1B Effl = N.D ppmv

→ Carbon 2A Effl. = N.D → Carbon 2B Effl = N.D ppmv

Temp. upstream Carbons = 72°F

Well #	Vac.	ppm	Valve
Line 1 = 0.62 "H_2O or 12.5 scfm			
Line 2 = 0.025 "H_2O or 13.0 scfm			

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene						
PHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

FILENAME: ARRES
VERSION DATE: 04-09-92

Memo

To: Terry Fox		No. of Pages: 1	Today's Date:	Time:
Company: Ultramar Inc		From: Chuck Parker	
FAX #: 209-583-3282		Company: WSES	
Comments: N.D.= None Detected (<10ppm)		Location: Bakersfield, CA	

Note: Two Horiba instruments were used for hydrocarbon measurements. Readings from both instruments were approximately the same

SYSTEMS MONITORING DATA

Date: 11-21-96 Location: Livermore, CA Field Technician: C. Parker

Station No: 604, Beacon Station Initial System Status: Up/~~Down~~ System Type: Carbon

Tot. Hrs: 70, H_2O K/O: 0 current % Full. ~~# of Full Drums, stored~~

Pipe Size I.D.: 2 "

BEFORE ANY ADJUSTMENT:

INITIAL Dilution Valve Position: ~~open~~, closed or ~~cracked~~, Flow Meter: _____ scfm

INITIAL Vac: 6.0 " Hg, Δp 0.08 " H_2O before dilut., Δp: — " H_2O after dilut., Calc: 25 scfm before dilut., Calc: — scfm after dilut.

INITIAL: Infl: _____ ppm before dilut. Infl: _____ ppm after dilut. Effl: _____ ppm CO_2 _____, H_2O _____ %, Motor Amps: _____

Initial Recirculation: ~~open~~ or closed

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm

FINAL Vac: _____ " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: _____ scfm before dilut., Calc: _____ scfm after dilut.

FINAL: Infl: _____ ppm before dilut. Infl: _____ ppm after dilut. Effl: _____ ppm CO_2 _____, H_2O _____ %, Motor Amps: _____

Final Recirculation: ~~open~~ or closed

~~Set Pt.~~: _____, ~~Chamber Temp.~~: _____, ~~Exit Temp.~~: _____, Motor Amp Rating: _____

STACK: Temperature: _____ °F, Magnehelic: _____ ", Calc: _____ scfm, H_2O: _____ %

Field Instrument: Horiba, Last Monitoring: 11-20-96

Well #	Vac.			ppm	Valve
3				30	0
2				<10	
6				50	
5				40	
4				<10	
1				<10	
7				30	✓
Infl = 10 ppm → Carbon 1 Effl. = N.D → Carbon 2 Effl = N.D					
Temp. upstream Carbons = 72°F					

Stack = 2½" Dia

Well #	Vac.			ppm	Valve
Line 1 = 0.02" H_2O or 12.5 scfm					
Line 2 = 0.02" H_2O or 12.5 scfm					
Temp. upstream carbons = 70°F					
= N.D → Carbon 1 Effl. = N.D ppmv					
= N.D → Carbon 2 Effl. = N.D ppmv					

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene		)				
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

Transmittal Memo

To	Terry Fox	No. of Pages	1
Company	Ultramar Inc	From	Chuck Parker
FAX #	209-583-3282	Company	VSES
Comments	N.D. - Hexane detected (Cleaning)	Location	Bakersfield, CA

TO: 583 3282

SYSTEMS MONITORING DATA

Date: 11-22-96, Location: Linemar, CA, Field Technician: C. Parker
Station No: 604, Beacon station, Initial System Status: Up, System Type: Carbon
Tot. Hrs: 92, H_2O K/O: 0 current % Full, ~~stored # of Full Drums:~~
Pipe Size I.D.: 2 "

BEFORE ANY ADJUSTMENT:
INITIAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm
INITIAL Vac: 60 " Hg, Δp: 0.05 " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: 25 scfm before dilut., Calc: _____ scfm after dilut.
INITIAL: Infl: _____ ppm before dilut., Infl: _____ ppm after dilut., Effl: _____ ppm CO_2 _____, H_2O _____ %, Motor Amps: _____
Initial Recirculation: open

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm
FINAL Vac: _____ " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: _____ scfm before dilut., Calc: _____ scfm after dilut.
FINAL: Infl: _____ ppm before dilut., Infl: _____ ppm after dilut., Effl: _____ ppm CO_2 _____, H_2O _____ %, Motor Amps: _____
Final Recirculation: open or closed

Set Pt: _____, Chamber Temp: _____, Exit Temp: _____, Motor Amp Rating: _____
STACK: Temperature: _____ °F, Magnehelic: _____ " , Calc: _____ scfm, H_2O: _____ %
Field Instrument: Horiba, Last Monitoring: 11-21-96

Stack Cz = 2x2'0"s

Well #	Vac.			ppm	Valve
3				15	9
2				<10	
6				40	
5				40	
4				<10	
1				<10	
7				20	↓
Infl	N.D.	→ Carbon 1A effl. = N.D. → Carbon 1B effl. = N.D. ppmv			
		→ Carbon 2A effl. = N.D. → Carbon 2B effl. = N.D. ppmv			

Well #	Vac.			ppm	Valve
Line 1 - 0.02" H_2O or 12.5 scfm					
Line 2 - 0.02" H_2O or 12.5 scfm					
Temp. upstream carbons = 64 °F					

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene						
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

FILENAME: AIRSS
VERSION DATE: 04-09-92

FAX Transmittal Memo		No. of Pages 1	Today's Date	Time
To	Terry Fox	From	Chuck Parker	
Company	Ultramar Inc	Company	WSES	
FAX #	209-583-3282	Location	Bakersfield, CA	
Comments	N.D. = None Detected (< 10 ppmv)			

SYSTEMS MONITORING DATA

Date: 12-10-96 Location: Livermore, CA Field Technician: C. Parker

Station No: 604, Beacon Site Initial System Status: Up ~~Down~~ System Type: Carbon

Tot. Hrs: 114, H_2O K/O: ____ (current) % Full, ~~# of Drums (stored)~~ Pipe Size I.D.: 2 "

BEFORE ANY ADJUSTMENT:

INITIAL Dilution Valve Position: ~~open~~, closed ~~or cracked~~, Flow Meter: ____ scfm

INITIAL Vac: 6.1 " Hg, Δp: 2.05 (before dilut.) " H_2O, Δp: ____ (after dilut.) " H_2O, Calc: 25 (before dilut.) scfm, Calc: ____ (after dilut.) scfm

INITIAL: Infl: ____ (before dilut.) ppm, Infl: ____ (after dilut.) ppm, Effl: N.D. ppm, CO_2 ____, H_2O ____ %, Motor Amps: ____

Initial Recirculation: ~~open or closed~~

FINAL Dilution Valve Position: open, closed or cracked, **Flow Meter:** ____ scfm

FINAL Vac: ____ " Hg, **Δp:** ____ (before dilut.) " H_2O, **Δp:** ____ (after dilut.) " H_2O, **Calc:** ____ (before dilut.) scfm, **Calc:** ____ (after dilut.) scfm

FINAL: Infl: ____ (before dilut.) ppm, Infl: ____ (after dilut.) ppm, Effl: ____ ppm, CO_2 ____, H_2O ____ %, **Motor Amps:** ____

Final Recirculation: open or closed

Set Pt: ____, Chamber Temp: ____, Exit Temp: ____, Motor Amp Rating: ____

STACK: Temperature: ____ °F, Magnehelic: ____ " ____, Calc: ____ scfm, H_2O: ____ %

Field Instrument: Horiba Last Monitoring: 11-22-96

Stack = Dia 12" Dia.

Well #	Vac.			ppm	Valve
3				30	
2				<10	
6				130	
5				30	
4				10	
1				<10	
7				<10	
Infl. = 10 ppmv			→ Carbon 1A Effl. =		
			Carbon 2A Effl. =		

Well #	Vac.			ppm	Valve
Line 1 = 0.02" H_2O Dp on 12.5 scfm					
Line 2 = 002" H_2O Dp on 12.5 scfm					
Temp upstream carbon = 68°F					
N.D. → Carbon 1B Effl. = N.D. ppmv					
N.D. → Carbon 2B Effl. = N.D. ppmv					

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene		)				
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

FILENAME: AMRS
VERSION DATE: 04-09-92

FAX Transmittal Memo TO: 583 3282 P01

To	Terry Fox	From	Chuck Parker
Company	Ultramar Inc	Company	WSES
FAX #	209-583-3282	Location	Bakersfield, CA
Comments	N.D. = None detected (<10)		

SYSTEMS MONITORING DATA

Date: 1-10-97, Location: Livermore, CA, Field Technician: C. Parker
Station No: 604, Beacon St., Initial System Status: Up/~~Down~~, System Type: Carbon
Tot. Hrs: 856, H_2O K/O: ~~0~~ (carbon) % Full, ~~# of Full Drums~~ (stored),
Pipe Size I.D.: 2 "

BEFORE ANY ADJUSTMENT:
INITIAL Dilution Valve Position: ~~open~~, closed or ~~throttled~~, Flow Meter: _____ scfm
INITIAL Vac: 6.2 " Hg, Δp: 0.05 (before dilut.) " H_2O, Δp: ___ (after dilut.) " H_2O, Calc: 20 (before dilut.) scfm, Calc: ___ (after dilut.) scfm
INITIAL: Infl: _____ (before dilut.) ppm, Infl: ___ (after dilut.) ppm, Effl: _____ ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____
Initial Recirculation: ~~open~~ or ~~throttled~~

FINAL Dilution Valve Position: ~~open~~, closed or ~~throttled~~, Flow Meter: _____ scfm
FINAL Vac: 6.2 " Hg, Δp: 0.06 (before dilut.) " H_2O, Δp: ___ (after dilut.) " H_2O, Calc: 22 (before dilut.) scfm, Calc: ___ (after dilut.) scfm
FINAL: Infl: N.D. (before dilut.) ppm, Infl: ___ (after dilut.) ppm, Effl: N.D. ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____
Final Recirculation: ~~open~~ or ~~throttled~~

Set Pt: _____, Chamber Temp: _____, Exit Temp: _____, Motor Amp Rating: _____
STACK: Temperature: _____ °F, Magnehelic: ___ " ___, Calc: _____ scfm, H_2O: _____ %
Field Instrument: Horiba, Last Monitoring: 12-19-96

Well #	Vac.			ppm	Valve
3				N.D.	O
2				N.D.	O
6				230	C→O
5				H₂O	O→C
4				N.D.	O
1				N.D.	C
7				N.D.	O
				→ Carbon 1A effl = N.D.	
Infl - N.D.					
				→ Carbon 2A effl = N.D.	

Well #	Vac.			ppm	Valve
Line 1: 0.01	H₂O	Dp or		10	Scfm
Line 2: 0.015	H₂O	Dp or		10	Scfm
→ Carbon 1B effl = N.D.					
→ Carbon 2B effl = N.D.					

Facsimile Memo

To Terry Fox		No. of Pages 1	Today's Date
Company Ultramar Inc		From Chuck Parker	Time
FAX # 209-583-3282		Company WSES	
Comments		Location Bakersfield, CA	

SYSTEMS MONITORING DATA

Date: 1-22-97, Location: Edgemere, Field Technician: C. Parker
Station No: 604 (Beacon Site) Initial System Status: Up/Down, System Type: Carbon
Tot. Hrs: 1126, H_2O K/O: C (current) % Full, ~~stored~~ ~~# of Full Drums~~,
Pipe Size I.D.: 2 "

BEFORE ANY ADJUSTMENT:
INITIAL Dilution Valve Position: open, closed or ~~cracked~~, Flow Meter: _____ scfm
INITIAL Vac: 6.1 " Hg, Δp: 0.05 (before dilut.) " H_2O, Δp: ___ (after dilut.) " H_2O, Calc: 20 (before dilut.) scfm, Calc: ___ (after dilut.) scfm
INITIAL: Infl: _____ (before dilut.) ppm, Infl: _____ (after dilut.) ppm, Effl: _____ ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____
Initial Recirculation: open or ~~closed~~

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm
FINAL Vac: _____ " Hg, Δp: _____ (before dilut.) " H_2O, Δp: _____ (after dilut.) " H_2O, Calc: _____ (before dilut.) scfm, Calc: _____ (after dilut.) scfm
FINAL: Infl: _____ (before dilut.) ppm, Infl: _____ (after dilut.) ppm, Effl: _____ ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____
Final Recirculation: open or closed

Set Pt: _____, Chamber Temp: _____, Exit Temp: _____, Motor Amp Rating: _____
STACK: Temperature: _____ °F, Magnehelic: _____ " ____, Calc: _____ scfm, H_2O: _____ %
Field Instrument: Horiba, Last Monitoring: 1-10-97

Stacks = Dwg 12"Dia.

Well #	Vac.			ppm	Valve
3				N.D.	O
2				N.D.	O
6				H_2O	O
5				H_2O	C
4				N.D.	O
1				H_2O	C
7				N.D.	O

→ Infl. = N.D. → Carbon 1A effl. = N.D. → Carbon 1B effl. = N.D. ppmv
→ Carbon 2A effl. = N.D. → Carbon 2B effl. N.D. ppmv.

Well #	Vac.			ppm	Valve
Line 1 = 0.015 H_2O Dp or				10	Scfm
Line 2 = 0.015 H_2O Dp or				10	Scfm

FAX Transmittal Memo

To	Terry Fox	No. of Pages	1
Company	Ultramar Inc	Today's Date	
FAX #	209-583-3282	Time	
Comments		From	Chuck Parker
		Company	WSES
		Location	Bakersfield, CA

SYSTEMS MONITORING DATA

Date: 7-11-96, Location: Livermore, CA Field Technician: C. Parker

Station No: 604, Initial System Status: ~~Start~~/Down, System Type: Evax

Tot. Hrs: 28664, H_2O K/O: 0 (current) % Full, — (stored) # of Full Drums, No Storage

Pipe Size I.D.: 4 "

BEFORE ANY ADJUSTMENT: Temp 2100F

INITIAL Dilution Valve Position: ~~open~~, closed ~~or cracked~~ Flow Meter: _____ scfm

INITIAL Vac: 5.0 " Hg, Δp: 0.1 (before dilut.) " H_2O, Δp: — (after dilut.) " H_2O, Calc: 108 (before dilut.) scfm, Calc: — (after dilut.) scfm

INITIAL: Infl: 20 (before dilut.) ppm, Infl: — (after dilut.) ppm, Effl: 100 ? ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____

Initial Recirculation: ~~open or closed~~

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm

FINAL Vac: _____ " Hg, Δp: _____ (before dilut.) " H_2O, Δp: _____ (after dilut.) " H_2O, Calc: _____ (before dilut.) scfm, Calc: _____ (after dilut.) scfm

FINAL: Infl: _____ (before dilut.) ppm, Infl: _____ (after dilut.) ppm, Effl: _____ ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____

Final Recirculation: open or closed

Set Pt: _____, Chamber Temp: _____, Exit Temp: _____, Motor Amp Rating: _____

STACK: Temperature: _____ °F, Magnehelic: _____ " _____, Calc: _____ scfm, H_2O: _____ %

Field Instrument: Heritec, Last Monitoring: _____

Well #	Vac.			ppm	Valve
19				10	
18				30	
13				<10	
9				20	
6				<10	
2				<10	
1				<10	
14				220	
16				<10	
5				<10	
17				<10	
20				<10	
7				150	
8				<10	

Well #	Vac.			ppm	Valve
10				<10	
15				<10	
12				<10	
3				80	
4				<10	
11				<10	

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene		)				
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

FILENAME: AMSS
VERSION DATE: 04-09-92

FAX Transmittal Memo

To	Tom Fox	No. of Pages	1
Company	Ultramar Inc	Today's Date	7-24-96
Fax #	209-583-3282	From	Chuck Parker
Comments		Company	WSES
		Location	Bakersfield, CA

SYSTEMS MONITORING DATA

Date: 7-24-96 Location: Livermore, CA Field Technician: C. Parker
Station No: 604, Initial System Status: Up ~~Down~~ System Type: Evac
Tot. Hrs: * (Meter failed), H_2O K/O: 0 current % Full, ____ stored # of Full Drums, (Parking Lot Unit)
Pipe Size I.D.: 4"

BEFORE ANY ADJUSTMENT:
INITIAL Dilution Valve Position: ~~open~~, closed ~~or throttled~~ Flow Meter: ____ scfm
INITIAL Vac: 4.7 " Hg, Δp: 0.1 " H_2O before dilut., Δp: ____ " H_2O ~~after dilut.~~, Calc: 108 scfm before dilut., Calc: ____ scfm ~~after dilut.~~
INITIAL: Infl: 10 ppm before dilut., Infl: ____ ppm ~~after dilut.~~, Effl: N.D. ppm, CO_2 ____, H_2O ____ %, Motor Amps: ____
Initial Recirculation: ~~open or closed~~

FINAL Dilution Valve Position: ~~open~~, closed ~~or throttled~~ Flow Meter: ____ scfm
FINAL Vac: 6.9 " Hg, Δp: 0.3 " H_2O before dilut., Δp: ____ " H_2O ~~after dilut.~~, Calc: 190 scfm before dilut., Calc: ____ scfm ~~after dilut.~~
FINAL: Infl: 10 ppm before dilut., Infl: ____ ppm ~~after dilut.~~, Effl: N.D. ppm, CO_2 ____, H_2O ____ %, Motor Amps: ____
Final Recirculation: ~~open or closed~~

Set Pt: 700°F Chamber Temp: 700°F, Exit Temp: 640°F Motor Amp Rating: ____
STACK: Temperature: 540 °F, Magnehelic: 0.065 " ____, Calc: 350 scfm, H_2O: ____ %
Field Instrument: Moriba, Last Monitoring: 7-11-96 Stack Dia. = 8"

Well #	Vac.			ppm	Valve
19				<10	0
18				<10	
13				<10	
9				20	
6				<10	
2				<10	
1				<10	
14				<10	
16				<10	
5				<10	
17				10	
20				<10	
7				90	
8				<10	↓

Well #	Vac.			ppm	Valve
10				<10	0
15				<10	
12				<10	
3				30	
4				<10	
11				<10	↓

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene						
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

FILENAME: AMSS
VERSION DATE: 04-09-92

FAX Transmittal Memo	No. of Pages	Today's Date	Time
To Terry Ead	From Chuck Parker		
Company Ultramar Inc	Company WSES		
FAX # 209-583-3282	Location Bakersfield, CA		
Comments Blow check installed			

SYSTEMS MONITORING DATA

Date: 8-14-96 Location: Livermore, CA Field Technician: C. Parker
Station No: 604 Initial System Status: ~~Shut~~/Down, System Type: Event
Tot. Hrs: 10.0, H_2O K/O: 0 current % Full. ~~stored~~ # of ~~Full~~ Drums,
Pipe Size I.D.: 4 "

BEFORE ANY ADJUSTMENT:
INITIAL Dilution Valve Position: ~~open~~, closed ~~or cracked~~ Flow Meter: _____ scfm
INITIAL Vac: 5.7 " Hg. Δp: 0.25 " H_2O before dilut., Δp: — " H_2O ~~after dilut.~~, Calc: _____ scfm before dilut., Calc: — scfm ~~after dilut.~~
INITIAL: Infl: 10 ppm before dilut. Infl: — ppm ~~after dilut.~~ Effl: N.D. ppm CO_2 _____, H_2O _____ %, Motor Amps: _____
Initial Recirculation: open ~~or closed~~

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm
FINAL Vac: _____ " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: _____ scfm before dilut., Calc: _____ scfm after dilut.
FINAL: Infl: _____ ppm before dilut. Infl: _____ ppm after dilut. Effl: _____ ppm CO_2 _____, H_2O _____ %, Motor Amps: _____
Final Recirculation: open or closed

Set Pt: 700°F Chamber Temp: 708F, Exit Temp: _____, Motor Amp Rating: _____
STACK: Temperature: _____ °F, Magnehelic: _____ " _____, Calc: _____ scfm, H_2O: _____ %
Field Instrument: Horiba, Last Monitoring: 7-24-96 Stack Dia. = 8"

Well #	Vac.			ppm	Valve
19				20	O
18				10	
13				<10	
9				40	
6				<10	
2				<10	
1				<10	
14				80	
16				<10	
5				<10	
17				10	
20				<10	
7				20	
8				<10	

Well #	Vac.			ppm	Valve
10				<10	O
15				<10	
12				<10	
3				10	
4				<10	
11				<10	

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene						
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

FILENAME: AIRCS
VERSION DATE: 04-09-92

Facsimile Memo

To	Terry Fox	No. of Pages	1
Company	Ultramar Inc	Today's Date	11-18-96
FAX #	209-583-3282	From	Chuck Parker
Comments		Company	WSES
		Location	Bakersfield, CA

TO: 583 3282 P05

SYSTEMS MONITORING DATA

Date: 11-18-96 Location: Livermore, CA Field Technician: C. Parker

Station No: 604, Parking Lot Initial System Status: Up/Down, System Type: Carbon

Tot. Hrs: 6.0, H_2O K/O: 0 current % Full, ~~stored~~ # of Full Drums,

Pipe Size I.D.: Dual 2"

BEFORE ANY ADJUSTMENT:

INITIAL Dilution Valve Position: ~~open~~, closed or ~~cracked~~, Flow Meter: ____ scfm

INITIAL Vac: 5.6 " Hg, Δp: 1.8 " H_2O, Δp: ____ " H_2O, Calc: 74 scfm, Calc: ____ scfm

before dilut. after dilut. before dilut. after dilut.

INITIAL: Infl: 2: <10 ppm, Carb. Intl: 1A: ND ppm, Effl: 2A: ND ppm, CO_2 ____, H_2O ____ %, Motor Amps: ____

before dilut. after dilut. 2B: ND

Initial Recirculation: ~~open or closed~~

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: ____ scfm

FINAL Vac: ____ " Hg, Δp: ____ " H_2O, Δp: ____ " H_2O, Calc: ____ scfm, Calc: ____ scfm

before dilut. after dilut. before dilut. after dilut.

FINAL: Infl: ____ ppm, Infl: ____ ppm, Effl: ____ ppm, CO_2 ____, H_2O ____ %, Motor Amps: ____

before dilut. after dilut.

Final Recirculation: ~~open or closed~~

Set Pt: ____, Chamber Temp: ____, Exit Temp: ____, Motor Amp Rating: ____

STACK: Temperature: ____ °F, Magnehelic: 0.7 ", Calc: 74 scfm, Total: 148 #

Field Instrument: Haribs, Last Monitoring: ____ 74

Stacks = 2" Dia.

Well #	Vac.	ppm	Valve
19		<10	0
18		10	
13		<10	
9		10	
6		<10	
2		<10	
1		<10	
14		<10	
16		<10	
5		<10	
17		10	
20		<10	
7		<10	
8		<10	

Well #	Vac.	ppm	Valve
10		10	0
15		<10	
12		<10	
3		140	
4		<10	
11		<10	

#1 Train = Infl → Carbon 1A → Carbon 1B

#2 Train = Infl → Carbon 2A → Carbon 2B

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene						
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

FILENAME: AIRSS
VERSION DATE: 04-09-92

FAX Transmittal Memo

To: Terry Fax		No. of Pages: 1	Today's Date: 11-19-96 Time:
Company: Ultramar Inc		From: Chuck Parker	
FAX #: 209-583-3282		Company: WSES	
Comments:		Location: Bakersfield, CA	

SYSTEMS MONITORING DATA

Date: 11-19-96, Location: Livermore, CA, Field Technician: C. Parker
Station No: 604, Parking Lot, Initial System Status: Up/~~Down~~, System Type: Carbon
Tot. Hrs: 27, H_2O K/O: 0 current % Full, ~~# of Full Drums, stored~~
Pipe Size I.D.: Dual 2"

BEFORE ANY ADJUSTMENT:
INITIAL Dilution Valve Position: ~~open~~, closed ~~or cracked~~, Flow Meter: _____ scfm
INITIAL Vac: 5.2 " Hg, Δp: 20.5 " H_2O before dilut., Δp: ____ " H_2O after dilut., Calc: 1.74 scfm before dilut., Calc: ____ scfm after dilut.
INITIAL: Infl: _____ ppm before dilut., Infl: ~~_____~~ ppm after dilut., Effl: _____ ppm, ~~CO_2 _____~~, ~~H_2O _____~~ %, ~~Motor Amps:~~ _____
Initial Recirculation: ~~open or closed~~

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm
FINAL Vac: _____ " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: _____ scfm before dilut., Calc: _____ scfm after dilut.
FINAL: Infl: _____ ppm before dilut., Infl: _____ ppm after dilut., Effl: _____ ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____
Final Recirculation: open or closed

Set Pt: _____, ~~Chamber Temp:~~ _____, ~~Exit Temp:~~ _____, ~~Motor Amp Rating~~
STACK: Temperature: _____ °F, Magnehelic: Line 1 0.7 " Line 2 0.7 " Calc: Line 1 74 scfm, Line 2 74 scfm, ~~H_2O~~: 148 scfm
Field Instrument: Horiba, Last Monitoring: 11-18-96

Stacks = 2 x 2" Dia

Well #	Vac.			ppm	Valve
19				<10	0
18				40	1
13				<10	
9				30	
6				<10	
2				10	
1				<10	
14				10	
16				160	
5				10	
17				30	
20				30	
7				<10	
8				<10	

Well #	Vac.			ppm	Valve
10				<10	0
15				10	
12				10	
3				30	
4				<10	
11				<10	
Line 1 Infl. 10 ppm → Carbon 1A = N.D.					
→ Carbon 1B effl. = N.D.					
Line 2 Infl. 10 ppm → Carbon 1A = N.D.					
→ Carbon 2B effl. = N.D.					

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene		)				
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

FILENAME: AIRSS
VERSION DATE: 04-09-92

FAX Transmittal Memo

To	Leroy Fox	TO: 583 3282	P02
Company	Ultramar Inc	No. of Pages / Today's Date / Time	
FAX #	209-583-3282	From	Chuck Parker
Comments	N.D. 2 None Detected (<10ppmv)	Company	WSES
		Location	Bakersfield, CA

SYSTEMS MONITORING DATA

Date: 11-20-96 Location: Livermore, CA Field Technician: C. Parker
Station No: 6604, Parking Lot Initial System Status: Up/~~Down~~ System Type: Carbon
Tot. Hrs: 53, H_2O K/O: ~~0~~ current % Full, ~~stored~~ # ~~of Full Drums~~,
Pipe Size I.D.: Duel 2"

BEFORE ANY ADJUSTMENT:
INITIAL Dilution Valve Position: ~~open~~, closed ~~or cracked~~, Flow Meter: _____ scfm
INITIAL Vac: 5.7 " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: _____ scfm before dilut., Calc: _____ scfm after dilut.
INITIAL: Infl: _____ ppm before dilut., Infl: _____ ppm after dilut., Effl: _____ ppm CO_2 _____, H_2O _____ %, Motor Amps: _____
Initial Recirculation: open or closed

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm
FINAL Vac: _____ " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: _____ scfm before dilut., Calc: _____ scfm after dilut.
FINAL: Infl: _____ ppm before dilut., Infl: _____ ppm after dilut., Effl: _____ ppm CO_2 _____, H_2O _____ %, Motor Amps: _____
Final Recirculation: open or closed

~~Set Pt.~~ _____, ~~Chamber Temp.~~: _____, ~~Exit Temp.~~: _____, Motor Amp Rating: _____
STACK: Temperature: _____ °F, Magnehelic: _____, Calc: _____ scfm, H_2O: _____ %
Field Instrument: Horiba, Last Monitoring: 11-19-96

Well #	Vac.			ppm	Valve
19				<10	0
18				20	
13				<10	
9				<10	
6				<10	
2				<10	
1				<10	
14				<10	
16				<10	
5				<10	
17				10	
20				<10	
7				<10	
8				<10	✓

Well #	Vac.			ppm	Valve
10				<10	0
15				<10	
12				<10	
3				<10	
4				<10	
11				<10	✓
Line 1 = 0.6 Hg" or 68 scfm					
Line 2 = 0.7" Hg or 66 scfm					
~~Effl~~ Temp prior to carbons					35
~~Line 2~~					178°F

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene		✓				
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

#1 Line = Infl = N.D. → Carbon 1A effl. = N.D. Carbon 1B effl. = N.D. ppmv
#2 Line = Infl = N.D. → Carbon 2A effl. = N.D. → Carbon 2B effl. = N.D. ppmv

FILENAME: AWSS
VERSION DATE: 04-09-92

Fax Transmittal Memo

To	Terry Fox	No. of Pages	1
Company	Ultramar Inc	Today's Date	
Fax #	209-583-3282	Time	
Comments	N.D. = None Detected (<10 ppm	From	Chuck Parker
		Company	WSES
		Location	Bakersfield, CA

Note: Two Horiba Instruments were used for Hydrocarbon measurements. Readings from both instruments were approximately the same.

SYSTEMS MONITORING DATA

Date: 11-21-96, Location: Livermore, CA, Field Technician: C. Parker
Station No: 664, Parking lot, Initial System Status: Up, System Type: Carbon
Tot. Hrs: 75, H_2O K/O: 0 current % Full, stored # of Full Drums,
Pipe Size I.D.: Dual 2"

BEFORE ANY ADJUSTMENT:
INITIAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm
INITIAL Vac: 56 " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: _____ scfm before dilut., Calc: _____ scfm after dilut.
INITIAL: Infl: _____ ppm before dilut., Infl: _____ ppm after dilut., Effl: _____ ppm CO_2 _____, H_2O _____ %, Motor Amps: _____
Initial Recirculation: open or closed

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm
FINAL Vac: _____ " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: _____ scfm before dilut., Calc: _____ scfm after dilut.
FINAL: Infl: _____ ppm before dilut., Infl: _____ ppm after dilut., Effl: _____ ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____
Final Recirculation: open or closed

Set Pt: _____, Chamber Temp: _____ Exit Temp: _____, Motor Amp Rating: _____
STACK: Temperature: _____ °F, Magnehelic: _____ " _____, Calc: _____ scfm, H_2O: _____ %
Field Instrument: Horiba Last Monitoring: 11-20-96

Stacks = 2 x 2" Dia.

Well #	Vac.			ppm	Valve
19				<10	O
18				<10	
13				<10	
9				<10	
6				<10	
2				<10	
1				<10	
14				<10	
16				<10	
5				<10	
17				<10	
20				<10	
7				<10	
8				<10	

Well #	Vac.			ppm	Valve
10				<10	C
15				<10	
12				<10	
3				<10	
4				<10	
11				<10	
#1 Line	0.7	" H_2O	on	74 scfm	
#2 Line	0.7	" H_2O	on	74 scfm	
Temperature Carbons = 170°F					

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene						
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

#1 Line - Infl. = N.D. → Carbon 1A = N.D. → Carbon 1B = N.D. ppmv
#2 Line - Infl. = N.D. → Carbon 2A = N.D. → Carbon 2B = N.D. ppmv

VERSION FILENAME: AWESS DATE: 04-03-92

Fax Transmittal Memo

To	Tom Fax	No. of Pages	1
Company	Ultramar Inc	From	Chuck Parker
FAX #	209-583-3282	Company	WSES
Comments	N.D. = None detected (<10 ppmv)	Location	Bakersfield, CA

TO: 583 3282 P04

SYSTEMS MONITORING DATA

Date: 11-22-96 Location: Livermore, CA Field Technician: C. Parker

Station No: 604, Parkson Lot Initial System Status: Up Down System Type: Carbon

Tot. Hrs: 99, H_2O K/O: 0 current % Full. ~~stored~~ ~~# of Full Drums~~

Pipe Size I.D.: Dual 2"

BEFORE ANY ADJUSTMENT:

INITIAL Dilution Valve Position: open, closed or ~~cracked~~, Flow Meter: _____ scfm

INITIAL Vac: 5.6 " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: _____ scfm before dilut., Calc: _____ scfm after dilut.

INITIAL: Infl: _____ ppm before dilut., Infl: _____ ppm after dilut., Effl: _____ ppm, CO_2 _____, H_2O _____ %, Meter Amps: _____

Initial Recirculation: open or closed

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm

FINAL Vac: _____ " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: _____ scfm before dilut., Calc: _____ scfm after dilut.

FINAL: Infl: _____ ppm before dilut., Infl: _____ ppm after dilut., Effl: _____ ppm, CO_2 _____, H_2O _____ %, Meter Amps: _____

Final Recirculation: open or closed

Set Pt: _____, Chamber Temp: _____, Exit Temp: _____, Meter Amp Rating: _____

STACK: Temperature: _____ °F, Magnehelic: _____ " _____, Calc: _____ scfm, H_2O: _____ %

Field Instrument: Horiba Last Monitoring: 11-21-96

Stacks = 2x2" ID.

Well #	Vac.			ppm	Valve
19				<10	0
18				<10	
13				<10	
9				<10	
6				<10	
2				<10	
1				<10	
14				<10	
16				<10	
5				<10	
17				<10	
20				<10	
7				<10	
8				<10	

Well #	Vac.			ppm	Valve
10				<10	0
15				<10	
12				<10	
3				<10	
4				<10	
11				<10	

Line 1 - 0.7 "H_2O on 74 scfm

Line 2 - 0.65 "H_2O on 72 scfm

Temp. upstream carbons = 166° F

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene						
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

Line 1 - Infl. = N.D. → Carbon 1A effl. = N.D. - Carbon 1B effl. = N.D. ppmv

Line 2 - Infl. = N.D. → Carbon 2A effl. = N.D. - Carbon 2B effl. = N.D. ppmv

FAX Transmittal Memo

To	Terry Fox	No. of Pages	1
Company	Ultramar Inc	Today's Date	
FAX #	209-583-3282	Time	
From	Chuck Parker		
Company	WSES		
Location	Bakersfield, CA		

Comments: N.D. = None Detected

SYSTEMS MONITORING DATA

Date: 12-10-96 Location: Lathrop, CA Field Technician: C. Parker
Station No: 664, Parking Lot SW Initial System Status: Up ~~Down~~, System Type: Carbon
Tot. Hrs: 120, H_2O K/O: 0 current % Full, ~~# of Full Drums stored~~ Pipe Size I.D.: 04 1/2"

BEFORE ANY ADJUSTMENT:
INITIAL Dilution Valve Position: ~~open~~, closed ~~or cracked~~ Flow Meter: _____ scfm
INITIAL Vac: 5.9 " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O ~~after dilut.~~, Calc: _____ scfm before dilut., ~~Calc: _____ scfm after dilut.~~
INITIAL: Infl: _____ ppm before dilut., ~~Infl: _____ ppm after dilut.~~, Effl: N.D. ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____
Initial Recirculation: ~~open or closed~~

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm
FINAL Vac: _____ " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: _____ scfm before dilut., Calc: _____ scfm after dilut.
FINAL: Infl: _____ ppm before dilut., Infl: _____ ppm after dilut., Effl: _____ ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____
Final Recirculation: open or closed

Set Pt: _____, Chamber Temp: _____, Exit Temp: _____, Motor Amp Rating: _____
STACK: Temperature: _____ °F, Magnehelic: _____ " _____, Calc: _____ scfm, H_2O: _____ %
Field Instrument: Horiba, Last Monitoring: 11-22-96

Well #	Vac.			ppm	Valve
19				<10	0
18				<10	
13				<10	
9				<10	
6				<10	
2				<10	
1				<10	
14				<10	
16				<10	
5				<10	
17				<10	
20				<10	
7				<10	
8				<10	

Well #	Vac.			ppm	Valve
10				<10	0
15				<10	
12				<10	
3				<10	
4				<10	
1				<10	
Line 1 - 0.7"H2O Δp on 74 Scfm					
Line 2 - 0.7"H2O Δp on 74 Scfm					
Temp. upstream carbons = 168°F					

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene						
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

Line 1 - Inf. = N.D. → Carbon 1A effl. = N.D. → Carbon 1B effl. = ND.
Line 2 - Inf. = N.D. → Carbon 2A effl. = N.D. → Carbon 2B effl. = N.D. ppmv

FILENAME: ANESS VERSION DATE: 04-09-92

Transmittal Memo

To: Terry Fox	No. of Pages: 1	Today's Date:	Time:
Company: Ultramar Inc	From: Chuck Parker		
FAX #: 209-583-3282	Company: WSES		
Comments: N.D. = None Detected (<1 ppmv)	Location: Bakersfield, CA		

TO: 583 3282 P02

SYSTEMS MONITORING DATA

Date: 12-19-96, Location: Livermore, CA, Field Technician: C. Parker
Station No: Ext, Parking Lot 5th, Initial System Status: Up ~~Down~~, System Type: Carbon
Tot. Hrs: 335, H_2O K/O: 50 % Full, ~~# of Full Drums stored~~,
(current 25%)
Pipe Size I.D.: Dual 2"

BEFORE ANY ADJUSTMENT:
INITIAL Dilution Valve Position: ~~open~~, closed ~~or cracked~~, Flow Meter: _____ scfm
INITIAL Vac: 5.7 " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: _____ scfm before dilut., Calc _____ scfm after dilut.
INITIAL: Infl: N.D. ppm before dilut., Infl: _____ ppm after dilut., Effl: N.D. ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____
Initial Recirculation: open ~~or cracked~~

FINAL Dilution Valve Position: open, closed or cracked, Flow Meter: _____ scfm
FINAL Vac: _____ " Hg, Δp: _____ " H_2O before dilut., Δp: _____ " H_2O after dilut., Calc: _____ scfm before dilut., Calc: _____ scfm after dilut.
FINAL: Infl: _____ ppm before dilut., Infl: _____ ppm after dilut., Effl: _____ ppm, CO_2 _____, H_2O _____ %, Motor Amps: _____
Final Recirculation: open or closed

Set Pt: _____, Chamber Temp: _____, Exit Temp: _____, Motor Amp Rating: _____
STACK: Temperature: _____ °F, Magnehelic: _____ " _____, Calc: _____ scfm, H_2O: _____ %
Field Instrument: Horiba, Last Monitoring: 12-16-96

Stacks: Dual 2" Dia

Well #	Vac.			ppm	Valve
19				H_2O	O
18				↓	↓
13				↓	
9				↓	
6				<10	
2				↓	
1				↓	
14				H_2O	
16				↓	
5				↓	
17				<10	
20				↓	
7				↓	
8				↓	↓

Well #	Vac.			ppm	Valve
10				H_2O	O
15				↓	↓
12				↓	
3				<10	
4				↓	
1				↓	↓

Line 1 - 0.7" H_2O Dp or 74 scfm
Line 2 - 0.7" H_2O Dp or 74 scfm

Temp upstream carbons = 140°

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
Benzene						
TPHg						

	Influent	Effluent	Date Analyzed	Det. Limit	Lab	Factor
CH_4						
C_3H_8						

Line 1 - Inf: N.D. → Carbon 1A effl. = N.D. → Carbon 1B effl. = N.D. ppm
Line 2 - Inf: N.D. → Carbon 1A effl. = N.D. → Carbon 2B effl. = N.D. ppm

FILENAME: AIRES VERSION DATE: 04-09-92

FAX Transmittal Memo		No. of Pages 1	Today's Date	Time
To Terry Fox		From Chuck Parker		
Company Ultramar Inc		Company USES		
FAX # 209-583-3282		Location Bakersfield, CA		
Comments (1) shut in during last survey due to H_2O.				

SYSTEMS MONITORING DATA

Date: 1-22-97 Location: Livermore, CA Field Technician: C. Parker
Station No: 604, parking Site Initial System Status: Up/Down, System Type: Carbon
Tot. Hrs: 858, H_2O ~~Kill~~: ~20 ~~gals~~ ~~% Full~~, ~~0~~ ~~# of Full Drums~~, Pipe Size I.D.: Dual 2"
(current) (stored)
Capacity 250

BEFORE ANY ADJUSTMENT:
INITIAL Dilution Valve Position: ~~open~~, closed ~~or cracked~~, Flow Meter: _____ scfm
INITIAL Vac: 5.8 " Hg, Δp: _____ " H_2O (before dilut.), Δp: _____ " H_2O (after dilut.), Calc: _____ scfm (before dilut.) ~~Calc: _____ scfm (after dilut.)~~
INITIAL: Infl: _____ ppm (before dilut.) Infl: ~~_____ ppm~~ (after dilut.) Effl: _____ ppm CO_2 _____, H_2O _____ %, Motor Amps: _____
Initial Recirculation: ~~open or closed~~

FINAL Dilution Valve Position: open, closed or cracked, **Flow Meter:** _____ scfm
FINAL Vac: _____ " Hg, **Δp:** _____ " H_2O (before dilut.), **Δp:** _____ " H_2O (after dilut.), **Calc:** _____ scfm (before dilut.), **Calc:** _____ scfm (after dilut.)
FINAL: Infl: _____ ppm (before dilut.), Infl: _____ ppm (after dilut.), Effl: _____ ppm, CO_2 _____, H_2O _____ %, **Motor Amps:** _____
Final Recirculation: open or closed

Set Pt: _____, Chamber Temp: _____, Exit Temp: _____, Motor Amp Rating: _____
STACK: Temperature: _____ °F, Magnehelic: _____ ", Calc: _____ scfm, H_2O: _____ %
Field Instrument: Horiba, Last Monitoring: 12-19-96
Stacks = Dual 2" Dia.

Well #	Vac.			ppm	Valve
19				(1)	
18				(1)	
13				(1)	
9				(1)	
6				N.D.	0
2				H_2O	0
1				N.D.	0
14				(1)	
16				(1)	
5				(1)	
17				N.D.	0
20				H_2O	0
7				N.D.	0
8				N.D.	0
10				(1)	
15				(1)	
12				(1)	
3				N.D.	0

Well #	Vac.			ppm	Valve
4				N.D.	0
1				N.D.	0
Line 1 - 0.025 H_2O Δp or ~15					scfm
Line 2 - 0.025 H_2O Δp or ~15					scfm

Line 1 - Inf = N.D. → Carbon 1A eff. N.D. → Carbon 1B eff. = N.D. ppmv
Line 2 - Inf. = N.D → Carbon 2A eff. N.D → Carbon 2B eff. = N.D. ppmv

Appendix B

Analytical Data for Groundwater Grab Samples at Livermore Arcade Shopping Center

APPENDIX B. ANALYTICAL DATA FOR GROUNDWATER GRAB SAMPLES AT LIVERMORE ARCADE SHOPPING CENTER

WEST LABORATORY

March 18, 1997
Sample Log 16539

Leon Crain
GCL- Environmental Science & Engineering
11501 Dublin Blvd., Suite 200
Dublin, CA 94568

Subject: Analytical Results for 7 Water Samples
Identified as: Safeway
Received: 03/10/97

Dear Mr. Crain:

Analysis of the sample(s) referenced above has been completed. This report is written to confirm results communicated on March 18, 1997 and describes procedures used to analyze the samples.

Sample(s) were analyzed using the following method(s):

"BTEX" (EPA Method 602/Purge-and-Trap)
"TPH as Gasoline" (Modified EPA Method 8015/Purge-and-Trap)

Please refer to the following table(s) for summarized analytical results and contact us at 916-753-9500 if you have questions regarding procedures or results. The chain-of-custody document is enclosed.

Approved by:

Stewart Podolsky
Senior Chemist

WEST LABORATORY

Sample Log 16539

MTBE (Methyl-t-butyl ether) By EPA Method 8020/602

From : Safeway
Sampled : 03/07/97
Received : 03/10/97
Matrix : Water

SAMPLE	(MRL) ug/L	Measured Value ug/L
VW-1	(5.0)	<5.0
VW-5	(5.0)	<5.0
VW-7	(5.0)	<5.0
VW-8	(5.0)	<5.0
VW-10	(5.0)	<5.0
VW-13	(5.0)	<5.0
MW-23	(5.0)	<5.0

Approved By:

D. Poddlsky

Stewart Poddlsky
Senior Chemist

WEST LABORATORY

Sample Log 16539

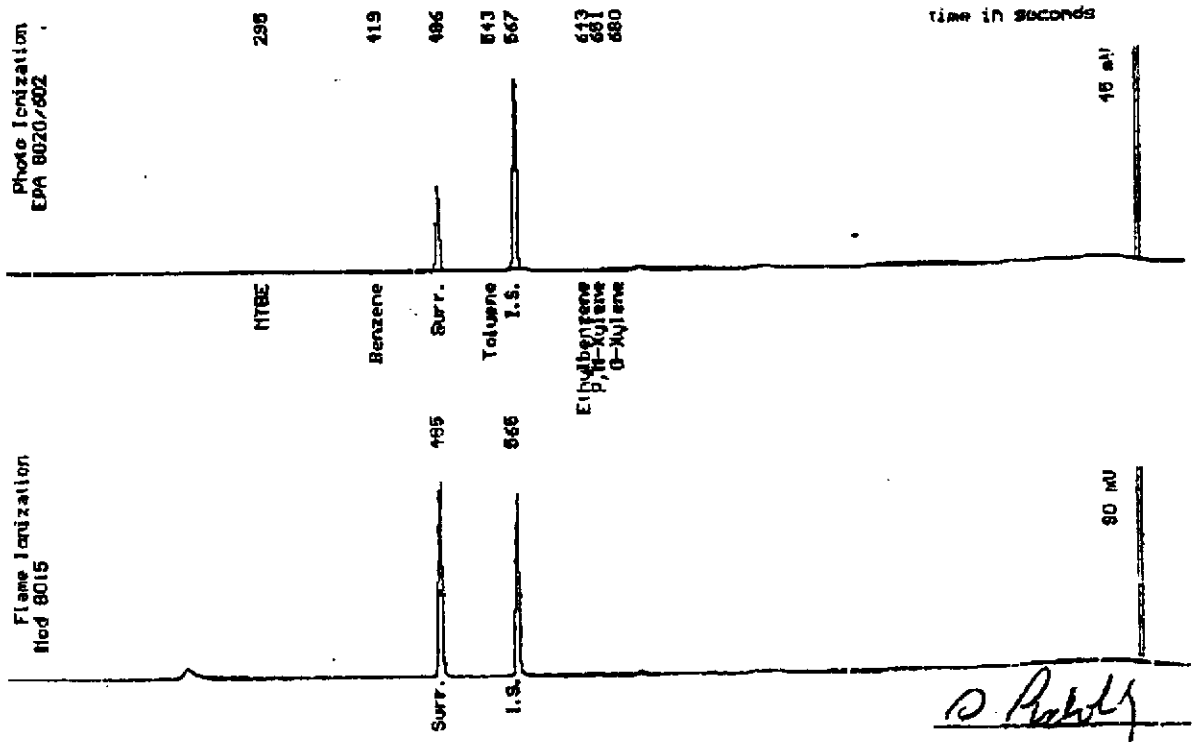
16539-01

Sample: VW-1

From : Safeway
Sampled : 03/07/97
Dilution : 1:1
Matrix : Water

QC Batch : 6183J

Parameter	(MRL) ug/L	Measured Value ug/L
Benzene	(.50)	<.50
Toluene	(.50)	<.50
Ethylbenzene	(.50)	<.50
Total Xylenes	(.50)	<.50
TPH as Gasoline	(50)	<50
Surrogate Recovery		92 %



Date Analyzed: 03-14-97
Column : 0.53mm ID X 60m Restek Rtx-1701

Joel Kiff
Senior Chemist

WEST LABORATORY

Sample Log 16539

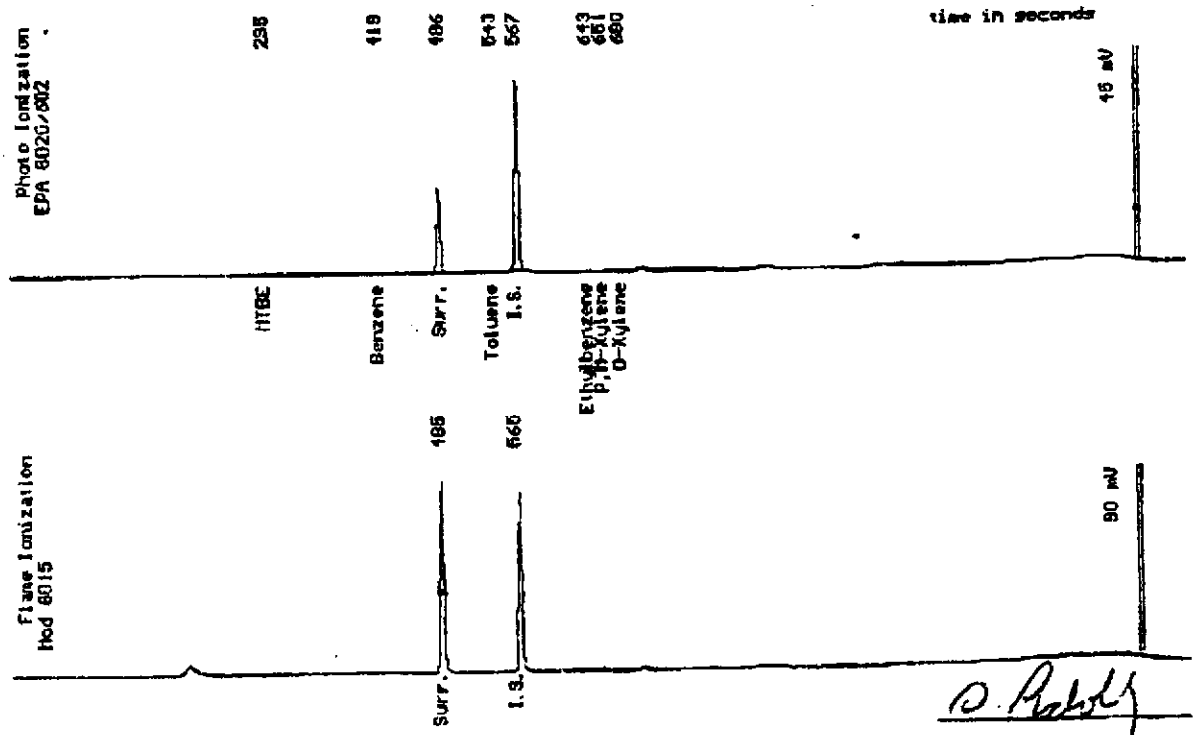
16539-01

Sample: VW-1

From : Safeway
Sampled : 03/07/97
Dilution : 1:1
Matrix : Water

QC Batch : 6183J

Parameter	(MRL) ug/L	Measured Value ug/L
Benzene	(.50)	<.50
Toluene	(.50)	<.50
Ethylbenzene	(.50)	<.50
Total Xylenes	(.50)	<.50
TPH as Gasoline	(50)	<50
Surrogate Recovery		92 %



Date Analyzed: 03-14-97
Column : 0.53mm ID X 60m Restek Rtx-1701

Joel Kiff
Senior Chemist

WEST LABORATORY

Sample Log 16539

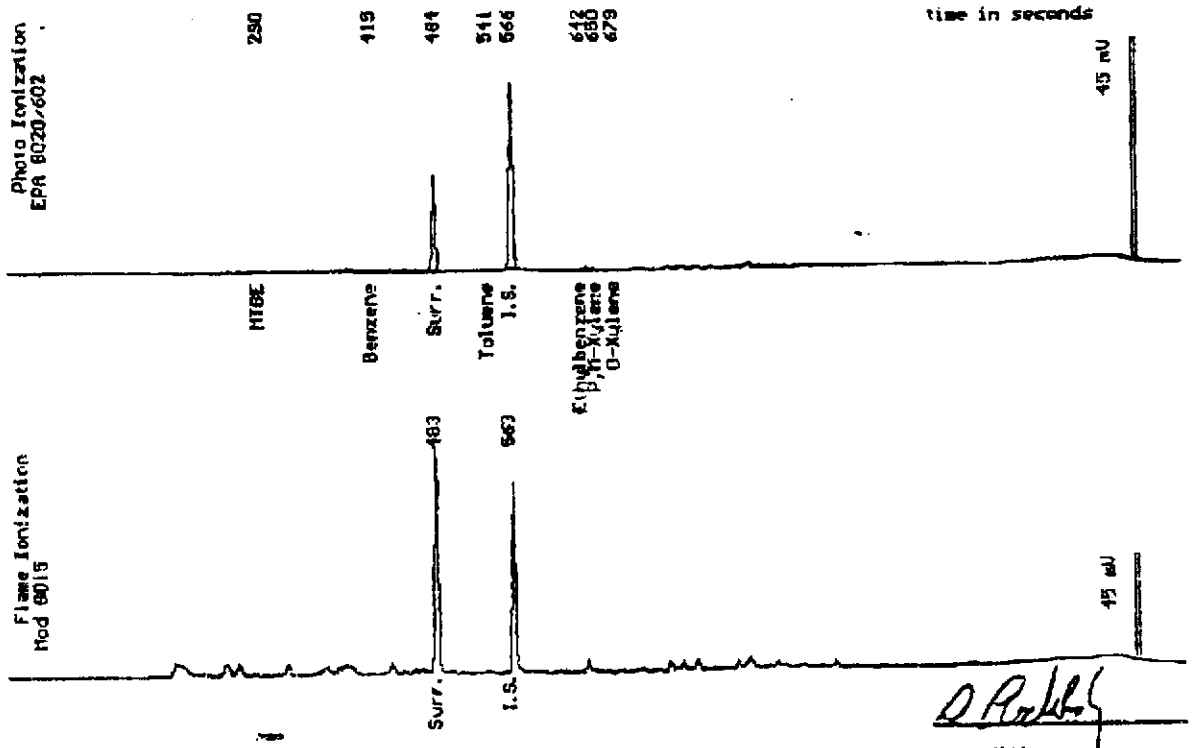
16539-02

Sample: VW-5

From : Safeway
Sampled : 03/07/97
Dilution : 1:1
Matrix : Water

QC Batch : 6183K

Parameter	(MRL) ug/L	Measured Value ug/L
Benzene	(.50)	<.50
Toluene	(.50)	<.50
Ethylbenzene	(.50)	<.50
Total Xylenes	(.50)	<.50
TPH as Gasoline	(50)	<50
Surrogate Recovery		93 %



Date Analyzed: 02-17-97
Column : 0.53mm ID X 60m Restek Rtx-1701

Joel Kiff
Senior Chemist

WEST LABORATORY

Sample Log 16539

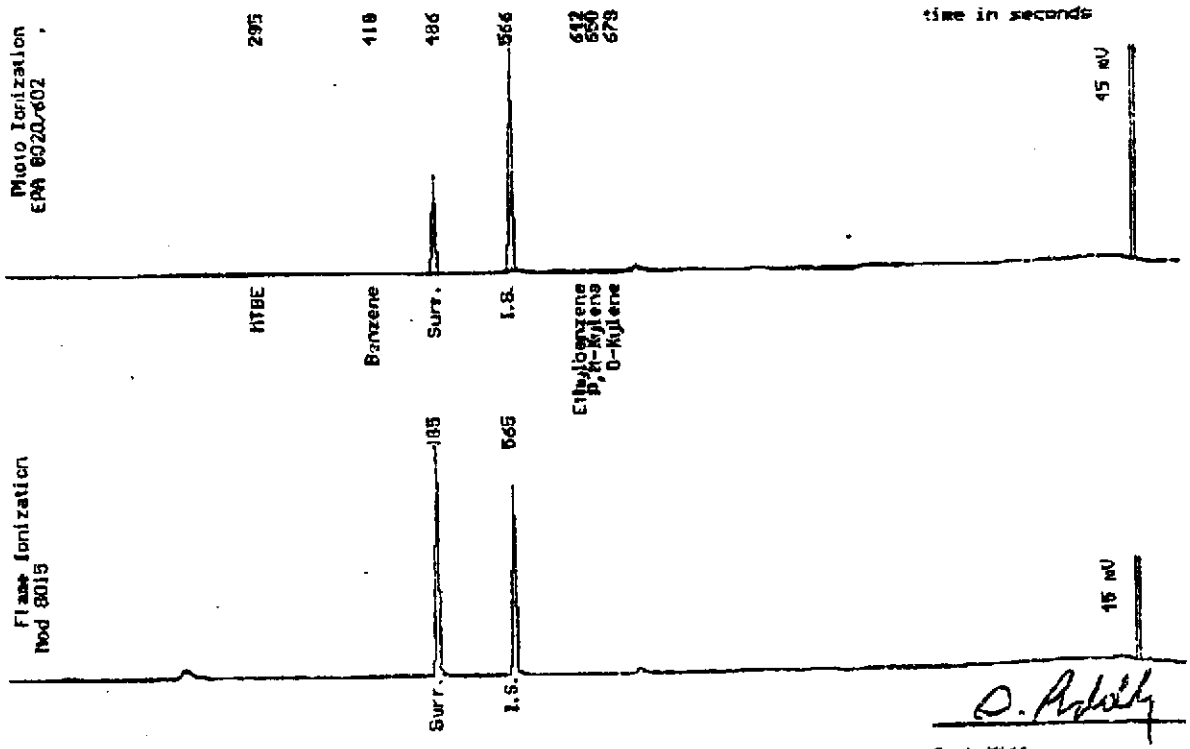
16539-03

Sample: VW-7

From : Safeway
Sampled : 03/07/97
Dilution : 1:1
Matrix : Water

QC Batch : 6183J

Parameter	(MRL) ug/L	Measured Value ug/L
Benzene	(.50)	<.50
Toluene	(.50)	<.50
Ethylbenzene	(.50)	<.50
Total Xylenes	(.50)	<.50
TPH as Gasoline	(50)	<50
Surrogate Recovery		94 %



Date Analyzed: 03-14-97
Column : 0.53mm ID X 60m Restek Rtx-1701

Joel Kiff
Senior Chemist

WEST LABORATORY

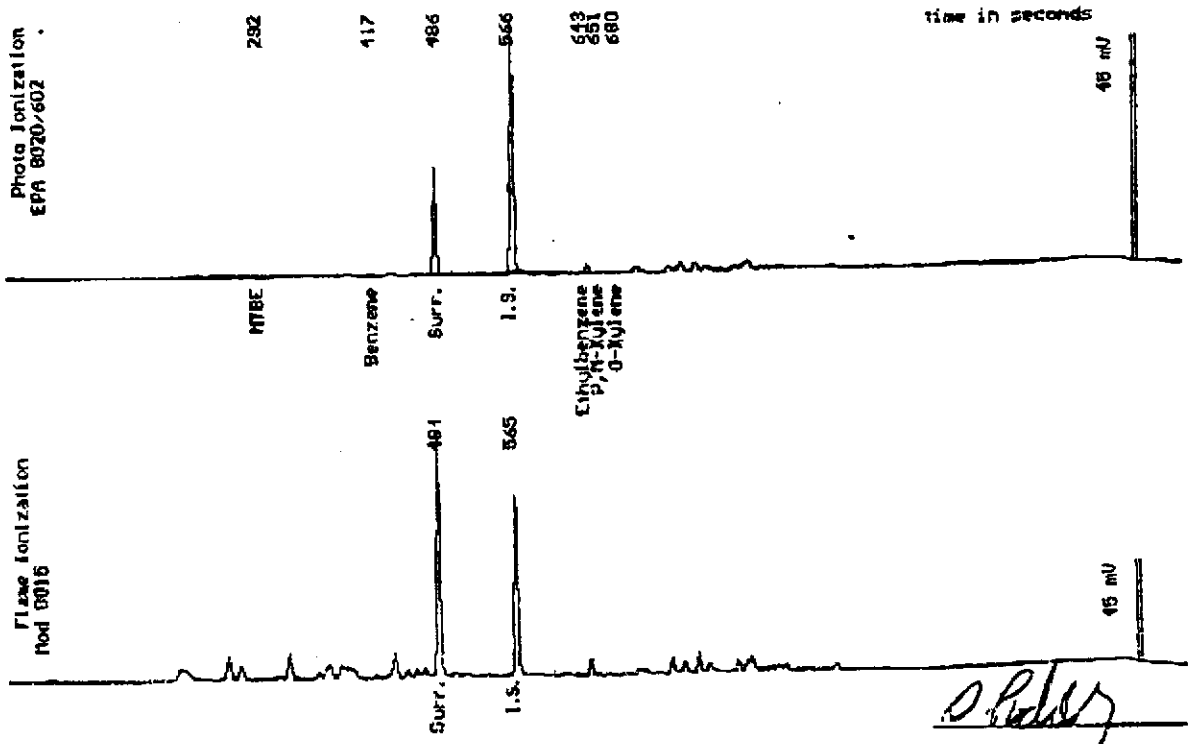
Sample Log 16539
16539-06

Sample: VW-13

From : Safeway
Sampled : 03/07/97
Dilution : 1:1
Matrix : Water

QC Batch : 6183J

Parameter	(MRL) ug/L	Measured Value ug/L
Benzene	(.50)	<.50
Toluene	(.50)	<.50
Ethylbenzene	(.50)	.73
Total Xylenes	(.50)	<.50
TPH as Gasoline	(50)	<50
Surrogate Recovery		93 %



Date Analyzed: 03-14-97
Column : 0.53mm ID X 60m Restek Rtx-1701

Joel Kiff
Senior Chemist

WEST LABORATORY

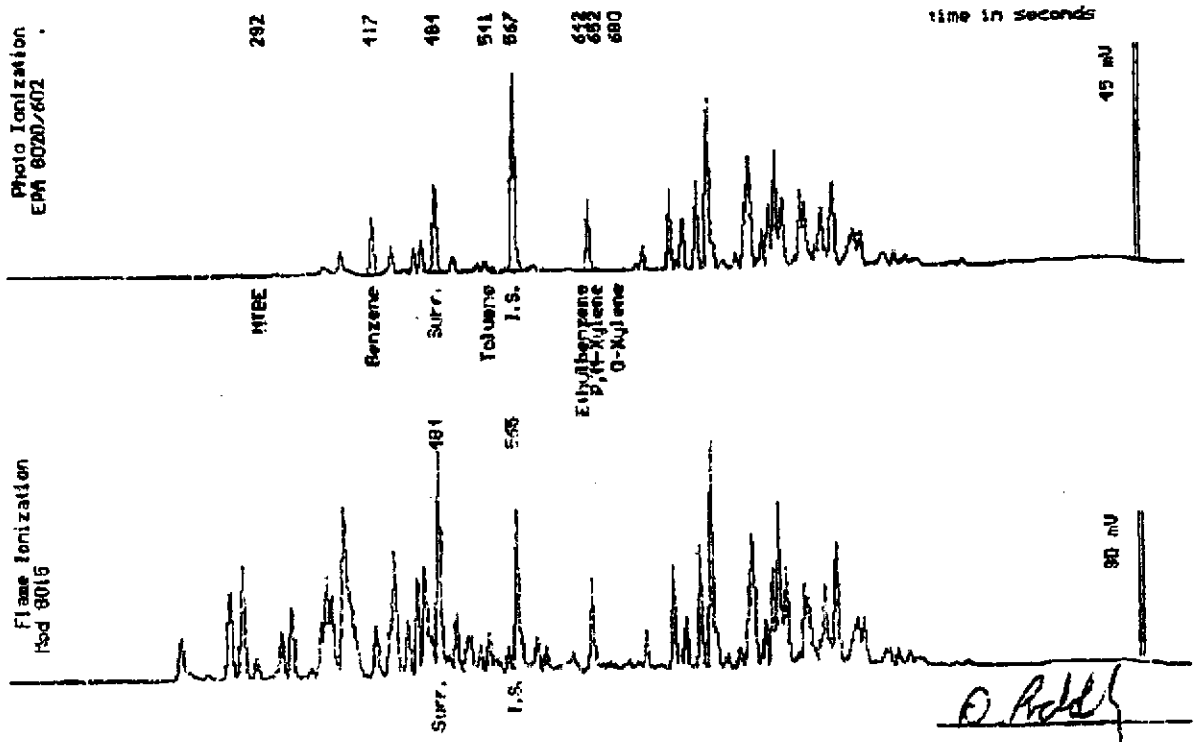
Sample Log 16539
16539-05

Sample: VW-10

From : Safeway
Sampled : 03/07/97
Dilution : 1:1
Matrix : Water

QC Batch : 6183J

Parameter	(MRL) ug/L	Measured Value ug/L
Benzene	(.50)	5.1
Toluene	(.50)	<.50
Ethylbenzene	(.50)	6.8
Total Xylenes	(.50)	<.50
TPH as Gasoline	(50)	440
Surrogate Recovery		104 %



Date Analyzed 03-14-97
Column : 0.53mm ID X 60m Restek Rtx-1701

Joel Kiff
Senior Chemist

WEST LABORATORY

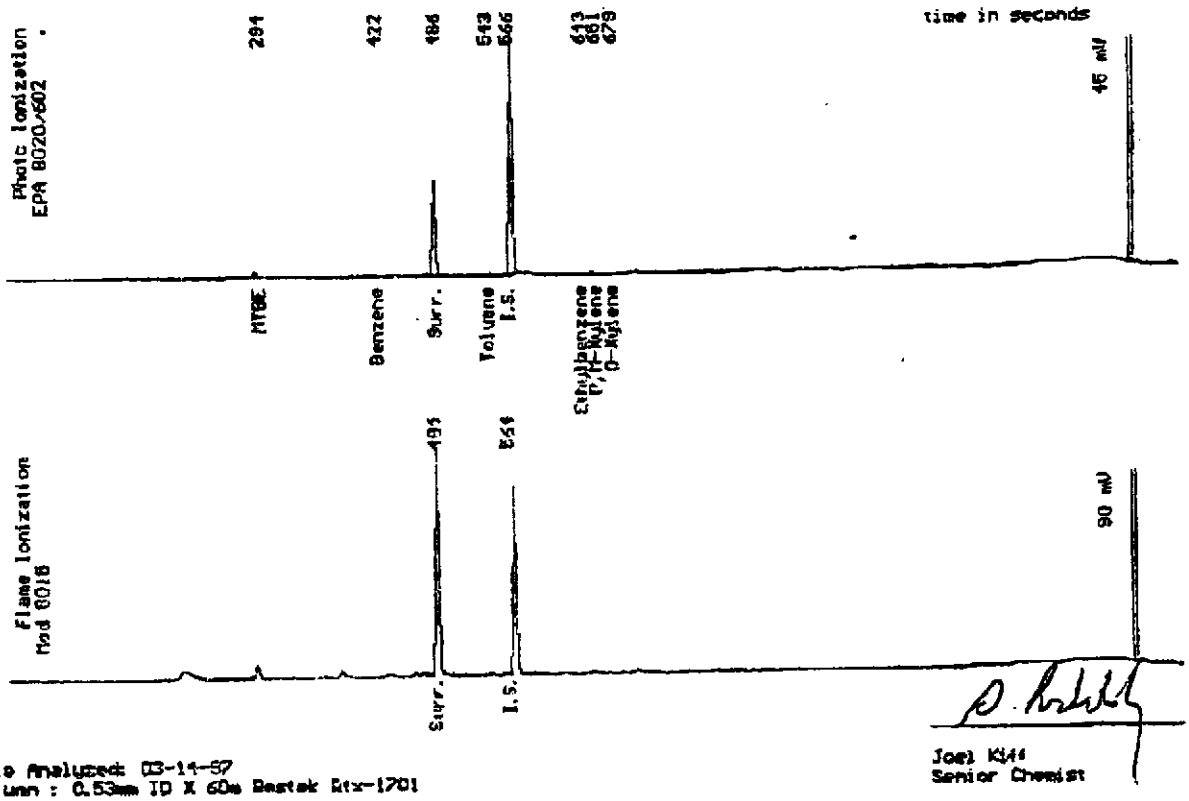
Sample Log 16539
16539-04

Sample: VW-8

From : Safeway
Sampled : 03/07/97
Dilution : 1:1
Matrix : Water

QC Batch : 6183J

Parameter	(MRL) ug/L	Measured Value ug/L
Benzene	(.50)	<.50
Toluene	(.50)	<.50
Ethylbenzene	(.50)	<.50
Total Xylenes	(.50)	<.50
TPH as Gasoline	(50)	<50
Surrogate Recovery		93 %



Date Analyzed: 03-14-97
Column : 0.53mm ID X 60m Restek Rtx-1701

Joel Kiff
Senior Chemist

WEST LABORATORY

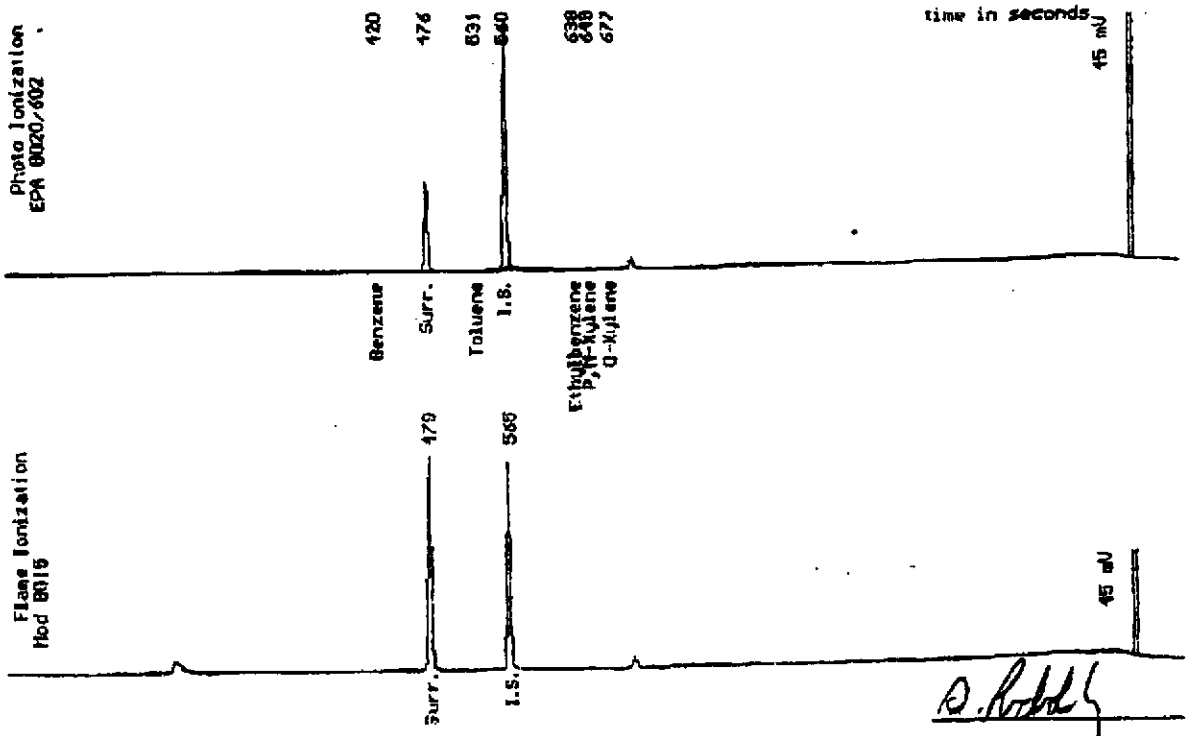
Sample Log 16539
16539-07

Sample: MW-23

From : Safeway
Sampled : 03/07/97
Dilution : 1:1
Matrix : Water

QC Batch : 6183J

Parameter	(MRL) ug/L	Measured Value ug/L
Benzene	(.50)	<.50
Toluene	(.50)	<.50
Ethylbenzene	(.50)	<.50
Total Xylenes	(.50)	<.50
TPH as Gasoline	(50)	<50
Surrogate Recovery		90 %



Date Analyzed: 03-14-97
Column : 0.53mm ID X 60m Restek Rtx-1701

Joel Kiff
Senior Chemist

Ultramar Inc.
CHAIN OF CUSTODY REPORT

BEACON

Beacon Station No.	Sampler (Print Name)	ANALYSES	Date	Form No.
Safeway	Hal Hansen		3-7-97	1 of 1
Project No.	Sampler (Signature)		Standard TAT	
Project Location	Affiliation			
Livermore	Douglas Env.			

Sample No./Identification	Date	Time	Lab No.	BTEX	TPH (gasoline)	TPH (diesel)	No. of Containers	REMARKS
VW-1	3-7-97	230	16539-01	X	X		2	
VW-5	3-7-97	248	02					
VW-7		202	03					
VW-8		218	04					
VW-10		1256	05					3/10/97 1630
VW-13		140	06					0° SW
MW-23		124	07					

Relinquished by: (Signature/Affiliation)	Date	Time	Received by: (Signature/Affiliation)	Date	Time
Hal Hansen Douglas Env.	3/10/97	1540	[illegible] West	3/10/97	1540
Relinquished by: (Signature/Affiliation)	Date	Time	Received by: (Signature/Affiliation)	Date	Time
[illegible] West	3/10/97	1630			
Relinquished by: (Signature/Affiliation)	Date	Time	Received by: (Signature/Affiliation)	Date	Time
			John Minty	03/10/97	1630

Report To: Leon Crain
863-5916

Bill to: ULTRAMAR INC.
525 West Third Street
Hanford, CA 93230
Attention: Penny Fox

WHITE: Return to Client with Report YELLOW: Laboratory Copy PINK: Originator Copy

32 6003 4-90

Appendix C

Ultramar, Inc. Beacon Station No. 604
Livermore, California Risk Assessment

ULTRAMAR, INC.
BEACON STATION NO. 604
LIVERMORE CALIFORNIA

RISK ASSESSMENT **MAY 28, 1997**

Prepared For:

Ultramar, Inc.
525 West Third St.
P. O. Box 466
Hansford, CA 93232

BDM

Environmental Site Investigation
Risk Assessment
Beacon Station No. 604
1619 First Street
Livermore, CA

Prepared by:

BDM International, Inc.
415 West Wall Street, Suite 1818
Midland, Texas 79701
(915) 682-0008
FAX (915) 682-0028

SUBMITTED BY:

Dale T. Littlejohn, CAPM No. 0200
Senior Project Manager

DATE: 5/20/97

REVIEWED BY:

O. Leon Crain
Senior Engineer

DATE:

TABLE OF CONTENTS

APPENDIX

1.0 Executive Summary

The following Risk Assessment has been prepared in accordance with the procedures specified in the American Society for Testing and Materials (ASTM) standard guide for *Risk-Based Corrective Action Applied at Petroleum Release Sites* (ASTM E 1739-95). Site-specific assumptions with regard to land use, water use, and future residential or commercial development are based on an interpretation of the behavior options available to the population in the area surrounding the site. Risks for each of the potential receptors were calculated for a worst-case exposure scenario using EPA default values where site-specific measurements were not available.

Several of the evaluated receptors potentially could be exposed to carcinogenic risks above the acceptable levels of 1×10^{-6} (current) and 1×10^{-4} (future) and/or non-carcinogenic risks (hazard quotient) above the acceptable level of 1.0. However, it appears that the most significant potential health risk is associated with the inhalation of VOC vapors from the groundwater by commercial workers within the Frosty Freeze building located adjacent to the Beacon Station site. Presently, there is no indication that a health risk has occurred in this area and the hydrocarbon concentrations in the groundwater near the building (MW-7) are below the levels required for a health risk to develop.

2.0 Exposure Assessment

2.1 Exposure Setting Characterization

2.1.1 Site Conditions

The Beacon Station No. 604 site is a convenience store with retail fuel (gasoline) underground storage tanks (USTs). A fuel release has occurred from the system that has impacted the underlying soil and groundwater. Details regarding the assessment, plume delineation, and remedial actions have been addressed in previous documents. The surface area above the hydrocarbon-impacted soil and groundwater is covered by concrete and asphalt, (75 to 100 percent). There are no open excavations or areas of exposed soil which might present a threat to the nearby population.

The site geology, as determined by drill cuttings, includes a 45-foot thick surface layer of gravelly sandy clay and clayey sandy gravel. The gravel ranges in size from granules to pebbles and the sand is medium to coarse-grained, poorly sorted, sub-angular to sub-rounded, with approximately 20% to 50% clay. Underlying the clayey gravel unit is a sandy gravel with much less clay that extends to the base of the investigation depth (65 feet).

The shallow unconfined aquifer is located approximately 25 to 35 feet below the surface (depending on seasonal fluctuation). The groundwater gradient extends to the northwest at 0.013 feet/foot. Hydrocarbon releases have occurred from the base of the gasoline UST, approximately 19 feet below the surface. Groundwater was impacted when the hydrocarbons leached through the vadose zone soil, between the base of the UST and the aquifer. The horizontal migration of contaminants is controlled by the down-gradient groundwater flow, with no apparent influence from man-made utilities or nearby water wells. The Risk Assessment has been prepared under the assumption that the groundwater contaminant plume extends to the northwest approximately 400 feet.

Subsurface utilities in the area below the depth of impacted soil and groundwater. There is no indication that the utility trench intersects the shallow aquifer, therefore it is not considered a potential pathway or hazard to the area population.

On the basis of the present groundwater information, it appears that the dissolved contaminants extend off-site below the southeast corner of an adjacent shopping center parking lot. No phase-separated hydrocarbons are present and there are no impacted or threatened surface waters.

2.1.2 Chemicals of Concern

The chemicals of concern include only those that are present in detectable concentrations and are listed with the Integrated Risk Information Service (IRIS). Health risk information on a chemical is provided in IRIS only after a comprehensive review of the chronic toxicity data by work groups composed of U.S. EPA scientists from several program offices. The IRIS database is presently considered by the industry to be the best source of toxicity data for application to a quantitative risk assessment. An effort is made to include the most common and hazardous chemicals in IRIS, however, new chemicals are added as reliable data becomes available.

Table 1 is a summary of chemicals of concern and the associated source area concentrations used in the risk assessment. A subsurface soil sample recovered from the base of the former gasoline tankhold in November 1992, contained the maximum concentrations of toluene, ethylbenzene, and total xylenes. A soil sample recovered during the installation of the remediation system in October 1995, contained the maximum concentration of benzene. These samples have been selected to represent the average source area soil concentrations.

The present maximum groundwater concentrations were selected from MW-2, immediately down-gradient from the former UST location, (benzene, toluene) and from MW-6, which is 150 feet down-gradient from MW-2 (ethylbenzene, xylenes). Both samples were recovered in March 1997. A statistical method of calculating the average source area concentration could not be performed because an adequate number of soil and groundwater samples above the detection level were not recovered.

Table 1
CHEMICALS OF CONCERN
Source Area Concentrations

Hydrocarbon Constituents	Surface Soil (mg/kg)	Subsurface Soil (mg/kg)	Groundwater (mg/L)
Aromatic Volatiles (8020)			
Benzene	NA	20.9	1.8
Toluene	NA	160	1.1
Ethylbenzene	NA	110	0.52
Xylenes	NA	700	2.300

NA No surface soil samples recovered.

Subsurface concentrations based on sample recovered from former gasoline tankhold at 19 feet BGS and remediation system installation.

Groundwater concentrations base on March 1997 samples recovered from MW-2 and MW-6.

ultramar\data.xls

2.1.3 Current and Future Land Use

The Beacon Station No. 604 site is located at 1619 West First Street in Livermore, California. The property is used as a retail convenient store with fuel pumps The nearest residential dwelling is located adjacent to the site, approximately 50 feet to the south and the nearest down-gradient residential dwelling is located approximately 1,800 feet to the northwest. The nearest commercial building is the Beacon Station No. 604 store located on the southeast edge of the soil and groundwater impact area. The nearest down-gradient commercial building (Frosty Freeze Restaurant) is located approximately 120 feet to the west, northwest. The City of Livermore has zoned the area along First Street and to the north as commercial development. Recent building trends indicate that commercial development will increase and residential use will decrease in the vicinity. There are no additional leaking petroleum storage tank sites located within a 1,000-foot radius of the Beacon Station site.

2.1.4 Current and Future Water Use

The shallow groundwater is not generally used for water supply or irrigation. The City of Livermore supplies water for residential and commercial use. In addition, a "contamination zone" has been established by the Zone 7 Water Agency due to an unrelated chemical release that has occurred northwest of the Beacon Station site. The designation of a contamination zone prevents all future water well completions in the shallow aquifer up to one-half mile down-gradient from the site release area. The nearest down-gradient water well that is believed to be completed such that a possibility may exist for communication with the impacted zone is located approximately 2,700 feet to the northwest. The nearest down-gradient deep water well is located approximately 1,600 feet from the Beacon Station site.

2.2 Potentially Exposed Populations

2.2.1 Residential Receptors

The current residential receptors that were considered with respect to the performance of the risk assessment include the users of the shallow residential water well located 2,700 feet down-gradient from the source area and the inhabitants of a residential dwelling located 1,800 feet down-gradient from the source area.

In addition to the current receptors, a scenario for a worst-case future residential receptor was considered at the nearest down-gradient location (2,500 feet) where a shallow residential water well can be installed, relative to the "contamination zone" designated area. It should be noted, however, that the likelihood of an individual installing a water well for domestic use of the shallow (impacted) aquifer is very low because it is considered undesirable, compared to the deeper groundwater zone, and the area is served by a public water utility.

2.2.2 Commercial Worker Receptors

Presently, the commercial worker receptors considered in this risk assessment include the on-site Beacon Station No. 604 employees and the employees of the Frosty Freeze Restaurant located 120 feet off-site.

In addition, the risk assessment has considered the possibility that the surface property could be sold or leased and a future commercial facility could be constructed above the impact area. Within this scenario a potential exposure pathway would be present via the inhalation of enclosed-spaced VOCs from the

subsurface soil and groundwater. The potential for exposure of a future on-site commercial worker via ingestion of the shallow "impacted" groundwater has been included, however, the likelihood an individual installing a water well for commercial use of this aquifer is very low for reasons stated above.

2.2.3 Construction Worker Receptors

Impacted surface soil is not present at the Beacon Station site. A scenario for future on-site construction worker receptors has not been included in the risk assessment because the impacted soil and groundwater is not present at a depth that would allow for inhalation of VOCs and dermal contact during the likely construction activities.

2.3 Exposure Pathway Analysis

2.3.1 Current Exposure Pathways

Potential exposure pathways and those identified as complete for current conditions at the Beacon Station site are listed in Table 2(a). They include: (1) Groundwater ingestion and dermal contact (while showering) by the residential receptors that utilize the shallow water well located 2,700 feet down-gradient from the site, (2) Inhalation of VOCs from the ambient emissions of the impacted subsurface soil and groundwater by an on-site commercial receptor, and (3) Inhalation of VOCs from the enclosed-space emissions of the impacted groundwater by an off-site commercial receptor located 120 feet down-gradient from the site.

2.3.2 Future Exposure Pathways

Potential exposure pathways and those identified as complete for the "worst-case" future conditions at the site are listed in Table 2(b). The future residential receptor pathways include: (1) Groundwater ingestion and dermal contact (while showering) by a potential future residential receptors that may utilize a shallow water well located 2,500 feet down-gradient from the site, (2) Groundwater ingestion by a potential future commercial receptor that may utilize a shallow water well located on-site, and (3) Inhalation of enclosed-space VOCs from the subsurface soil and groundwater by an on-site potential future commercial receptors.

Explosive vapor exposure routes, such as utilities, basements, and subsurface sumps are not considered complete because these structures are not present near the impacted soil or groundwater. Other pathways related to the consumption of fish, livestock, and agricultural produce that may potentially be affected by the use of the surface water have not been included in the risk assessment because the toxicology data for these pathways are not reliable and it is believed that these risks are more conservatively addressed by evaluating the pathways related to dermal contact and ingestion of the groundwater.

All of the current and future complete exposure pathways, and potential receptors that were subjected to the quantitative risk evaluation are summarized in Table 3.

Table 2(a)
Potential Exposure Pathways
Current Conditions

Exposure Medium and Exposure Route	Receptors (✓) On-site or (Distance) Off-site					Complete Pathway (Yes/No)
	Residential		Commercial Worker		Constr.	
	On-site	Off-site	On-site	Off-site	On-site	
Groundwater						
Ingestion		2700'				Yes
Dermal contact		2700'				Yes
Inhalation of VOCs		1800'	Ambient	120'		Yes
Surface Water						
Ingestion						No
Dermal Contact						No
Ingestion (swimming)						No
Air						
Inhalation of soil emissions			Ambient			Yes
Soil						
Ingestion of soil						No
Dermal contact						No

Table 2(b)
Potential Exposure Pathways
Future Conditions

Exposure Medium and Exposure Route	Receptors (✓) On-site, (Distance) Off-site					Complete Pathway (Yes/No)
	Residential		Commercial Worker		Constr.	
	On-site	Off-site	On-site	Off-site	On-site	
Groundwater						
Ingestion		2500'	✓			Yes
Dermal contact		2500'				Yes
Inhalation of VOCs			Enclosed			Yes
Surface Water						
Ingestion						No
Dermal Contact						No
Ingestion (swimming)						No
Air						
Inhalation of soil emissions			Enclosed			Yes
Soil						
Ingestion of soil						No
Dermal contact						No

Table 3
Exposure Pathways Selected for Quantitative Risk Evaluation

Potentially Exposed Receptor	Exposure Route, Medium and Exposure point	Reason for Selection
Current On-site Resident	None	There are no current residential receptors located on-site
Current Off-site Resident	Ingestion of the impacted groundwater from a water well located 2,700 feet down-gradient from the site.	Assumes that the water well is operational and used for domestic purposes
	Dermal contact (during showering) with groundwater from a water well located 2,700 feet down-gradient from the site.	
	Enclosed-space inhalation of VOCs from the impacted groundwater below a residential dwelling located 1,800 feet down gradient from the site.	
Future On-site Resident	None	Livermore zoning law will prevent an on-site residential dwelling or water well from being constructed.
Future Off-site Resident	Ingestion of the impacted groundwater from a hypothetical water well located 2,500 feet down-gradient from the site.	Assumes that a water well will be installed and completed in the impacted aquifer immediately beyond the "contamination zone".
	Dermal contact (during showering) with groundwater from a hypothetical water well located 2,500 feet down-gradient from the site.	
Current On-site Commercial Worker	Ambient inhalation of VOCs from the impacted groundwater below the property.	Assumes that the workers will be outdoors and the concrete and asphalt cover does not prevent the migration of vapors.
	Ambient inhalation of VOCs from the impacted subsurface soil below the property.	
Current Off-site Commercial Worker	Enclosed-space inhalation of VOCs from the impacted groundwater below a commercial building located 120 feet down-gradient from the site.	Assumes that the Frosty Freeze building is directly down-gradient from the source area.
Future On-site Commercial Worker	Enclosed-space inhalation of VOCs from the impacted groundwater below a hypothetical commercial building.	Assumes that a commercial building will be constructed at the location of the impacted soil and groundwater and that a water well will be installed and completed in the impacted aquifer.
	Ingestion of the impacted groundwater from a hypothetical water well near a hypothetical commercial building.	
	Enclosed-space inhalation of VOCs from the impacted subsurface soil below a hypothetical commercial building.	
Future Off-site Commercial Worker	None	Pathway more conservatively evaluated by future on-site commercial worker scenario.
Current and Future On-site Construction Worker	None	Scenario not evaluated due to the depth of the impacted soil and groundwater.

3.0 Exposure Point Concentrations

3.1 Measured Exposure Point Concentrations

All of pathways listed in Table 3, involve direct contact with groundwater (ingestion and dermal contact), or inhalation of vapors from the groundwater and subsurface soil (ambient or enclosed-space). Exposure point concentrations applied to all of the potential current and future pathways were derived from actual soil and groundwater measurements (Table 1).

The off-site groundwater exposure point concentrations were estimated by calculating the natural attenuation factor (NAF) of the groundwater from the source area to the exposure point using Domenico's contaminant fate and transport model. All of the ambient and enclosed-space inhalation exposure point concentrations were numerically derived using the appropriate volatilization factors and effective diffusion coefficients.

3.2 Calculated Exposure Point Concentrations

3.2.1 Ambient Inhalation of Volatiles From Subsurface Soil

The following formulas were used to calculate the exposure point concentrations for the ambient (outdoor) inhalation of emissions (C_{air}) from the subsurface soil:

$$C_{air}\left[mg/m^3 - air\right] = \frac{C_{soil}}{\left(1/VF_{samb}\right)}$$

where as the VF_{samb} (volatilization factor of soil to ambient air) is expressed as:

$$VF_{samb}\left[\frac{\left(mg/m^3 - air\right)}{\left(mg/kg - soil\right)}\right] = \left(\frac{A}{U_{air} \times W \times \delta_{air}}\right) \times \frac{\left(2 \times D_{ei} \times \theta_T \times K_{as}\right)}{\left(3.14 \times \alpha \times t\right)^{1/2}} \times \left(\frac{kg}{10^3 g}\right) \times \left(\frac{10^4 cm^2}{m^2}\right)$$

the D_{ei} (effective diffusivity in the vadose zone) is expressed as:

$$D_{ei}\left[cm^2/s\right] = D^{air} \times \theta_T^{1.33}$$

the K_{as} (soil-air partition coefficient) is expressed as:

$$K_{as}\left[\frac{g - soil}{cm^3 - air}\right] = \frac{H'}{k_s} = \frac{H'}{k_{oc} \times f_{oc}}$$

the α (dispersivity factor) is expressed as:

$$\alpha\left[\frac{cm^2}{s}\right] = \frac{D_{ei} \times \theta_T}{\theta_T + \frac{\rho_s}{K_{as}}}$$

3.2.2 Ambient Inhalation of VOCs From Groundwater

The following formulas were used to calculate the exposure point concentrations for the ambient (outdoor) inhalation of VOCs (C_{air}) from the groundwater:

$$C_{air}\left[mg/m^3 - air\right] = \frac{C_{wtr}}{\left(1/VF_{wamb}\right)}$$

where as the VF_{wamb} (volatilization factor of groundwater to ambient air) is expressed as:

$$VF_{wamb}\left[\frac{\left(mg/m^3 - air\right)}{\left(mg/kg - H_2O\right)}\right] = \frac{H'}{1+\left(\frac{U_{air}\times\delta_{air}\times W\times L_{gw}}{A\times D_{ws}^{eff}}\times\frac{10^2\,cm}{m}\right)}\times 10^3\,\frac{L}{m^3}$$

and D_{ws}^{eff} (effective diffusion coefficient between groundwater and soil) is expressed as:

$$D_{ws}^{eff}\left[cm^2/s\right] = \left(h_{cap}+h_v\right)\left[\frac{h_{cap}}{D_{cap}^{eff}}+\frac{h_v}{D_s^{eff}}\right]^{-1}$$

and D_{cap}^{eff} (effective diffusion coefficient through the capillary fringe is expressed as:

$$D_{cap}^{eff}\left[cm^2/s\right] = D^{air}\times\frac{\theta_{acap}^{3.33}}{\theta_T^{2.0}}+\frac{D^{wat}}{H'}\times\frac{\theta_{wcap}^{3.33}}{\theta_T^{2.0}}$$

3.2.3 Enclosed-Space Inhalation of Vapors From Subsurface Soil

The following formulas were used to calculate the exposure point concentrations for the enclosed-space (indoor) inhalation of VOCs (C_{air}) from the subsurface soil:

$$C_{air}\left[mg/m^3 - air\right] = \frac{C_{soil}}{\left(1/VF_{sesp}\right)}$$

where as the VF_{seap} (volatilization factor of soil to enclosed air) is expressed as:

$$VF_{seap}\left[\frac{(mg/m^3-air)}{(mg/kg-soil)}\right]=\frac{\dfrac{H'\times\rho_s}{\left[\theta_{ws}+(k_s\times\rho_s)+(H'\times\theta_{as})\right]}\left[\dfrac{D_s^{eff}/L_s}{ER\times L_B}\right]}{1+\left[\dfrac{D_s^{eff}/L_s}{ER\times L_B}\right]+\left[\dfrac{D_s^{eff}/L_s}{(D_{crack}^{eff}/L_{crack})\times\eta}\right]}\times 10^3$$

or as: $$VF_{seap}\left[\frac{(mg/m^3-air)}{(mg/kg-soil)}\right]=\frac{\rho_s\times d_s}{L_B\times ER\times t}\times 10^3$$ whichever is less.

The D_s^{eff} (effective diffusion coefficient in soil) is expressed as:

$$D_s^{eff}\left[cm^2/s\right]=D^{air}\times\frac{\theta_{as}^{3.33}}{\theta_T^{2.0}}+\frac{D^{wat}}{H'}\times\frac{\theta_{ws}^{3.33}}{\theta_T^{2.0}}$$

and D_{cracks}^{eff} (effective diffusion coefficient through foundation cracks) is expressed as:

$$D_{crack}^{eff}\left[cm^2/s\right]=D^{air}\times\frac{\theta_{acrack}^{3.33}}{(\theta_{acrack}+\theta_{wcrack})^2}+\frac{D^{wat}}{H'}\times\frac{\theta_{wcrack}^{3.33}}{(\theta_{acrack}+\theta_{wcrack})^2}$$

3.2.4 Enclosed-Space Inhalation of Vapors From Groundwater

The following formulas were used to calculate the exposure point concentrations for the enclosed-space (indoor) inhalation of vapors (C_{air}) from the groundwater:

$$C_{air}\left[mg/m^3-air\right]=\frac{C_{water}}{(1/VF_{wesp})}$$

where as the VF_{wesp} (volatilization factor of groundwater to enclosed air) is expressed as:

$$VF_{wesp}\left[\frac{(mg/m^3-air)}{(mg/L-H_2O)}\right]=\frac{H'\left[\dfrac{D_{ws}^{eff}/L_{gw}}{ER\times L_B}\right]}{1+\left[\dfrac{D_{ws}^{eff}/L_{gw}}{ER\times L_B}\right]+\left[\dfrac{D_{ws}^{eff}/L_{gw}}{(D_{crack}^{eff}/L_{crack})\times\eta}\right]}\times 10^3\,\frac{L}{m^3}$$

3.2.5 Subsurface Soil Leaching to Groundwater

The following formulas were used to calculate the exposure point concentrations for subsurface soil contaminants leaching to the underlying groundwater. The results of this calculation were compared to the concentrations of contaminants actually measured from the groundwater monitoring activities. The

maximum value was then used to calculate all other exposure point concentrations associated with the groundwater:

$$C_{water}[mg/L-water]=\frac{C_{soil}}{(1/LF_{sw})}$$

where as the LF_{sw} (leachate factor of subsurface soil to groundwater) is expressed as:

$$LF_{sw}\left[\frac{(mg/L-H_2O)}{(mg/kg-soil)}\right]=\frac{K_{sw}}{LDF}$$

and the K_{sw} (soil leachate partition factor) is expressed as:

$$K_{sw}\left[\frac{(mg/L-H_2O)}{(mg/kg-soil)}\right]=\frac{\rho_s}{\theta_{ws}+k_s\times\rho_s+H'\times\theta_{as}}$$

3.3 Domenico's Contaminant Transport Model

The Domenico analytical solute transport model has been incorporated to account for attenuation of affected groundwater between the source area and the various exposure points used in the risk assessment. The model is based on the solution to the following equation:

$$\frac{C_x[mg/L-water]}{C_{source}[mg/L-water]}=\exp\left(\frac{x}{2\alpha_x}\left[1-\sqrt{1+\frac{4\lambda_i\alpha_x R_i}{v}}\right]\right)erf\left(\frac{S_w}{4\sqrt{\alpha_y x}}\right)erf\left(\frac{S_d}{4\sqrt{\alpha_z x}}\right)$$

where R_i (retardation factor for the individual constituent) is expressed as:

$$R_i=1+\frac{(f_{oc}\times K_{oc})\rho_s}{\theta_T}$$

and the v (groundwater seepage velocity) is expressed as: $$v=\frac{K\times i}{\theta_T}$$

The model uses a penetrating vertical plane source, perpendicular to groundwater flow, to stimulate the release of organics from the mixing zone to the groundwater as it passes through the plane. Within the flow regime, the model accounts for the effects of advection, dispersion, sorption, and biodegradation (if required) in order to predict steady-state plume concentrations at an exposure point located on the plume centerline directly down-gradient from the source at a specified distance.

The release source is assumed to be infinite and constant with the concentrations determined by either the measured historic analytical results from the source area groundwater samples or by calculating the expected groundwater contamination from the known subsurface soil concentrations. The degree of contaminant mixing predicted by the model is a function of the dispersion coefficients, hydraulic

conductivity, hydraulic flow gradient, and soil porosity. The dispersion coefficients have been conservatively calculated as described in the table above. A retardation factor has been calculated using information on the organic-carbon partition coefficient for each chemical of concern and the fraction of organic carbon of the soil matrix.

Due to the inflexibility of the RBCA Tool Kit (Groundwater Services, Inc.) relative to the exposure pathways identified at the site, the software was used only to calculate the modeled exposure point concentrations (NAF values) from the source area groundwater to each off-site exposure point located at 120, 1,800, 2,500, and 2,700 feet down-gradient.

All other exposure point concentrations were calculated using Microsoft Excel™ spreadsheets provided in Appendix B-1. The parameters used for all exposure point concentration calculations are listed on Table 4.

Table 4
Exposure Point Concentration Calculation Parameters

PARAMETER	DESCRIPTION	VALUES USED
Field Measurements		
C_{soil}	Source Contaminant Concentration	**measured** (mg/kg)
C_{water}	Dissolved Contaminant Concentration	**measured (calculated)** (mg/kg)
A	Contaminated Soil Area	**100** m^2
L_s	Depth to Subsurface Soil Source	**580** cm (19 ft)
L_{gw}	Depth to Groundwater ($h_{cap} + h_v$)	**760** cm (25 ft)
W	Width of Soil Source, Parallel to Flow	**20** m
h_{cap}	Thickness of Capillary Fringe	5 cm
h_v	Thickness of Vadose Zone	**755** cm
d_s	Thickness of Affected Soils	**180** cm
S_w	Groundwater Source Width	**40** m (120 Ft)
S_d	Groundwater Source Thickness	**6.1** m (20 Ft)
ρ_s	Soil Bulk Density	1.70 gm/ cm^3-soil
f_{oc}	Fraction of Organic Carbon	0.01 g-carbon/g-soil
θ_{ws}	Vol. Water Content in Vadose Zone	0.12 cm^3-H_2O/cm^3-soil
θ_{as}	Vol. Air Content in Vadose Zone	0.26 cm^3-air/cm^3-soil
θ_T	Total Soil Porosity	0.38 cm^3/cm^3-soil
θ_{wcap}	Vol. Wtr Cont. in Capillary Fringe Soils	0.342 cm^3-H_2O/cm^3-soil
θ_{acap}	Vol. Air Cont. in Capillary Fringe Soils	0.038 cm^3-air/cm^3-soil
θ_{wcrack}	Vol. Wtr Content in Found/Wall Crack	0.12 cm^3-H_2O/cm^3-total volume
θ_{acrack}	Vol. Air Content in Found/Wall Crack	0.26 cm^3-air/cm^3-total volume
x	Transport Distance (down-gradient)	**120, 1800, 2500, & 2700** (ft)
α_x	Longitudinal Dispersivity	0.1x (m)
α_y	Transverse Dispersivity	$0.33\alpha_x$
α_z	Vertical Dispersivity	$0.05\alpha_x$
K	Hydraulic Conductivity	**7.5 E-4** cm/sec
i	Hydraulic Gradient	**0.013** cm/cm
V_{gw}	Groundwater Velocity (Darcy)	**310** cm/yr
U_{air}	Ambient Wind Speed in Mixing Zone	2.25 m/sec

δ_{air}	Ambient Air Mixing Zone Height	2.0 m
η	Aerial Fraction of Cracks in Foundation	0.01 cm^2-cracks/cm^2-total area
L_{crack}	Encl-Space Found. or Wall Thickness	15 cm
LDF	Leachate Dilution Factor	100 (unitless)
Chemical-Specific Measurements		
H'	Henry's Law Constant	chemical-specific (cm^3-H_2O/cm^3-air)
k_{oc}	Organic Carbon Partition Coefficient	chem. spec. (mg/kg-carb./mg/L-H_2O)
k_s	Soil-Water Sorption Coefficient	$f_{oc} \times k_{oc}$. (cm^3-H_2O/g-soil)
D^{wat}	Diffusion Coefficient in Water	chemical-specific (cm^2/s)
D^{air}	Diffusion Coefficient in Air	chemical-specific (cm^2/s)
τ	Averaging Time for Vapor Flux	chemical-specific (sec.)
λ_i	First-Order Degradation Rate	chemical-specific (day^{-1})
Residential-Specific Parameters		
ER	Enclosed-Space Air Exchange Rate	0.00014 s^{-1} L/s
L_B	Enclosed-Space Vol./Infiltr. Area Ratio	200 cm
t	Exposure Interval	9.5E+08 (sec)
Commercial-Specific Parameters		
ER	Enclosed-Space Air Exchange Rate	0.00023 s^{-1} L/s
L_B	Enclosed-Space Vol./Infiltr. Area Ratio	300 cm
t	Exposure Interval	7.9E+08 (sec)

Values listed in **bold** type are not EPA default values

A summary of the calculated exposure point concentrations is presented in Table 5. The spreadsheets used to generate the exposure point concentrations have been provided in Appendix A and B. All of the values listed were calculated under an assumption that no biodegradation has occurred during the transport of the groundwater.

Table 5

EXPOSURE POINT CONCENTRATIONS
Natural Attenuation with No Biodegradation

onsite commercial

Compounds	Subsurface Soil (source area)			
	Maximum Concentration (mg/kg)	Volitalize to Air		
		Ambient (mg/m^3)	Enclosed (R) (mg/m^3)	Enclosed (C) (mg/m^3)
Aromatic Volatiles				
Benzene	2.09E+01	5.98E-04	NA	1.17E-01
Toluene	1.60E+02	2.39E-03	NA	6.21E-01
Ethylbenzene	1.10E+02	8.08E-04	NA	1.08E-01
Total Xylenes	7.00E+02	1.16E-02	NA	3.28E+00

Compounds	Groundwater (source area)			
	Maximum Concentration (mg/L)	Volitalize to Air		
		Ambient (mg/m^3)	Enclosed (R) (mg/m^3)	Enclosed (C) (mg/m^3)
Aromatic Volatiles				
Benzene	1.80E+00	1.37E-05	NA	1.11E-02
Toluene	1.10E+00	8.14E-06	NA	6.73E-03
Ethylbenzene	5.20E-01	3.47E-06	NA	2.87E-03
Total Xylenes	2.78E+00	1.97E-05	NA	1.64E-02

Compounds	Groundwater (120 feet down-gradient)			
	Maximum Concentration (mg/L)	Volitalize to Air		
		Ambient (mg/m^3)	Enclosed (R) (mg/m^3)	Enclosed (C) (mg/m^3)
Aromatic Volatiles				
Benzene	1.00E+00	NA	NA	6.18E-03
Toluene	6.20E-01	NA	NA	3.80E-03
Ethylbenzene	2.90E-01	NA	NA	1.60E-03
Total Xylenes	1.60E+00	NA	NA	9.43E-03

Table 5

EXPOSURE POINT CONCENTRATIONS
Natural Attenuation with No Biodegradation

Compounds	Groundwater (1800 feet down-gradient)			
	Maximum Concentration (mg/L)	Volitalize to Air		
		Ambient (mg/m^3)	Enclosed (R) (mg/m^3)	Enclosed (C) (mg/m^3)
Aromatic Volatiles				
Benzene	8.20E-03	NA	1.25E-04	NA
Toluene	5.00E-03	NA	7.54E-05	NA
Ethylbenzene	2.40E-03	NA	3.26E-05	NA
Total Xylenes	1.30E-02	NA	1.89E-04	NA

Compounds	Groundwater (2500 feet down-gradient)			
	Maximum Concentration (mg/L)	Volitalize to Air		
		Ambient (mg/m^3)	Enclosed (R) (mg/m^3)	Enclosed (C) (mg/m^3)
Aromatic Volatiles				
Benzene	4.30E-03	NA	6.55E-05	NA
Toluene	2.60E-03	NA	3.92E-05	NA
Ethylbenzene	1.20E-03	NA	1.63E-05	NA
Total Xylenes	6.60E-03	NA	9.59E-05	NA

Compounds	Groundwater (2700 feet down-gradient)			
	Maximum Concentration (mg/L)	Volitalize to Air		
		Ambient (mg/m^3)	Enclosed (R) (mg/m^3)	Enclosed (C) (mg/m^3)
Aromatic Volatiles				
Benzene	3.70E-03	NA	5.63E-05	NA
Toluene	2.20E-03	NA	3.32E-05	NA
Ethylbenzene	1.10E-03	NA	1.50E-05	NA
Total Xylenes	5.70E-03	NA	8.28E-05	NA

4.0 Estimate of Chemical Intake

The tables provided in Appendix C-1, C-2, and C-3 indicate the amount of chemical intake and the resulting carcinogenic risk or hazard quotient calculated by pathway for each of the exposure scenarios. The EPA default parameters used in the following equations are listed in Table 6(a) and 6(b).

4.1 Ingestion of Groundwater

The "ingestion of groundwater" equation was used to estimate chemical intake from: (1) the future on-site commercial exposure point, (2) the current off-site residential exposure point located 2,700 feet down-gradient, and (3) the future off-site residential exposure point located 2,500 feet down-gradient (Appendix C-1).

$$Intake\left[mg/kg-day\right] = C^{water}\left[\frac{IR_w \times EF_{gw} \times ED_{gw}}{BW \times AT \times 365 days/year}\right]$$

4.2 Inhalation of Vapors from Subsurface Soil and Groundwater

The following "inhalation of vapors" equation was used to estimate chemical intake from: (1) the current on-site commercial exposure point (ambient groundwater + subsurface soil), (2) the current off-site commercial exposure point (enclosed-space groundwater) located 120 feet down-gradient, (3) the current off-site residential exposure point (enclosed-space groundwater) located 1,800 feet down-gradient, and (4) the future on-site commercial exposure points (enclosed-space groundwater + subsurface soil) (Appendix C-2).

$$Intake\left[mg/kg-day\right] = C^{air}\left[\frac{IR_a \times EF_{air} \times ED_{air}}{BW \times AT \times 365 days/year}\right]$$

4.3 Dermal Contact with the Groundwater

The "dermal contact with groundwater" equation was used to estimate chemical intake for: (1) the current off-site residential exposure point (shower) located 2,700 feet down-gradient, and (2) the future off-site residential exposure point (showering) located 2,500 feet down-gradient (Appendix C-3).

$$Intake\left[mg/kg-day\right] = C^{water}\left[\frac{EF_{gw-d} \times ED_{gw-d} \times EV \times SA \times Z}{BW \times AT \times 365 days/year \times 1000 cm^3/L}\right]$$

where Z (dermal factor) is expressed as: $Z\left[cm/event\right] = 2K_p\sqrt{6\tau\frac{t_{event}}{\pi}}$ when the t_{event} value is

less than the t^* (chemical specific) value. The Z (dermal factor) is expressed as:

$$Z[cm/event] = K_p\left[\frac{t_{event}}{1+B} + 2\tau\left(\frac{1+3B}{1+B}\right)\right]$$ when the t_{event} value is greater than the t^* (chemical specific) value.

Table 6(a)
Reasonable Maximum Exposure Parameters

Parameter	Description	Current Default Values (construction)	
		Residential	Commercial
IR_w	Daily Water Ingestion Rate	2.0 L/day	1.0 L/day
IR_a	Daily Indoor Inhalation Rate	15 m^3/day	20 m^3/day
EF_{gw}	Exposure Frequency (gw)	350 days/year	250 days/year
$EF_{gw\text{-}d}$	Exposure Frequency (gw-swim)	5 days/year	Not Applicable
$EF_{soil/air}$	Exposure Frequency (soil and air)	350 days/year	250 days/year
ED_{gw}	Exposure Duration (gw)	30 years	25 years (0.083)
$ED_{gw\text{-}d}$	Exposure Duration (gw-dermal)	33 years	(accidental - 0.083)
$ED_{soil/air}$	Exposure Duration (soil and air)	30 years	25 years (0.083)
BW	Body Weight	Adult - 70 kg	Child - 15 kg
AT_c	Averaging Time (carcinogens)	70 years	70 years
AT_n	Averaging Time (non-carcinogens)	same as ED (exposure duration)	
EV	Event Frequency (showering)	1.0 events/day	Not Applicable
τ	Averaging Time for Vapor Flux	chemical-specific (hr)	
K_p	Dermal Permeability Constant	chemical specific (cm/hr)	
t_{event}	Duration of event (showering)	0.25 hr/day	Not Applicable
SA_w	Total Skin Surface Area (shower/swim)	23,000 cm^2	Not Applicable
SA_s	Exposed Skin Surface Area (gw/soil)	5800 cm^2	5800 cm^2
B	Rel. Contribution of Perm. Coeff.	chemical specific (unitless)	
$IF_{soil/air}$	Age-Adjusted Soil Ingestion Factor	114 mg-yr/kg-day	
M	Soil to Skin Adherence Factor	1.0 mg/cm^2	1.0 mg/cm^2
PEF	Particulate Emission Factor	2.92×10^{10}	
RAF_d	Dermal Relative Absorption Factor	0.5 (volatiles)/0.05 (PAH)	

The exposure parameters for the future conditions are based on the EPA's "Most Likely Exposure" (MLE). The values used in the Sharon Ridge risk assessment are listed in Table 6(b) below.

Table 6(b)
Most Likely Exposure Parameters

Parameter	Description	Future Default Values (construction)	
		Residential	Commercial
IR_w	Daily Water Ingestion Rate	1.4 L/day	1.0 L/day
IR_a	Daily Indoor Inhalation Rate	15 m^3/day	20 m^3/day
EF_{gw}	Exposure Frequency (gw)	235 days/year	250 days/year
$EF_{gw\text{-}d}$	Exposure Frequency (gw-swim)	5 days/year	NA

$EF_{soil/air}$	Exposure Frequency (soil and air)	235 days/year	250 days/year
ED_{gw}	Exposure Duration (gw)	9 years	25 years (0.083)
ED_{gw-d}	Exposure Duration (gw-dermal)	33 years	(accidental - 0.083)
$ED_{soil/air}$	Exposure Duration (soil and air)	9 years	25 years (0.083)
BW	Body Weight	Adult - 70 kg	Child - 15 kg
AT_c	Averaging Time (carcinogens)	70 years	70 years
AT_n	Averaging Time (non-carcinogens)	same as ED (exposure duration)	
EV	Event Frequency (showering)	1.0 events/day	Not Applicable
τ	Averaging Time for Vapor Flux	chemical-specific (hr)	
K_p	Dermal Permeability Constant	chemical specific (cm/hr)	
t_{event}	Duration of event (showering)	0.167 hr/day	Not Applicable
SA_w	Total Skin Surface Area (shower/swim)	20,000 cm^2	Not Applicable
SA_s	Exposed Skin Surface Area (gw/soil)	5,000 cm^2	5,000 cm^2
B	Rel. Contribution of Perm. Coeff.	chemical specific (unitless)	
VF	Chemical Volatilization Rate	chemical specific (m^3/kg)	
$IF_{soil/air}$	Age-Adjusted Soil Ingestion Factor	84 mg-yr/kg-day	
M	Soil to Skin Adherence Factor	0.2 mg/cm^2	0.2 mg/cm^2
PEF	Particulate Emission Factor	2.92×10^{10}	
RAF_d	Dermal Relative Absorption Factor	0.5 (volatiles)/0.05 (PAH)	

5.0 Toxicity Assessment

The specific critical toxicity values (reference dose or slope factor) for each of the chemicals of concern and the reference from which the values were taken are provided in Table 11.

Table 7

Critical Toxicity Values used in the Quantitative Risk Evaluation

Chemicals	Benzene	Toluene	Ethylbenzene	Xylenes
Reference Dose				
RfD_o	--	0.20	0.10	2.0
RfD_i	0.0017	0.40	1.0	0.086
RfD_d	--	0.16	0.097	1.84
Slope Factor				
SF_o	0.0290	--	--	--
SF_i	0.0291	--	--	--
SF_d	0.0299	--	--	--

6.0 Risk Characterization

The Appendix C tables (C-1 through C-3) provide the results of the calculated total hazard quotient (non-carcinogen) and risk (carcinogen) for each chemical of concern and each exposure pathway. The total cumulative hazard quotient and risk for each potential (human) receptor, both current and future, are provided in Table 8(a) and 8(b).

All of the evaluated receptors, except for the future residential receptor located 2,500 feet down-gradient are potentially exposed to carcinogenic risks above the acceptable levels of 1×10^{-6} (current) and 1×10^{-4} (future) and/or non-carcinogenic risks (hazard quotient) above the acceptable level of 1.0. Exceedance of the acceptable risk levels are due to inhalation of vapors and ingestion of benzene and xylenes from the subsurface soil and groundwater.

The maximum hazard quotient calculated at the site (22.6) and the maximum carcinogen risk (2.61×10^{-4}) is associated with a potential future commercial receptor (enclosed-space). Site-specific Target Levels (SSTL) for the chemicals responsible for these values have been calculated and provided in Appendix C-4.

Table 8(a)

Current Cumulative Pathway Risk (No Biodegradation)
Acceptable Limits = 1.0 Hazard Quotient / 1x(10)-6 "Class A" Carcinogen Risk

Human Receptors	Commercial Receptor On-site		Construction Worker Receptor On-site		Residential Receptor On-site	
Exposure Pathways	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk
Ingestion from Groundwater, Subsurface Soil, and/or Surface Water	NA	NA	NA	NA	NA	NA
Inhalation of Vapors (Ambient) from Groundwater and/or Subsurface Soil	9.82E-02	**1.24E-06**	NA	NA	NA	NA
Dermal Contact with Groundwater Subsurface Soil, and/or Surface Water	NA	NA	NA	NA	NA	NA
Total Receptor Risk	9.82E-02	**1.24E-06**	NA	NA	NA	NA

Human Receptors	Commercial Receptor Off-site (120')		Construction Worker Receptor Off-site		Residential Receptor Off-site (1800-2700')	
Exposure Pathways	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk
Ingestion from Groundwater, Subsurface Soil, and/or Surface Water	NA	NA	NA	NA	6.81E-04	**1.26E-06**
Inhalation of Vapors (Enclosed-space) from Groundwater and/or Subsurface Soil	7.35E-01	**1.26E-05**	NA	NA	1.56E-02	3.20E-07
Dermal Contact with Groundwater Subsurface Soil, and/or Surface Water	NA	NA	NA	NA	5.98E-04	2.73E-07
Total Receptor Risk	**7.35E-01**	**1.26E-05**	NA	NA	1.69E-02	**1.85E-06**

Table 8(b)

Future Cumulative Pathway Risk (No Biodegradation)
Acceptable Limits = 1.0 Hazard Quotient / 1x(10)-4 "Class A" Carcinogen Risk

Human Receptors	Commercial Receptor On-site		Construction Worker Receptor On-site		Residential Receptor On-site	
Exposure Pathways	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk
Ingestion from Groundwater, Subsurface Soil, and/or Surface Water	1.18E-01	**1.82E-04**	NA	NA	NA	NA
Inhalation of Vapors (Enclosed-space) from Groundwater and/or Subsurface Soil	**2.26E+01**	**2.61E-04**	NA	NA	NA	NA
Dermal Contact with Groundwater Subsurface Soil, and/or Surface Water	NA	NA	NA	NA	NA	NA
Total Receptor Risk	**2.27E+01**	**4.43E-04**	NA	NA	NA	NA

Human Receptors	Commercial Receptor Off-site		Construction Worker Receptor Off-site		Residential Receptor Off-site (2500')	
Exposure Pathways	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk	Hazard Quotient	Carcinogen Risk
Ingestion from Groundwater, Subsurface Soil, and/or Surface Water	NA	NA	NA	NA	3.64E-04	2.06E-07
Inhalation of Vapors (Enclosed-space) from Groundwater and/or Subsurface Soil	NA	NA	NA	NA	NA	NA
Dermal Contact with Groundwater Subsurface Soil, and/or Surface Water	NA	NA	NA	NA	3.65E-04	1.63E-07
Total Receptor Risk	NA	NA	NA	NA	7.29E-04	3.70E-07

Bold - Cumulative Values Exceed Acceptable Levels

7.0 Uncertainty

The application of health risk standards to evaluate the potential dangers regarding the release of chemicals to the air, soil, surface water, or groundwater requires that many assumptions be made to quantify the character of the release relative to the potentially exposed population. A discussion of these uncertainties is presented on the basis of the required application to the site-specific and toxicity assessment parameters.

7.1 Site-Specific Uncertainties

The site-specific assumptions with regard to land use, water use, and future residential or commercial development are based on an interpretation of the behavior options available to the population in the area surrounding the LPST site. Risks for each of the potential receptors were determined using the following worst-case exposure scenarios:

- The calculated risks to the "current on-site commercial receptor" assumes (using EPA defaults) that the Beacon Station No. 604 employee inhales 20 m^3 of air per day, for 250 days per year (8 hours per day), over a 25 year period. The work activity must be conducted outdoors on the north side of the property (near the pump islands). This scenario not realistic because the majority of the worker's time is spent inside the facility, southeast of the hydrocarbon impacted areas. If a more realistic assumption is made that the worker spends only one hour per day outdoors, then both the carcinogenic and non-carcinogenic risks decrease to acceptable levels.

- The calculated risks to the "current off-site residential receptor" located 2,700 feet down-gradient from the source area, assumes that: (1) the water well at this location is both screened in the shallow impacted aquifer and is used for human ingestion, and (2) no biodegradation has occurred in the aquifer between the source area and the water well. The carcinogenic risk calculated for this scenario (1.26×10^{-6}) exceeds the acceptable level by a very small margin. Had the data been available to include biodegradation in the natural attenuation model, there is no question that the calculated risk would be well below the acceptable levels.

- The calculated risks to the "current off-site commercial receptor" (Frosty Freeze Restaurant) represents the most significant possible health risk. The modeling conducted for this scenario assumes that the commercial structure is located immediately down-gradient from the source area. Based on the most recent groundwater gradient data, this may not actually be the case. In order for a potential health risk to develop in this area the concentration of dissolved benzene in the groundwater below the Frosty Freeze building must increase from the current level of 0.035 mg/L (MW-7) to approximately 0.088 mg/L. 0.870

- The calculated risks to the "future on-site commercial receptor" assumes a commercial building will one day be constructed on the northwest corner of the Beacon Station No. 604 property. The likelihood that this scenario may occur is presently controlled by the property owner. If necessary, deed restriction or institutional controls can be incorporated to eliminated the potential health risks.

7.2 Toxicity Assessment Uncertainty

The chemical-specific critical toxicity values (reference dose or slope factor) used in the risk evaluation were supplied (directly or indirectly) by the EPA through the Integrated Risk Information Service. Generally, several uncertainty factors (of 10 each) are applied to the toxicity value that is provided. This conservative over-estimation is designed to account for: (1) interspecies extrapolation and intraspecies

variability; (2) sensitive human sub-populations; (3) less-than-chronic duration of the study; and (4) other deficiencies in the study such as incompleteness of the data base.

8.0 Effects and Special Considerations

Presently, the hydrocarbon-impacted soil and groundwater at the hydrocarbon release site has had no visible effect on the vegetation. Additionally, there are no odors or stained soils which may affect the aesthetic value of the property. Sensitive environmental receptors, recreational areas, or known protected animal habitats are not present in the area surrounding the site.

9.0 Bibliography

1. EPA, 1989, Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A).

2. EPA, 1992, Dermal Exposure Assessment: Principals and Applications

3. EPA Region III Risk Based Concentration Table, EPA Region 3, March 7, 1995.

4. EPA's Integrated Risk Information System (IRIS)

5. EPA's Health Effects Assessment Summary Tables (HEAST)

6. USEPA, 1989: Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF) - USEPA, OAQPS, Air Emission Models, (EPA-450/3-87-026).

APPENDIX A
RBCA Tool Kit Output Tables
(used for fate & transport values only)

Run #1 - 120 feet from source area

RBCA CHEMICAL DATABASE

Physical Property Data

CAS Number	Constituent	type	Molecular Weight (g/mole) MW	ref	Diffusion Coefficients In air (cm2/s) Dair	re	In water (cm2/s) Dwat	re	log (Koc) or log(Kd) (@ 20 - 25 C) (l/kg) Koc	ref	Henry's Law Constant (@ 20 - 25 C) (atm-m3/mol)	(unitless)	re	Vapor Pressure (@ 20 - 25 C) (mm Hg) Pure Component	ref	Solubility (@ 20 - 25 C) (mg/l) Pure Component	ref	acid pKa	base pKb	ref
71-43-2	Benzene	A	78.1	5	9.30E-02	A	1.10E-05	A	1.58	A	5.29E-03	2.20E-01	A	9.52E+01	4	1.75E+03	A			
100-41-4	Ethylbenzene	A	106.2	5	7.60E-02	A	8.50E-06	A	1.98	A	7.69E-03	3.20E-01	A	1.00E+01	4	1.52E+02	5			
108-88-3	Toluene	A	92.4	5	8.50E-02	A	9.40E-06	A	2.13	A	6.25E-03	2.60E-01	A	3.00E+01	4	5.15E+02	29			
1330-20-7	Xylene (mixed isomers)	A	106.2	5	7.20E-02	A	8.50E-06	A	2.38	A	6.97E-03	2.90E-01	A	7.00E+00	4	1.98E+02	5			

Site Name: Beacon Station No. Site Location: Livermoore, CA Completed By: Dale Littlejohn Date Completed: 5/27/1997

Software version: v 1.0

RBCA CHEMICAL DATABASE

Toxicity Data

CAS Number	Constituent	Reference Dose (mg/kg/day) Oral RfD_oral	ref	Inhalation RfD_Inhal	re	Slope Factors 1/(mg/kg/day) Oral SF_oral	ref	Inhalation SF_Inhal	ref	EPA Weight of Evidence	Is Constituent Carcinogenic ?
71-43-2	Benzene	-	R	1.70E-03	R	2.90E-02	A	2.90E-02	A	A	TRUE
100-41-4	Ethylbenzene	1.00E-01	A	2.86E-01	A	-	R	-	R	D	FALSE
108-88-3	Toluene	2.00E-01	A,R	1.14E-01	,	-	R	-	R	D	FALSE
1330-20-7	Xylene (mixed isomers)	2.00E+00	A,R	2.00E+00	A	-	R	-	R	D	FALSE

Site Name: Beacon Statio Site Location: Livermoore, CA Completed By: Dale Littlejohn Date Completed: 5/27/1997

Software version: v 1.0

RBCA CHEMICAL DATABASE

Miscellaneous Chemical Data

CAS Number	Constituent	Maximum Contaminant Level MCL (mg/L)	Maximum Contaminant Level reference	Permissible Exposure Limit PEL/TLV (mg/m3)	PEL/TLV ref	Relative Absorption Factors Oral	Relative Absorption Factors Dermal	Detection Limits Groundwater (mg/L)	Groundwater ref	Detection Limits Soil (mg/kg)	Soil re	Half Life (First-Order Decay) (days) Saturated	Half Life (First-Order Decay) (days) Unsaturated	Half Life ref
71-43-2	Benzene	5.00E-03	52 FR 25690	3.20E+00	OSHA	1	0.5	0.002	C	0.005	S	720	720	H
100-41-4	Ethylbenzene	7.00E-01	6 FR 3526 (30 Jan 91	4.34E+02	ACGIH	1	0.5	0.002	C	0.005	S	228	228	H
108-88-3	Toluene	1.00E+00	6 FR 3526 (30 Jan 91	1.47E+02	ACGIH	1	0.5	0.002	C	0.005	S	28	28	H
1330-20-7	Xylene (mixed isomers)	1.00E+01	6 FR 3526 (30 Jan 91	4.34E+02	ACGIH	1	0.5	0.005	C	0.005	S	360	360	H

Site Name: Beacon Statio Site Location: Livermoore, CA Completed By: Dale Littlejohn Date Completed: 5/27/1997

Software version: v 1.0

RBCA SITE ASSESSMENT | Input Screen 7

REPRESENTATIVE COC CONCENTRATIONS IN SOURCE MEDIA

(Complete the following table)

CONSTITUENT	Representative COC Concentration in Groundwater value (mg/L)	note	in Surface Soil value (mg/kg	note	in Subsurface Soil alue (mg/kg	note
Benzene	1.8E+0				2.1E+1	
Ethylbenzene	5.2E-1				1.1E+2	
Toluene	1.1E+0				1.6E+2	
Xylene (mixed isomers)	2.8E+0				7.0E+2	

Site Name: Beacon Station No. 604
Site Location: Livermoore, CA

Completed By: Dale Littlejohn
Date Completed: 5/27/1997

RBCA SITE ASSESSMENT | Input Screen 9.4

GROUNDWATER DAF VALUES

(Enter DAF values in the grey area of the following table)

CONSTITUENT	Dilution Attenuation Factor (DAF) in Groundwater	
	Residential Receptor	Comm./Ind. Receptor
Benzene	1.0E+0	1.8E+0
Ethylbenzene	1.0E+0	1.8E+0
Toluene	1.0E+0	1.8E+0
Xylene (mixed isomers)	1.0E+0	1.8E+0

Site Name: Beacon Station No. 604
Site Location: Livermoore, CA

Completed By: Dale Littlejohn
Date Completed: 5/27/1997

Site Name: Beacon Station No. 604 | Site Location: Livermoore, CA | Completed By: Dale Littlejohn | Date Completed: 5/27/1997 | 6 OF 6

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAY IS ACTIVE)

GROUNDWATER: INGESTION

Constituents of Concern	Exposure Concentration: 1) Source Medium — Groundwater Concentration (mg/L)	2) NAF Value (dim) — Receptor: Off-Site Commercial	3) Exposure Medium — Groundwater: POE Conc. (mg/L) (1)/(2): Off-Site Commercial	4) Exposure Multiplier (IRxEFxED)/(BWxAT) (L/kg-day): Off-Site Commercial	5) Average Daily Intake Rate (mg/kg-day): Off-Site Commercial	MAX. PATHWAY INTAKE (mg/kg-day) (Maximum intake of active pathways soil leaching & groundwater routes.): Off-Site Commercial
Benzene	1.8E+0	1.8E+0	1.0E+0	3.5E-3	3.6E-3	3.6E-3
Ethylbenzene	5.2E-1	1.8E+0	2.9E-1	9.8E-3	2.9E-3	2.9E-3
Toluene	1.1E+0	1.8E+0	6.2E-1	9.8E-3	6.1E-3	6.1E-3
Xylene (mixed isomers)	2.8E+0	1.8E+0	1.6E+0	9.8E-3	1.5E-2	1.5E-2

NOTE: AT = Averaging time (days) | BW = Body Weight (kg) | CF = Units conversion factor | ED = Exp. duration (yrs) | EF = Exposure frequencey (days/yr) | IR = Intake rate (L/day or mg/day) | POE = Point of exposure

Serial: G-483-YPX-784 | Software: GSI RBCA Spreadsheet Version: v 1.0

Site Name: Beacon Station No. 604 | Site Location: Livermoore, CA | Completed By: Dale Littlejohn | Date Completed: 5/27/1997 | 3 OF 3

TIER 2 PATHWAY RISK CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAYS ARE ACTIVE)

Constituents of Concern	(1) EPA Carcinogenic Classification	CARCINOGENIC RISK: (2) Total Carcinogenic Intake Rate (mg/kg/day)		(3) Oral Slope Factor	(4) Individual COC Risk (2) x (3)		TOXIC EFFECTS: (5) Total Toxicant Intake Rate (mg/kg/day)		(6) Oral Reference Dose	(7) Individual COC Hazard Quotient (5) / (6)	
			Off-Site Commercial	(mg/kg-day)^-1		Off-Site Commercial		Off-Site Commercial	(mg/kg-day)		Off-Site Commercial
Benzene	A		3.6E-3	2.9E-2		1.0E-4					
Ethylbenzene	D							2.9E-3	1.0E-1		2.9E-2
Toluene	D							6.1E-3	2.0E-1		3.0E-2
Xylene (mixed isomers)	D							1.5E-2	2.0E+0		7.7E-3

Total Pathway Carcinogenic Risk = 0.0E+0 | 1.0E-4

Total Pathway Hazard Index = 0.0E+0 | 6.7E-2

Site Name: Beacon Station No. 604
Site Location: Livermoore, CA

Completed By: Dale Littlejohn
Date Completed: 5/27/1997

GROUNDWATER SSTL VALUES

Target Risk (Class A & B) 1.0E-6
Target Risk (Class C) 1.0E-5
Target Hazard Quotient 1.0E+0

☐ MCL exposure limit?
☐ PEL exposure limit?

Calculation Option: 2

SSTL Results For Complete Exposure Pathways ("x" if Complete)

CONSTITUENTS OF CONCERN		Representative Concentration	X Groundwater Ingestion			X Groundwater Volatilization to Indoor Air		Groundwater Volatilization to Outdoor Air		Applicable SSTL	SSTL Exceeded ?	Required CRF
CAS No.	Name	(mg/L)	Residential: (on-site)	Commercial: 120 feet	Regulatory(MCL): 120 feet	Residential: (on-site)	Commercial: (on-site)	Residential (on-site)	Commercial: (on-site)	(mg/L	"■" If yes	Only if "yes" left
71-43-2	Benzene	1.8E+0	NA	1.7E-2	NA	NA	8.4E-2	NA	NA	1.7E-2	■	1.0E+02
100-41-4	Ethylbenzene	5.2E-1	NA	1.8E+1	NA	NA	>Sol	NA	NA	1.8E+1	☐	<1
108-88-3	Toluene	1.1E+0	NA	3.6E+1	NA	NA	9.6E+1	NA	NA	3.6E+1	☐	<1
1330-20-7	Xylene (mixed isomers)	2.8E+0	NA	>Sol	NA	NA	>Sol	NA	NA	>Sol	☐	<1

Run #2 - 1800 feet from source area

RBCA TIER 1/TIER 2 EVALUATION

Output Table 1

Site Name: Beacon Station No. 604 | Job Identification: BS604-120 | Software: GSI RBCA Spreadsheet
Site Location: Livermoore, CA | Date Completed: 5/27/97 | Version: v 1.0
Completed By: Dale Littlejohn

NOTE: values which differ from Tier 1 default values are shown in bold italics and underlined.

DEFAULT PARAMETERS

Exposure Parameter	Definition (Units)	Residential Adult	Residential (1-6yrs)	Residential (1-16 yrs)	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
ATc	Averaging time for carcinogens (yr)	70				
ATn	Averaging time for non-carcinogens (yr)	30	6	16	25	1
BW	Body Weight (kg)	70	15	35	70	
ED	Exposure Duration (yr)	30	6	16	25	1
EF	Exposure Frequency (days/yr)	350			250	180
EF.Derm	Exposure Frequency for dermal exposure	350			250	
IRgw	Ingestion Rate of Water (l/day)	2			1	
IRs	Ingestion Rate of Soil (mg/day)	100	200		50	100
IRadj	Adjusted soil ing. rate (mg*yr/kg-d)	1.1E+02			9.4E+01	
IRa.in	Inhalation rate indoor (m^3/day)	15			20	
IRa.out	Inhalation rate outdoor (m^3/day)	20			20	10
SA	Skin surface area (dermal) (cm^2)	***3.2E+03***		***2.0E+03***	3.2E+03	3.2E+03
SAadj	Adjusted dermal area (cm^2*yr/kg)	1.6E+03			1.3E+03	
M	Soil to Skin adherence factor	***0.5***				
AAFs	Age adjustment on soil ingestion	FALSE			FALSE	
AAFd	Age adjustment on skin surface area	FALSE			FALSE	
tox	Use EPA tox data for air (or PEL based)	TRUE				
gwMCL?	Use MCL as exposure limit in groundwater?	FALSE				

Matrix of Exposed Persons to Complete Exposure Pathways		Residential	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
Groundwater Pathways:				
GW.i	Groundwater Ingestion	FALSE	TRUE	
GW.v	Volatilization to Outdoor Air	FALSE	FALSE	
GW.b	Vapor Intrusion to Buildings	FALSE	TRUE	
Soil Pathways				
S.v	Volatiles from Subsurface Soils	FALSE	FALSE	
SS.v	Volatiles and Particulate Inhalation	FALSE	FALSE	FALSE
SS.d	Direct Ingestion and Dermal Contact	FALSE	FALSE	FALSE
S.l	Leaching to Groundwater from all Soils	FALSE	FALSE	
S.b	Intrusion to Buildings - Subsurface Soils	FALSE	TRUE	

Matrix of Receptor Distance and Location on- or off-site		Residential Distance	Residential On-Site	Commercial/Industrial Distance	Commercial/Industrial On-Site
GW	Groundwater receptor (cm)	3.7E+03	FALSE	3.7E+03	FALSE
S	Inhalation receptor (cm)		FALSE		FALSE

Matrix of Target Risks		Individual	Cumulative
TRab	Target Risk (class A&B carcinogens)	1.0E-06	
TRc	Target Risk (class C carcinogens)	1.0E-05	
THQ	Target Hazard Quotient	1.0E+00	
Opt	Calculation Option (1, 2, or 3)	2	
Tier	RBCA Tier	2	

Surface Parameters	Definition (Units)	Residential	Commercial/Industrial Chronic	Commercial/Industrial Construction
t	Exposure duration (yr)	30	25	1
A	Contaminated soil area (cm^2)	***1.0E+06***		***1.0E+06***
W	Length of affected soil parallel to wind (cm)	***1.0E+03***		1.0E+03
W.gw	Length of affected soil parallel to groundwater (c	***1.0E+03***		
Uair	Ambient air velocity in mixing zone (cm/s)	2.3E+02		
delta	Air mixing zone height (cm)	2.0E+02		
Lss	Definition of surficial soils (cm)	***6.1E+01***		
Pe	Particulate areal emission rate (g/cm^2/s)	2.2E-10		

Groundwater	Definition (Units)	Value
delta.gw	Groundwater mixing zone depth (cm)	2.0E+02
I	Groundwater infiltration rate (cm/yr)	3.0E+01
Ugw	Groundwater Darcy velocity (cm/yr)	***3.1E+02***
Ugw.tr	Groundwater Transport velocity (cm/yr)	***8.1E+02***
Ks	Saturated Hydraulic Conductivity(cm/s)	7.5E-04
grad	Groundwater Gradient (cm/cm)	1.3E-02
Sw	Width of groundwater source zone (cm)	3.7E+03
Sd	Depth of groundwater source zone (cm)	6.1E+02
BC	Biodegradation Capacity (mg/L)	
BIO?	Is Bioattenuation Considered	FALSE
phi.eff	Effective Porosity in Water-Bearing Unit	3.8E-01
foc.sat	Fraction organic carbon in water-bearing unit	***1.0E-02***

Soil	Definition (Units)	Value		
hc	Capillary zone thickness (cm)	5.0E+00		
hv	Vadose zone thickness (cm)	***7.6E+02***		
rho	Soil density (g/cm^3)	1.7		
foc	Fraction of organic carbon in vadose zone	0.01		
phi	Soil porosity in vadose zone	0.38		
Lgw	Depth to groundwater (cm)	***7.6E+02***		
Ls	Depth to top of affected soil (cm)	***5.8E+02***		
Lsubs	Thickness of affected subsurface soils (cm)	***1.8E+02***		
pH	Soil/groundwater pH	6.5		
		capillary	vadose	foundation
phi.w	Volumetric water content	0.342	0.12	0.12
phi.a	Volumetric air content	0.038	0.26	0.26

Building	Definition (Units)	Residential	Commercial
Lb	Building volume/area ratio (cm)	2.0E+02	3.0E+02
ER	Building air exchange rate (s^-1)	1.4E-04	2.3E-04
Lcrk	Foundation crack thickness (cm)	1.5E+01	
eta	Foundation crack fraction	0.01	

Dispersive Transport Parameters	Definition (Units)	Residential	Commercial
Groundwater			
ax	Longitudinal dispersion coefficient (cm)		3.7E+02
ay	Transverse dispersion coefficient (cm)		1.2E+02
az	Vertical dispersion coefficient (cm)		1.8E+01
Vapor			
dcy	Transverse dispersion coefficient (cm)		
dcz	Vertical dispersion coefficient (cm)		

RBCA TIER 1/TIER 2 EVALUATION

Output Table 1

Site Name: Beacon No. 604 (1800 feet) Job Identification: BS604-1800
Site Location: Livermoore, CA Date Completed: 5/27/97
Completed By: Dale Littlejohn

Software: GSI RBCA Spreadsheet
Version: v 1.0

NOTE: values which differ from Tier 1 default values are shown in bold italics and underlined.

DEFAULT PARAMETERS

Exposure Parameter	Definition (Units)	Residential Adult	Residential (1-6yrs)	Residential (1-16 yrs)	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
ATc	Averaging time for carcinogens (yr)	70				
ATn	Averaging time for non-carcinogens (yr)	30	6	16	25	1
BW	Body Weight (kg)	70	15	35	70	
ED	Exposure Duration (yr)	30	6	16	25	1
EF	Exposure Frequency (days/yr)	350			250	180
EF.Derm	Exposure Frequency for dermal exposure	350			250	
IRgw	Ingestion Rate of Water (l/day)	2			1	
IRs	Ingestion Rate of Soil (mg/day)	100	200		50	100
IRadj	Adjusted soil Ing. rate (mg*yr/kg*d)	1.1E+02			9.4E+01	
IRa.in	Inhalation rate indoor (m^3/day)	15			20	
IRa.out	Inhalation rate outdoor (m^3/day)	20			20	10
SA	Skin surface area (dermal) (cm^2)	***3.2E+03***		***2.0E+03***	3.2E+03	3.2E+03
SAadj	Adjusted dermal area (cm^2*yr/kg)	1.6E+03			1.3E+03	
M	Soil to Skin adherence factor	***0.5***				
AAFs	Age adjustment on soil ingestion	FALSE			FALSE	
AAFd	Age adjustment on skin surface area	FALSE			FALSE	
tox	Use EPA tox data for air (or PEL based)	TRUE				
gwMCL?	Use MCL as exposure limit in groundwater?	FALSE				

Surface Parameters	Definition (Units)	Residential	Commercial/Industrial Chronic	Commercial/Industrial Construction
t	Exposure duration (yr)	30	25	1
A	Contaminated soil area (cm^2)	***1.0E+06***		***1.0E+06***
W	Length of affected soil parallel to wind (cm)	***1.0E+03***		1.0E+03
W.gw	Length of affected soil parallel to groundwater (c	***1.0E+03***		
Uair	Ambient air velocity in mixing zone (cm/s)	2.3E+02		
delta	Air mixing zone height (cm)	2.0E+02		
Lss	Definition of surficial soils (cm)	***0.1E+01***		
Pe	Particulate areal emission rate (g/cm^2/s)	2.2E-10		

Groundwater	Definition (Units)	Value
delta.gw	Groundwater mixing zone depth (cm)	2.0E+02
I	Groundwater infiltration rate (cm/yr)	3.0E+01
Ugw	Groundwater Darcy velocity (cm/yr)	***3.1E+02***
Ugw.tr	Groundwater Transport velocity (cm/yr)	***8.1E+02***
Ks	Saturated Hydraulic Conductivity(cm/s)	7.5E-04
grad	Groundwater Gradient (cm/cm)	1.3E-02
Sw	Width of groundwater source zone (cm)	3.7E+03
Sd	Depth of groundwater source zone (cm)	6.1E+02
BC	Biodegradation Capacity (mg/L)	
BIO?	Is Bioattenuation Considered	FALSE
phi.eff	Effective Porosity in Water-Bearing Unit	3.8E-01
foc.sat	Fraction organic carbon in water-bearing unit	***1.0E-02***

Soil	Definition (Units)	Value
hc	Capillary zone thickness (cm)	5.0E+00
hv	Vadose zone thickness (cm)	***7.6E+02***
rho	Soil density (g/cm^3)	1.7
foc	Fraction of organic carbon in vadose zone	0.01
phi	Soil porosity in vadose zone	0.38
Lgw	Depth to groundwater (cm)	***7.6E+02***
Ls	Depth to top of affected soil (cm)	***5.8E+02***
Lsubs	Thickness of affected subsurface soils (cm)	***1.8E+02***
pH	Soil/groundwater pH	6.5

		capillary	vadose	foundation
phi.w	Volumetric water content	0.342	0.12	0.12
phi.a	Volumetric air content	0.038	0.26	0.26

Matrix of Exposed Persons to Complete Exposure Pathways		Residential	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
Groundwater Pathways:				
GW.i	Groundwater Ingestion	FALSE	TRUE	
GW.v	Volatilization to Outdoor Air	FALSE	FALSE	
GW.b	Vapor Intrusion to Buildings	FALSE	FALSE	
Soil Pathways				
S.v	Volatiles from Subsurface Soils	FALSE	FALSE	
SS.v	Volatiles and Particulate Inhalation	FALSE	FALSE	FALSE
SS.d	Direct Ingestion and Dermal Contact	FALSE	FALSE	FALSE
S.l	Leaching to Groundwater from all Soils	FALSE	FALSE	
S.b	Intrusion to Buildings - Subsurface Soils	FALSE	FALSE	

Building	Definition (Units)	Residential	Commercial
Lb	Building volume/area ratio (cm)	2.0E+02	3.0E+02
ER	Building air exchange rate (s^-1)	1.4E-04	2.3E-04
Lcrk	Foundation crack thickness (cm)	1.5E+01	
eta	Foundation crack fraction	0.01	

Matrix of Receptor Distance and Location on- or off-site		Residential Distance	Residential On-Site	Commercial/Industrial Distance	Commercial/Industrial On-Site
GW	Groundwater receptor (cm)	5.5E+04	FALSE	5.5E+04	FALSE
S	Inhalation receptor (cm)		FALSE		FALSE

Matrix of Target Risks		Individual	Cumulative
TRab	Target Risk (class A&B carcinogens)	1.0E-06	
TRc	Target Risk (class C carcinogens)	1.0E-05	
THQ	Target Hazard Quotient	1.0E+00	
Opt	Calculation Option (1, 2, or 3)	2	
Tier	RBCA Tier	2	

Dispersive Transport Parameters	Definition (Units)	Residential	Commercial
Groundwater			
ax	Longitudinal dispersion coefficient (cm)		5.5E+03
ay	Transverse dispersion coefficient (cm)		1.8E+03
az	Vertical dispersion coefficient (cm)		2.7E+02
Vapor			
dcy	Transverse dispersion coefficient (cm)		
dcz	Vertical dispersion coefficient (cm)		

Site Name: Beacon No. 604 (1800 feel) | Site Location: Livermoore, CA | Completed By: Dale Littlejohn | Date Completed: 5/27/1997 | 6 OF 6

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAY IS ACTIVE)

GROUNDWATER: INGESTION

Constituents of Concern	Exposure Concentration 1) Source Medium: Groundwater Concentration (mg/L)	2) NAF Value (dim) Receptor: Off-Site Commercial	3) Exposure Medium: Groundwater: POE Conc. (mg/L) (1)/(2) Off-Site Commercial	4) Exposure Multiplier (IRxEFxED)/(BWxAT) (L/kg-day) Off-Site Commercial	5) Average Daily Intake Rate (mg/kg-day) Off-Site Commercial	MAX. PATHWAY INTAKE (mg/kg-day) (Maximum intake of active pathways soil leaching & groundwater routes.) Off-Site Commercial
Benzene	1.8E+0	2.2E+2	8.2E-3	3.5E-3	2.9E-5	2.9E-5
Ethylbenzene	5.2E-1	2.2E+2	2.4E-3	9.8E-3	2.3E-5	2.3E-5
Toluene	1.1E+0	2.2E+2	5.0E-3	9.8E-3	4.9E-5	4.9E-5
Xylene (mixed isomers)	2.8E+0	2.2E+2	1.3E-2	9.8E-3	1.2E-4	1.2E-4

NOTE: AT = Averaging time (days)
BW = Body Weight (kg)
CF = Units conversion factor
ED = Exp. duration (yrs)
EF = Exposure frequencey (days/yr)
IR = Intake rate (L/day or mg/day)
POE = Point of exposure

Serial: G-483-YPX-784
Software: GSI RBCA Spreadsheet
Version: v 1.0

Site Name: Beacon No. 604 (1800 feet) | Site Location: Livermoore, CA | Completed By: Dale Littlejohn | Date Completed: 5/27/1997 | 3 OF 3

TIER 2 PATHWAY RISK CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAYS ARE ACTIVE)

	CARCINOGENIC RISK					TOXIC EFFECTS				
Constituents of Concern	(1) EPA Carcinogenic Classification	(2) Total Carcinogenic Intake Rate (mg/kg/day) Off-Site	(2) Total Carcinogenic Intake Rate (mg/kg/day) Commercial	(3) Oral Slope Factor (mg/kg-day)^-1	(4) Individual COC Risk (2) x (3) Off-Site	(4) Individual COC Risk (2) x (3) Commercial	(5) Total Toxicant Intake Rate (mg/kg/day) Off-Site	(5) Total Toxicant Intake Rate (mg/kg/day) Commercial	(6) Oral Reference Dose (mg/kg-day)	(7) Individual COC Hazard Quotient (5) / (6) Off-Site	(7) Individual COC Hazard Quotient (5) / (6) Commercial
Benzene	A		2.9E-5	2.9E-2		8.3E-7		2.3E-5	1.0E-1		2.3E-4
Ethylbenzene	D							4.9E-5	2.0E-1		2.5E-4
Toluene	D							1.2E-4	2.0E+0		6.2E-5
Xylene (mixed isomers)	D										

Total Pathway Carcinogenic Risk = 0.0E+0 | 8.3E-7

Total Pathway Hazard Index = 0.0E+0 | 5.4E-4

Serial: G-483-YPX-784 Software: GSI RBCA Spreadsheet Version: v 1.0

RBCA SITE ASSESSMENT

Tier 2 Worksheet 9.3

Site Name: Beacon No. 604 (1800 feet)
Site Location: Livermoore, CA

Completed By: Dale Littlejohn
Date Completed: 5/27/1997

GROUNDWATER SSTL VALUES

Target Risk (Class A & B) 1.0E-6
Target Risk (Class C) 1.0E-5
Target Hazard Quotient 1.0E+0

☐ MCL exposure limit?
☐ PEL exposure limit?

Calculation Option: 2

SSTL Results For Complete Exposure Pathways ("x" if Complete)

CONSTITUENTS OF CONCERN		Representative Concentration	X Groundwater Ingestion			Groundwater Volatilization to Indoor Air		Groundwater Volatilization to Outdoor Air		Applicable SSTL	SSTL Exceeded ?	Required CRF
CAS No.	Name	(mg/L)	Residential: (on-site)	Commercial: 1800 feet	Regulatory(MCL): 1800 feet	Residential: (on-site)	Commercial: (on-site)	Residential (on-site)	Commercial: (on-site)	(mg/L	"■" If yes	Only if "yes" left
71-43-2	Benzene	1.8E+0	NA	2.2E+0	NA	NA	NA	NA	NA	2.2E+0	☐	<1
100-41-4	Ethylbenzene	5.2E-1	NA	>Sol	NA	NA	NA	NA	NA	>Sol	☐	<1
108-88-3	Toluene	1.1E+0	NA	>Sol	NA	NA	NA	NA	NA	>Sol	☐	<1
1330-20-7	Xylene (mixed isomers)	2.8E+0	NA	>Sol	NA	NA	NA	NA	NA	>Sol	☐	<1

Software: GSI RBCA Spreadsheet
Version: v 1.0

Serial: 0

Run #3 - 2500 feet from source area

RBCA TIER 1/TIER 2 EVALUATION

Output Table 1

Site Name: Beacon No. 604 (2500 feet) Job Identification: BS604-2500
Site Location: Livermoore, CA Date Completed: 5/27/97
Completed By: Dale Littlejohn

Software: GSI RBCA Spreadsheet
Version: v 1.0

NOTE: values which differ from Tier 1 default values are shown in bold italics and underlined.

DEFAULT PARAMETERS

Exposure Parameter	Definition (Units)	Residential Adult	Residential (1-6yrs)	Residential (1-16 yrs)	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
ATc	Averaging time for carcinogens (yr)	70				
ATn	Averaging time for non-carcinogens (yr)	30	6	16	25	1
BW	Body Weight (kg)	70	15	35	70	
ED	Exposure Duration (yr)	30	6	16	25	1
EF	Exposure Frequency (days/yr)	350			250	180
EF.Derm	Exposure Frequency for dermal exposure	350			250	
IRgw	Ingestion Rate of Water (l/day)	2			1	
IRs	Ingestion Rate of Soil (mg/day)	100	200		50	100
IRadj	Adjusted soil ing. rate (mg-yr/kg-d)	1.1E+02			9.4E+01	
IRa.in	Inhalation rate indoor (m^3/day)	15			20	
IRa.out	Inhalation rate outdoor (m^3/day)	20			20	10
SA	Skin surface area (dermal) (cm^2)	***3.2E+03***		***2.0E+03***	3.2E+03	3.2E+03
SAadj	Adjusted dermal area (cm^2-yr/kg)	1.6E+03			1.3E+03	
M	Soil to Skin adherence factor	***0.5***				
AAFs	Age adjustment on soil ingestion	FALSE			FALSE	
AAFd	Age adjustment on skin surface area	FALSE			FALSE	
tox	Use EPA tox data for air (or PEL based)	TRUE				
gwMCL?	Use MCL as exposure limit in groundwater?	FALSE				

Matrix of Exposed Persons to Complete Exposure Pathways		Residential	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
Groundwater Pathways:				
GW.i	Groundwater Ingestion	FALSE	TRUE	
GW.v	Volatilization to Outdoor Air	FALSE	FALSE	
GW.b	Vapor Intrusion to Buildings	FALSE	FALSE	
Soil Pathways				
S.v	Volatiles from Subsurface Soils	FALSE	FALSE	
SS.v	Volatiles and Particulate Inhalation	FALSE	FALSE	FALSE
SS.d	Direct Ingestion and Dermal Contact	FALSE	FALSE	FALSE
S.l	Leaching to Groundwater from all Soils	FALSE	FALSE	
S.b	Intrusion to Buildings - Subsurface Soils	FALSE	FALSE	

Matrix of Receptor Distance and Location on- or off-site		Residential Distance	Residential On-Site	Commercial/Industrial Distance	Commercial/Industrial On-Site
GW	Groundwater receptor (cm)	7.6E+04	FALSE	7.6E+04	FALSE
S	Inhalation receptor (cm)		FALSE		FALSE

Matrix of Target Risks		Individual	Cumulative
TRab	Target Risk (class A&B carcinogens)	1.0E-06	
TRc	Target Risk (class C carcinogens)	1.0E-05	
THQ	Target Hazard Quotient	1.0E+00	
Opt	Calculation Option (1, 2, or 3)	2	
Tier	RBCA Tier	2	

Surface Parameters	Definition (Units)	Residential	Commercial/Industrial Chronic	Commercial/Industrial Construction
t	Exposure duration (yr)	30	25	1
A	Contaminated soil area (cm^2)	***1.0E+06***		***1.0E+06***
W	Length of affected soil parallel to wind (cm)	***1.0E+03***		1.0E+03
W.gw	Length of affected soil parallel to groundwater (c	***1.0E+03***		
Uair	Ambient air velocity in mixing zone (cm/s)	2.3E+02		
delta	Air mixing zone height (cm)	2.0E+02		
Lss	Definition of surficial soils (cm)	***6.1E+01***		
Pe	Particulate areal emission rate (g/cm^2/s)	2.2E-10		

Groundwater	Definition (Units)	Value
delta.gw	Groundwater mixing zone depth (cm)	2.0E+02
I	Groundwater infiltration rate (cm/yr)	3.0E+01
Ugw	Groundwater Darcy velocity (cm/yr)	***3.1E+02***
Ugw.tr	Groundwater Transport velocity (cm/yr)	***8.1E+02***
Ks	Saturated Hydraulic Conductivity(cm/s)	7.5E-04
grad	Groundwater Gradient (cm/cm)	1.3E-02
Sw	Width of groundwater source zone (cm)	3.7E+03
Sd	Depth of groundwater source zone (cm)	6.1E+02
BC	Biodegradation Capacity (mg/L)	
BIO?	Is Bioattenuation Considered	FALSE
phi.eff	Effective Porosity in Water-Bearing Unit	3.8E-01
foc.sat	Fraction organic carbon in water-bearing unit	***1.0E-02***

Soil	Definition (Units)	Value		
hc	Capillary zone thickness (cm)	5.0E+00		
hv	Vadose zone thickness (cm)	***7.6E+02***		
rho	Soil density (g/cm^3)	1.7		
foc	Fraction of organic carbon in vadose zone	0.01		
phi	Soil porosity in vadose zone	0.38		
Lgw	Depth to groundwater (cm)	***7.6E+02***		
Ls	Depth to top of affected soil (cm)	***5.8E+02***		
Lsubs	Thickness of affected subsurface soils (cm)	***1.8E+02***		
pH	Soil/groundwater pH	6.5		
		capillary	vadose	foundation
phi.w	Volumetric water content	0.342	0.12	0.12
phi.a	Volumetric air content	0.038	0.26	0.26

Building	Definition (Units)	Residential	Commercial
Lb	Building volume/area ratio (cm)	2.0E+02	3.0E+02
ER	Building air exchange rate (s^-1)	1.4E-04	2.3E-04
Lcrk	Foundation crack thickness (cm)	1.5E+01	
eta	Foundation crack fraction	0.01	

Dispersive Transport Parameters	Definition (Units)	Residential	Commercial
Groundwater			
ax	Longitudinal dispersion coefficient (cm)		7.6E+03
ay	Transverse dispersion coefficient (cm)		2.5E+03
az	Vertical dispersion coefficient (cm)		3.8E+02
Vapor			
dcy	Transverse dispersion coefficient (cm)		
dcz	Vertical dispersion coefficient (cm)		

Site Name: Beacon No. 604 (2500 feet) | Site Location: Livermoore, CA | Completed By: Dale Littlejohn | Date Completed: 5/27/1997 | 6 OF 6

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAY IS ACTIVE)

GROUNDWATER: INGESTION

Constituents of Concern	Exposure Concentration: 1) Source Medium — Groundwater Concentration (mg/L)	2) NAF Value (dim) — Receptor: Off-Site Commercial	3) Exposure Medium — Groundwater: POE Conc. (mg/L) (1)(2): Off-Site Commercial	4) Exposure Multiplier (IRxEFxED)/(BWxAT) (L/kg-day): Off-Site Commercial	5) Average Daily Intake Rate (mg/kg-day): Off-Site Commercial	MAX. PATHWAY INTAKE (mg/kg-day) (Maximum intake of active pathways soil leaching & groundwater routes.): Off-Site Commercial
Benzene	1.8E+0	4.2E+2	4.3E-3	3.5E-3	1.5E-5	1.5E-5
Ethylbenzene	5.2E-1	4.2E+2	1.2E-3	9.8E-3	1.2E-5	1.2E-5
Toluene	1.1E+0	4.2E+2	2.6E-3	9.8E-3	2.6E-5	2.6E-5
Xylene (mixed isomers)	2.8E+0	4.2E+2	6.6E-3	9.8E-3	6.5E-5	6.5E-5

NOTE: AT = Averaging time (days)
BW = Body Weight (kg)
CF = Units conversion factor
ED = Exp. duration (yrs)
EF = Exposure frequency (days/yr)
IR = Intake rate (L/day or mg/day)
POE = Point of exposure

Serial: G-483-YPX-784
Software: GSI RBCA Spreadsheet
Version: v 1.0

Site Name: Beacon No. 604 (2500 feet) | Site Location: Livermoore, CA | Completed By: Dale Littlejohn | Date Completed: 5/27/1997 | 3 OF 3

TIER 2 PATHWAY RISK CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAYS ARE ACTIVE)

	CARCINOGENIC RISK						TOXIC EFFECTS				
	(1) EPA	(2) Total Carcinogenic Intake Rate (mg/kg/day)		(3) Oral Slope Factor	(4) Individual COC Risk (2) x (3)		(5) Total Toxicant Intake Rate (mg/kg/day)		(6) Oral Reference Dose	(7) Individual COC Hazard Quotient (5) / (6)	
Constituents of Concern	Carcinogenic Classification		Off-Site Commercial	(mg/kg-day)^-1		Off-Site Commercial		Off-Site Commercial	(mg/kg-day)		Off-Site Commercial
Benzene	A		1.5E-5	2.9E-2		4.3E-7					
Ethylbenzene	D							1.2E-5	1.0E-1		1.2E-4
Toluene	D							2.6E-5	2.0E-1		1.3E-4
Xylene (mixed isomers)	D							6.5E-5	2.0E+0		3.2E-5
Total Pathway Carcinogenic Risk =					0.0E+0	4.3E-7	***Total Pathway Hazard Index =***			0.0E+0	2.6E-4

RBCA SITE ASSESSMENT

Tier 2 Worksheet 9.3

Site Name: Beacon No. 604 (2500 feet)
Site Location: Livermoore, CA

Completed By: Dale Littlejohn
Date Completed: 5/27/1997

GROUNDWATER SSTL VALUES

Target Risk (Class A & B) 1.0E-6
Target Risk (Class C) 1.0E-5
Target Hazard Quotient 1.0E+0

☐ MCL exposure limit?
☐ PEL exposure limit?

Calculation Option: 2

SSTL Results For Complete Exposure Pathways ("x" if Complete)

CONSTITUENTS OF CONCERN		Representative Concentration	X Groundwater Ingestion			Groundwater Volatilization to Indoor Air		Groundwater Volatilization to Outdoor Air		Applicable SSTL	SSTL Exceeded ?	Required CRF
CAS No.	Name	(mg/L)	Residential: (on-site)	Commercial: 2500 feet	Regulatory(MCL): 2500 feet	Residential: (on-site)	Commercial: (on-site)	Residential (on-site)	Commercial: (on-site)	(mg/L	"■" If yes	Only if "yes" left
71-43-2	Benzene	1.8E+0	NA	4.2E+0	NA	NA	NA	NA	NA	4.2E+0	☐	<1
100-41-4	Ethylbenzene	5.2E-1	NA	>Sol	NA	NA	NA	NA	NA	>Sol	☐	<1
108-88-3	Toluene	1.1E+0	NA	>Sol	NA	NA	NA	NA	NA	>Sol	☐	<1
1330-20-7	Xylene (mixed isomers)	2.8E+0	NA	>Sol	NA	NA	NA	NA	NA	>Sol	☐	<1

Software: GSI RBCA Spreadsheet
Version: v 1.0

Serial: 0

Run #4 - 2700 feet from source area

RBCA TIER 1/TIER 2 EVALUATION

Output Table 1

Site Name: Beacon No. 604 (2700 feet) Job Identification: BS604-2700
Site Location: Livermoore, CA Date Completed: 5/27/97
Completed By: Dale Littlejohn

Software: GSI RBCA Spreadsheet
Version: v 1.0

NOTE: values which differ from Tier 1 default values are shown in bold italics and underlined.

DEFAULT PARAMETERS

Exposure Parameter	Definition (Units)	Residential Adult	Residential (1-6yrs)	Residential (1-16 yrs)	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
ATc	Averaging time for carcinogens (yr)	70				
ATn	Averaging time for non-carcinogens (yr)	30	6	16	25	1
BW	Body Weight (kg)	70	15	35	70	
ED	Exposure Duration (yr)	30	6	16	25	1
EF	Exposure Frequency (days/yr)	350			250	180
EF.Derm	Exposure Frequency for dermal exposure	350			250	
IRgw	Ingestion Rate of Water (l/day)	2			1	
IRs	Ingestion Rate of Soil (mg/day)	100	200		50	100
IRadj	Adjusted soil ing. rate (mg*yr/kg-d)	1.1E+02			9.4E+01	
IRa.in	Inhalation rate indoor (m^3/day)	15			20	
IRa.out	Inhalation rate outdoor (m^3/day)	20			20	10
SA	Skin surface area (dermal) (cm^2)	***3.2E+03***		***2.0E+03***	3.2E+03	3.2E+03
SAadj	Adjusted dermal area (cm^2*yr/kg)	1.6E+03			1.3E+03	
M	Soil to Skin adherence factor	***0.5***				
AAFs	Age adjustment on soil ingestion	FALSE			FALSE	
AAFd	Age adjustment on skin surface area	FALSE			FALSE	
tox	Use EPA tox data for air (or PEL based)	TRUE				
gwMCL?	Use MCL as exposure limit in groundwater?	FALSE				

Matrix of Exposed Persons to Complete Exposure Pathways		Residential	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
Groundwater Pathways:				
GW.i	Groundwater Ingestion	FALSE	TRUE	
GW.v	Volatilization to Outdoor Air	FALSE	FALSE	
GW.b	Vapor Intrusion to Buildings	FALSE	FALSE	
Soil Pathways				
S.v	Volatiles from Subsurface Soils	FALSE	FALSE	
SS.v	Volatiles and Particulate Inhalation	FALSE	FALSE	FALSE
SS.d	Direct Ingestion and Dermal Contact	FALSE	FALSE	FALSE
S.l	Leaching to Groundwater from all Soils	FALSE	FALSE	
S.b	Intrusion to Buildings - Subsurface Soils	FALSE	FALSE	

Matrix of Receptor Distance and Location on- or off-site		Residential Distance	Residential On-Site	Commercial/Industrial Distance	Commercial/Industrial On-Site
GW	Groundwater receptor (cm)	8.2E+04	FALSE	8.2E+04	FALSE
S	Inhalation receptor (cm)		FALSE		FALSE

Matrix of Target Risks		Individual	Cumulative
TRab	Target Risk (class A&B carcinogens)	1.0E-06	
TRc	Target Risk (class C carcinogens)	1.0E-05	
THQ	Target Hazard Quotient	1.0E+00	
Opt	Calculation Option (1, 2, or 3)	2	
Tier	RBCA Tier	2	

Surface Parameters	Definition (Units)	Residential	Commercial/Industrial Chronic	Commercial/Industrial Construction
t	Exposure duration (yr)	30	25	1
A	Contaminated soil area (cm^2)	***1.0E+06***		***1.0E+06***
W	Length of affected soil parallel to wind (cm)	***1.0E+03***		1.0E+03
W.gw	Length of affected soil parallel to groundwater (c	***1.0E+03***		
Uair	Ambient air velocity in mixing zone (cm/s)	2.3E+02		
delta	Air mixing zone height (cm)	2.0E+02		
Lss	Definition of surficial soils (cm)	***6.1E+01***		
Pe	Particulate areal emission rate (g/cm^2/s)	2.2E-10		

Groundwater	Definition (Units)	Value
delta.gw	Groundwater mixing zone depth (cm)	2.0E+02
I	Groundwater infiltration rate (cm/yr)	3.0E+01
Ugw	Groundwater Darcy velocity (cm/yr)	***3.1E+02***
Ugw.tr	Groundwater Transport velocity (cm/yr)	***8.1E+02***
Ks	Saturated Hydraulic Conductivity(cm/s)	7.5E-04
grad	Groundwater Gradient (cm/cm)	1.3E-02
Sw	Width of groundwater source zone (cm)	3.7E+03
Sd	Depth of groundwater source zone (cm)	8.1E+02
BC	Biodegradation Capacity (mg/L)	
BIO?	Is Bioattenuation Considered	FALSE
phi.eff	Effective Porosity in Water-Bearing Unit	3.8E-01
foc.sat	Fraction organic carbon in water-bearing unit	***1.0E-02***

Soil	Definition (Units)	Value		
hc	Capillary zone thickness (cm)	5.0E+00		
hv	Vadose zone thickness (cm)	***7.6E+02***		
rho	Soil density (g/cm^3)	1.7		
foc	Fraction of organic carbon in vadose zone	0.01		
phi	Soil porosity in vadose zone	0.38		
Lgw	Depth to groundwater (cm)	***7.6E+02***		
Ls	Depth to top of affected soil (cm)	***5.8E+02***		
Lsubs	Thickness of affected subsurface soils (cm)	***1.8E+02***		
pH	Soil/groundwater pH	6.5		
		capillary	vadose	foundation
phi.w	Volumetric water content	0.342	0.12	0.12
phi.a	Volumetric air content	0.038	0.26	0.26

Building	Definition (Units)	Residential	Commercial
Lb	Building volume/area ratio (cm)	2.0E+02	3.0E+02
ER	Building air exchange rate (s^-1)	1.4E-04	2.3E-04
Lcrk	Foundation crack thickness (cm)	1.5E+01	
eta	Foundation crack fraction	0.01	

Dispersive Transport Parameters	Definition (Units)	Residential	Commercial
Groundwater			
ax	Longitudinal dispersion coefficient (cm)		8.2E+03
ay	Transverse dispersion coefficient (cm)		2.7E+03
az	Vertical dispersion coefficient (cm)		4.1E+02
Vapor			
dcy	Transverse dispersion coefficient (cm)		
dcz	Vertical dispersion coefficient (cm)		

Site Name: Beacon No. 604 (2700 feet) | Site Location: Livermoore, CA | Completed By: Dale Littlejohn | Date Completed: 5/27/1997 | 6 OF 6

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAY IS ACTIVE)

GROUNDWATER: INGESTION

Constituents of Concern	Exposure Concentration: 1) Source Medium — Groundwater Concentration (mg/L)	2) NAF Value (dim) — Receptor: Off-Site Commercial	3) Exposure Medium — Groundwater: POE Conc. (mg/L) (1)/(2): Off-Site Commercial	4) Exposure Multiplier (IRxEFxED)/(BWxAT) (L/kg-day): Off-Site Commercial	5) Average Daily Intake Rate (mg/kg-day): Off-Site Commercial	MAX. PATHWAY INTAKE (mg/kg-day) (Maximum intake of active pathways soil leaching & groundwater routes.): Off-Site Commercial
Benzene	1.8E+0	4.9E+2	3.7E-3	3.5E-3	1.3E-5	1.3E-5
Ethylbenzene	5.2E-1	4.9E+2	1.1E-3	9.8E-3	1.0E-5	1.0E-5
Toluene	1.1E+0	4.9E+2	2.2E-3	9.8E-3	2.2E-5	2.2E-5
Xylene (mixed isomers)	2.8E+0	4.9E+2	5.7E-3	9.8E-3	5.5E-5	5.5E-5

NOTE: AT = Averaging time (days)
BW = Body Weight (kg)
CF = Units conversion factor
ED = Exp. duration (yrs)
EF = Exposure frequencey (days/yr)
IR = Intake rate (L/day or mg/day)
POE = Point of exposure

Serial: G-483-YPX-784
Software: GSI RBCA Spreadsheet
Version: v 1.0

Site Name: Beacon No. 604 (2700 feet) | Site Location: Livermoore, CA | Completed By: Dale Littlejohn | Date Completed: 5/27/1997 | 3 OF 3

TIER 2 PATHWAY RISK CALCULATION

GROUNDWATER EXPOSURE PATHWAYS ■ (CHECKED IF PATHWAYS ARE ACTIVE)

Constituents of Concern	(1) EPA Carcinogenic Classification	CARCINOGENIC RISK: (2) Total Carcinogenic Intake Rate (mg/kg/day) Off-Site	Commercial	(3) Oral Slope Factor (mg/kg-day)^-1	(4) Individual COC Risk (2) x (3) Off-Site	Commercial	TOXIC EFFECTS: (5) Total Toxicant Intake Rate (mg/kg/day) Off-Site	Commercial	(6) Oral Reference Dose (mg/kg-day)	(7) Individual COC Hazard Quotient (5) / (6) Off-Site	Commercial
Benzene	A		1.3E-5	2.9E-2		3.7E-7					
Ethylbenzene	D							1.0E-5	1.0E-1		1.0E-4
Toluene	D							2.2E-5	2.0E-1		1.1E-4
Xylene (mixed isomers)	D							5.5E-5	2.0E+0		2.8E-5

Total Pathway Carcinogenic Risk = 0.0E+0 | 3.7E-7

Total Pathway Hazard Index = 0.0E+0 | 2.4E-4

Serial: G-483-YPX-784 Software: GSI RBCA Spreadsheet Version: v 1.0

RBCA SITE ASSESSMENT

Tier 2 Worksheet 9.3

Site Name: Beacon No. 604 (2700 feet)
Site Location: Livermoore, CA

Completed By: Dale Littlejohn
Date Completed: 5/27/1997

GROUNDWATER SSTL VALUES

Target Risk (Class A & B) 1.0E-6
Target Risk (Class C) 1.0E-5
Target Hazard Quotient 1.0E+0

☐ MCL exposure limit?
☐ PEL exposure limit?

Calculation Option: 2

SSTL Results For Complete Exposure Pathways ("x" If Complete)

CONSTITUENTS OF CONCERN		Representative Concentration	X Groundwater Ingestion			Groundwater Volatilization to Indoor Air		Groundwater Volatilization to Outdoor Air		Applicable SSTL	SSTL Exceeded ?	Required CRF
CAS No.	Name	(mg/L)	Residential: (on-site)	Commercial: 2700 feet	Regulatory(MCL): 2700 feet	Residential: (on-site)	Commercial: (on-site)	Residential (on-site)	Commercial: (on-site)	(mg/L	"■" If yes	Only if "yes" left
71-43-2	Benzene	1.8E+0	NA	4.8E+0	NA	NA	NA	NA	NA	4.8E+0	☐	<1
100-41-4	Ethylbenzene	5.2E-1	NA	>Sol	NA	NA	NA	NA	NA	>Sol	☐	<1
108-88-3	Toluene	1.1E+0	NA	>Sol	NA	NA	NA	NA	NA	>Sol	☐	<1
1330-20-7	Xylene (mixed isomers)	2.8E+0	NA	>Sol	NA	NA	NA	NA	NA	>Sol	☐	<1

Software: GSI RBCA Spreadsheet
Version: v 1.0

Serial: 0

APPENDIX B
Exposure Point Volatilization Spreadsheets

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (source area)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Field Measurements				
C_{soil} (mg/kg)	20.9	160	110	700
C_{gw} - leach from soil (mg/L)	0.223	0.514	0.099	2.783
C_{gw} - measured (mg/L)	1.8	1.1	0.52	2.300
C_{gw} - max (mg/L)	1.800	1.100	0.520	2.783
A (m^2)	100	100	100	100
L_s (cm)	580	580	580	580
L_{gw} (gw)	760	760	760	760
W (m)	20.0	20.0	20.0	20.0
h_{cap} (cm)	5.0	5.0	5.0	5.0
h_v (cm)	755.0	755	755	755
d_s (cm)	180.0	180	180	180
S_w (cm)	4000	4000	4000	4000
S_d (cm)	610	610	610	610
rho (gm/cm^3)	1.7	1.7	1.7	1.7
f_{oc} (g-carbon/g-soil)	0.01	0.01	0.01	0.01
phi wtr-vadose	0.12	0.12	0.12	0.12
phi air-vadose	0.26	0.26	0.26	0.26
phi total	0.38	0.38	0.38	0.38
phi wtr-cap	0.342	0.342	0.342	0.342
phi air-cap	0.038	0.038	0.038	0.038
phi wtr-crack	0.12	0.12	0.12	0.12
phi air-crack	0.26	0.26	0.26	0.26
Qr (cm^3/yr)	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V_{gw} (cm/yr)	310	310	310	310
U_{air} (m/s)	2.25	2.25	2.25	2.25
delta air (m)	2.0	2.0	2.0	2.0
eta (cm^2-cracks/cm^2-total area)	0.01	0.01	0.01	0.01
L_{crack} (cm)	15.0	15.0	15.0	15.0
LDF (unitless)	100.0	100.0	100.0	100.0
Chemical-Specific Parameters				
H (at 20-C atm/mol	5.59E-03	6.37E-03	6.43E-03	7.04E-03
H' (unitless)	2.32E-01	2.65E-01	2.67E-01	2.93E-01
k_{oc} (mg/kg-carb/mg/L-wtr)	83	300	1100	240
k_s (cm^3-wtr/g-soil)	0.83	3	11	2.4
D^{air} (cm^2/s)	9.33E-02	8.38E-02	7.48E-02	7.40E-02
D^{water} (cm^2/s)	1.10E-05	9.40E-06	8.50E-06	8.50E-06
tau (sec)	936	1152	1404	1404
Residential-Specific Parameters				
ER (s^{-1} L/s)	0.00014	0.00014	0.00014	0.00014
L_b (cm)	200	200	200	200
t (sec)	9.50E+08	9.50E+08	9.50E+08	9.50E+08
Commercial-Specific Parameters				
ER (s^{-1} L/s)	0.00023	0.00023	0.00023	0.00023
L_b (cm)	300	300	300	300
t (sec)	7.90E+08	7.90E+08	7.90E+08	7.90E+08

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (source area)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Ambient Inhalation of Volatiles				
From Subsurface Soil				
D_{ei}	2.58E-02	2.31E-02	2.07E-02	2.04E-02
K_{as}	2.80E-01	8.83E-02	2.43E-02	1.22E-01
Dispersivity	1.52E-03	4.48E-04	1.12E-04	5.42E-04
VF_{samb}	2.86E-05	1.49E-05	7.35E-06	1.65E-05
NAF	3.49E+04	6.70E+04	1.36E+05	6.04E+04
Exp. Pt. Concentration (mg/m^3)	**5.98E-04**	**2.39E-03**	**8.08E-04**	**1.16E-02**
Ambient Inhalation of Volatiles				
From Groundwater				
D_{cap}^{eff}	2.13E-05	1.77E-05	1.58E-05	1.52E-05
D_s^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_{ws}^{eff}	2.24E-03	1.91E-03	1.71E-03	1.65E-03
VF_{wamb}	7.62E-06	7.40E-06	6.68E-06	7.08E-06
NAF	1.31E+05	1.35E+05	1.50E+05	1.41E+05
Exp. Pt. Concentration (mg/m^3)	**1.37E-05**	**8.14E-06**	**3.47E-06**	**1.97E-05**
Residential Enclosed-Space Inhalation				
of Volatiles From Subsurface Soil				
D_{crack}^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_s^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
K_{sw}	1.07E+00	3.21E-01	9.00E-02	3.98E-01
VF_{seap} (1)	3.10E-02	9.56E-03	2.41E-03	1.15E-02
VF_{seap} (2)	1.15E-02	1.15E-02	1.15E-02	1.15E-02
VF_{seap} (min)	1.15E-02	9.56E-03	2.41E-03	1.15E-02
NAF	8.69E+01	1.05E+02	4.15E+02	8.69E+01
Exp. Pt. Concentration (mg/m^3)	**2.40E-01**	**1.53E+00**	**2.65E-01**	**8.05E+00**
Commercial Enclosed-Space Inhalation				
of Volatiles From Subsurface Soil				
VF_{seap} (1)	1.26E-02	3.88E-03	9.78E-04	4.68E-03
VF_{seap} (2)	5.61E-03	5.61E-03	5.61E-03	5.61E-03
VF_{seap} (min)	5.61E-03	3.88E-03	9.78E-04	4.68E-03
NAF	1.78E+02	2.58E+02	1.02E+03	2.14E+02
Exp. Pt. Concentration (mg/m^3)	**1.17E-01**	**6.21E-01**	**1.08E-01**	**3.28E+00**
Residential Enclosed-Space Inhalation				
of Volatiles From Groundwater				
D_{crack}^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_{ws}^{eff}	2.24E-03	1.91E-03	1.71E-03	1.65E-03
VF_{weap}	1.52E-02	1.51E-02	1.36E-02	1.45E-02
NAF	6.57E+01	6.63E+01	7.35E+01	6.88E+01
Exp. Pt. Concentration (mg/m^3)	**2.74E-02**	**1.66E-02**	**7.07E-03**	**4.04E-02**

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (source area)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Commercial Enclosed-Space Inhalation				
of Volatiles From Groundwater				
VF_{weap}	6.18E-03	6.12E-03	5.52E-03	5.90E-03
NAF	1.62E+02	1.63E+02	1.81E+02	1.70E+02
Exp. Pt. Concentration (mg/m^3)	**1.11E-02**	**6.73E-03**	**2.87E-03**	**1.64E-02**
Subsurface Soil Leaching to				
Groundwater				
LF_{sw}	1.07E-02	3.21E-03	9.00E-04	3.98E-03
NAF	9.36E+01	3.11E+02	1.11E+03	2.52E+02
Exp. Pt. Concentration (mg/L)	**2.23E-01**	**5.14E-01**	**9.90E-02**	**2.78E+00**

Run #2 - 120 feet from source area

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (120 feet off-site)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Field Measurements				
C_{soil} (mg/kg)	0	0	0	0
C_{gw} - leach from soil (mg/L)	0.000	0.000	0.000	0.000
C_{gw} - measured (mg/L)	1	0.62	0.29	1.600
C_{gw} - max (mg/L)	1.000	0.620	0.290	1.600
A (m^2)	100	100	100	100
L_s (cm)	580	580	580	580
L_{gw} (gw)	760	760	760	760
W (m)	20.0	20.0	20.0	20.0
h_{cap} (cm)	5.0	5.0	5.0	5.0
h_v (cm)	755.0	755	755	755
d_s (cm)	180.0	180	180	180
S_w (cm)	4000	4000	4000	4000
S_d (cm)	610	610	610	610
rho (gm/cm^3)	1.7	1.7	1.7	1.7
f_{oc} (g-carbon/g-soil)	0.01	0.01	0.01	0.01
phi wtr-vadose	0.12	0.12	0.12	0.12
phi air-vadose	0.26	0.26	0.26	0.26
phi total	0.38	0.38	0.38	0.38
phi wtr-cap	0.342	0.342	0.342	0.342
phi air-cap	0.038	0.038	0.038	0.038
phi wtr-crack	0.12	0.12	0.12	0.12
phi air-crack	0.26	0.26	0.26	0.26
Qr (cm^3/yr)	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V_{gw} (cm/yr)	310	310	310	310
U_{air} (m/s)	2.25	2.25	2.25	2.25
delta air (m)	2.0	2.0	2.0	2.0
eta (cm^2-cracks/cm^2-total area)	0.01	0.01	0.01	0.01
L_{crack} (cm)	15.0	15.0	15.0	15.0
LDF (unitless)	100.0	100.0	100.0	100.0
Chemical-Specific Parameters				
H (at 20-C atm/mol	5.59E-03	6.37E-03	6.43E-03	7.04E-03
H' (unitless)	2.32E-01	2.65E-01	2.67E-01	2.93E-01
k_{oc} (mg/kg-carb/mg/L-wtr)	83	300	1100	240
k_s (cm^3-wtr/g-soil)	0.83	3	11	2.4
D^{air} (cm^2/s)	9.33E-02	8.38E-02	7.48E-02	7.40E-02
D^{water} (cm^2/s)	1.10E-05	9.40E-06	8.50E-06	8.50E-06
tau (sec)	936	1152	1404	1404
Residential-Specific Parameters				
ER (s^{-1} L/s)	0.00014	0.00014	0.00014	0.00014
L_b (cm)	200	200	200	200
t (sec)	9.50E+08	9.50E+08	9.50E+08	9.50E+08
Commercial-Specific Parameters				
ER (s^{-1} L/s)	0.00023	0.00023	0.00023	0.00023
L_b (cm)	300	300	300	300
t (sec)	7.90E+08	7.90E+08	7.90E+08	7.90E+08

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (120 feet off-site)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Ambient Inhalation of Volatiles				
From Subsurface Soil				
D_{ei}	2.58E-02	2.31E-02	2.07E-02	2.04E-02
K_{as}	2.80E-01	8.83E-02	2.43E-02	1.22E-01
Dispersivity	1.52E-03	4.48E-04	1.12E-04	5.42E-04
VF_{samb}	2.86E-05	1.49E-05	7.35E-06	1.65E-05
NAF	3.49E+04	6.70E+04	1.36E+05	6.04E+04
Exp. Pt. Concentration (mg/m^3)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Ambient Inhalation of Volatiles				
From Groundwater				
D_{cap}^{eff}	2.13E-05	1.77E-05	1.58E-05	1.52E-05
D_s^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_{ws}^{eff}	2.24E-03	1.91E-03	1.71E-03	1.65E-03
VF_{wamb}	7.62E-06	7.40E-06	6.68E-06	7.08E-06
NAF	1.31E+05	1.35E+05	1.50E+05	1.41E+05
Exp. Pt. Concentration (mg/m^3)	**7.62E-06**	**4.59E-06**	**1.94E-06**	**1.13E-05**
Residential Enclosed-Space Inhalation				
of Volatiles From Subsurface Soil				
D_{crack}^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_s^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
K_{sw}	1.07E+00	3.21E-01	9.00E-02	3.98E-01
VF_{seap} (1)	3.10E-02	9.56E-03	2.41E-03	1.15E-02
VF_{seap} (2)	1.15E-02	1.15E-02	1.15E-02	1.15E-02
VF_{seap} (min)	1.15E-02	9.56E-03	2.41E-03	1.15E-02
NAF	8.69E+01	1.05E+02	4.15E+02	8.69E+01
Exp. Pt. Concentration (mg/m^3)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Commercial Enclosed-Space Inhalation				
of Volatiles From Subsurface Soil				
VF_{seap} (1)	1.26E-02	3.88E-03	9.78E-04	4.68E-03
VF_{seap} (2)	5.61E-03	5.61E-03	5.61E-03	5.61E-03
VF_{seap} (min)	5.61E-03	3.88E-03	9.78E-04	4.68E-03
NAF	1.78E+02	2.58E+02	1.02E+03	2.14E+02
Exp. Pt. Concentration (mg/m^3)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Residential Enclosed-Space Inhalation				
of Volatiles From Groundwater				
D_{crack}^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_{ws}^{eff}	2.24E-03	1.91E-03	1.71E-03	1.65E-03
VF_{weap}	1.52E-02	1.51E-02	1.36E-02	1.45E-02
NAF	6.57E+01	6.63E+01	7.35E+01	6.88E+01
Exp. Pt. Concentration (mg/m^3)	**1.52E-02**	**9.35E-03**	**3.94E-03**	**2.32E-02**

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (120 feet off-site)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Commercial Enclosed-Space Inhalation				
of Volatiles From Groundwater				
VF_{weap}	6.18E-03	6.12E-03	5.52E-03	5.90E-03
NAF	1.62E+02	1.63E+02	1.81E+02	1.70E+02
Exp. Pt. Concentration (mg/m^3)	**6.18E-03**	**3.80E-03**	**1.60E-03**	**9.43E-03**
Subsurface Soil Leaching to				
Groundwater				
LF_{sw}	1.07E-02	3.21E-03	9.00E-04	3.98E-03
NAF	9.36E+01	3.11E+02	1.11E+03	2.52E+02
Exp. Pt. Concentration (mg/L)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**

Run #3 - 1800 feet from source area

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (1800 feet off-site)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Field Measurements				
C_{soil} (mg/kg)	0	0	0	0
C_{gw} - leach from soil (mg/L)	0.000	0.000	0.000	0.000
C_{gw} - measured (mg/L)	0.0082	0.005	0.0024	0.013
C_{gw} - max (mg/L)	0.008	0.005	0.002	0.013
A (m^2)	100	100	100	100
L_s (cm)	580	580	580	580
L_{gw} (gw)	760	760	760	760
W (m)	20.0	20.0	20.0	20.0
h_{cap} (cm)	5.0	5.0	5.0	5.0
h_v (cm)	755.0	755	755	755
d_s (cm)	180.0	180	180	180
S_w (cm)	4000	4000	4000	4000
S_d (cm)	610	610	610	610
rho (gm/cm^3)	1.7	1.7	1.7	1.7
f_{oc} (g-carbon/g-soil)	0.01	0.01	0.01	0.01
phi wtr-vadose	0.12	0.12	0.12	0.12
phi air-vadose	0.26	0.26	0.26	0.26
phi total	0.38	0.38	0.38	0.38
phi wtr-cap	0.342	0.342	0.342	0.342
phi air-cap	0.038	0.038	0.038	0.038
phi wtr-crack	0.12	0.12	0.12	0.12
phi air-crack	0.26	0.26	0.26	0.26
Qr (cm^3/yr)	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V_{gw} (cm/yr)	310	310	310	310
U_{air} (m/s)	2.25	2.25	2.25	2.25
delta air (m)	2.0	2.0	2.0	2.0
eta (cm^2-cracks/cm^2-total area)	0.01	0.01	0.01	0.01
L_{crack} (cm)	15.0	15.0	15.0	15.0
LDF (unitless)	100.0	100.0	100.0	100.0
Chemical-Specific Parameters				
H (at 20-C atm/mol	5.59E-03	6.37E-03	6.43E-03	7.04E-03
H' (unitless)	2.32E-01	2.65E-01	2.67E-01	2.93E-01
k_{oc} (mg/kg-carb/mg/L-wtr)	83	300	1100	240
k_s (cm^3-wtr/g-soil)	0.83	3	11	2.4
D^{air} (cm^2/s)	9.33E-02	8.38E-02	7.48E-02	7.40E-02
D^{water} (cm^2/s)	1.10E-05	9.40E-06	8.50E-06	8.50E-06
tau (sec)	936	1152	1404	1404
Residential-Specific Parameters				
ER (s^{-1} L/s)	0.00014	0.00014	0.00014	0.00014
L_b (cm)	200	200	200	200
t (sec)	9.50E+08	9.50E+08	9.50E+08	9.50E+08
Commercial-Specific Parameters				
ER (s^{-1} L/s)	0.00023	0.00023	0.00023	0.00023
L_b (cm)	300	300	300	300
t (sec)	7.90E+08	7.90E+08	7.90E+08	7.90E+08

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (1800 feet off-site)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Ambient Inhalation of Volatiles				
From Subsurface Soil				
D_{ei}	2.58E-02	2.31E-02	2.07E-02	2.04E-02
K_{as}	2.80E-01	8.83E-02	2.43E-02	1.22E-01
Dispersivity	1.52E-03	4.48E-04	1.12E-04	5.42E-04
VF_{samb}	2.86E-05	1.49E-05	7.35E-06	1.65E-05
NAF	3.49E+04	6.70E+04	1.36E+05	6.04E+04
Exp. Pt. Concentration (mg/m^3)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Ambient Inhalation of Volatiles				
From Groundwater				
D_{cap}^{eff}	2.13E-05	1.77E-05	1.58E-05	1.52E-05
D_s^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_{ws}^{eff}	2.24E-03	1.91E-03	1.71E-03	1.65E-03
VF_{wamb}	7.62E-06	7.40E-06	6.68E-06	7.08E-06
NAF	1.31E+05	1.35E+05	1.50E+05	1.41E+05
Exp. Pt. Concentration (mg/m^3)	**6.25E-08**	**3.70E-08**	**1.60E-08**	**9.20E-08**
Residential Enclosed-Space Inhalation				
of Volatiles From Subsurface Soil				
D_{crack}^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_s^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
K_{sw}	1.07E+00	3.21E-01	9.00E-02	3.98E-01
VF_{seap} (1)	3.10E-02	9.56E-03	2.41E-03	1.15E-02
VF_{seap} (2)	1.15E-02	1.15E-02	1.15E-02	1.15E-02
VF_{seap} (min)	1.15E-02	9.56E-03	2.41E-03	1.15E-02
NAF	8.69E+01	1.05E+02	4.15E+02	8.69E+01
Exp. Pt. Concentration (mg/m^3)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Commercial Enclosed-Space Inhalation				
of Volatiles From Subsurface Soil				
VF_{seap} (1)	1.26E-02	3.88E-03	9.78E-04	4.68E-03
VF_{seap} (2)	5.61E-03	5.61E-03	5.61E-03	5.61E-03
VF_{seap} (min)	5.61E-03	3.88E-03	9.78E-04	4.68E-03
NAF	1.78E+02	2.58E+02	1.02E+03	2.14E+02
Exp. Pt. Concentration (mg/m^3)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Residential Enclosed-Space Inhalation				
of Volatiles From Groundwater				
D_{crack}^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_{ws}^{eff}	2.24E-03	1.91E-03	1.71E-03	1.65E-03
VF_{weap}	1.52E-02	1.51E-02	1.36E-02	1.45E-02
NAF	6.57E+01	6.63E+01	7.35E+01	6.88E+01
Exp. Pt. Concentration (mg/m^3)	**1.25E-04**	**7.54E-05**	**3.26E-05**	**1.89E-04**

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (1800 feet off-site)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Commercial Enclosed-Space Inhalation				
of Volatiles From Groundwater				
VF_{weap}	6.18E-03	6.12E-03	5.52E-03	5.90E-03
NAF	1.62E+02	1.63E+02	1.81E+02	1.70E+02
Exp. Pt. Concentration (mg/m^3)	**5.07E-05**	**3.06E-05**	**1.32E-05**	**7.66E-05**
Subsurface Soil Leaching to				
Groundwater				
LF_{sw}	1.07E-02	3.21E-03	9.00E-04	3.98E-03
NAF	9.36E+01	3.11E+02	1.11E+03	2.52E+02
Exp. Pt. Concentration (mg/L)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**

Run #4 - 2500 feet from source area

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (2500 feet off-site)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Field Measurements				
C_{soil} (mg/kg)	0	0	0	0
C_{gw} - leach from soil (mg/L)	0.000	0.000	0.000	0.000
C_{gw} - measured (mg/L)	0.0043	0.0026	0.0012	0.0066
C_{gw} - max (mg/L)	4.30E-03	2.60E-03	1.20E-03	6.60E-03
A (m^2)	100	100	100	100
L_s (cm)	580	580	580	580
L_{gw} (gw)	760	760	760	760
W (m)	20.0	20.0	20.0	20.0
h_{cap} (cm)	5.0	5.0	5.0	5.0
h_v (cm)	755.0	755	755	755
d_s (cm)	180.0	180	180	180
S_w (cm)	4000	4000	4000	4000
S_d (cm)	610	610	610	610
rho (gm/cm^3)	1.7	1.7	1.7	1.7
f_{oc} (g-carbon/g-soil)	0.01	0.01	0.01	0.01
phi wtr-vadose	0.12	0.12	0.12	0.12
phi air-vadose	0.26	0.26	0.26	0.26
phi total	0.38	0.38	0.38	0.38
phi wtr-cap	0.342	0.342	0.342	0.342
phi air-cap	0.038	0.038	0.038	0.038
phi wtr-crack	0.12	0.12	0.12	0.12
phi air-crack	0.26	0.26	0.26	0.26
Qr (cm^3/yr)	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V_{gw} (cm/yr)	310	310	310	310
U_{air} (m/s)	2.25	2.25	2.25	2.25
delta air (m)	2.0	2.0	2.0	2.0
eta (cm^2-cracks/cm^2-total area)	0.01	0.01	0.01	0.01
L_{crack} (cm)	15.0	15.0	15.0	15.0
LDF (unitless)	100.0	100.0	100.0	100.0
Chemical-Specific Parameters				
H (at 20-C atm/mol	5.59E-03	6.37E-03	6.43E-03	7.04E-03
H' (unitless)	2.32E-01	2.65E-01	2.67E-01	2.93E-01
k_{oc} (mg/kg-carb/mg/L-wtr)	83	300	1100	240
k_s (cm^3-wtr/g-soil)	0.83	3	11	2.4
D^{air} (cm^2/s)	9.33E-02	8.38E-02	7.48E-02	7.40E-02
D^{water} (cm^2/s)	1.10E-05	9.40E-06	8.50E-06	8.50E-06
tau (sec)	936	1152	1404	1404
Residential-Specific Parameters				
ER (s^{-1} L/s)	0.00014	0.00014	0.00014	0.00014
L_b (cm)	200	200	200	200
t (sec)	9.50E+08	9.50E+08	9.50E+08	9.50E+08
Commercial-Specific Parameters				
ER (s^{-1} L/s)	0.00023	0.00023	0.00023	0.00023
L_b (cm)	300	300	300	300
t (sec)	7.90E+08	7.90E+08	7.90E+08	7.90E+08

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (2500 feet off-site)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Ambient Inhalation of Volatiles				
From Subsurface Soil				
D_{ei}	2.58E-02	2.31E-02	2.07E-02	2.04E-02
K_{as}	2.80E-01	8.83E-02	2.43E-02	1.22E-01
Dispersivity	1.52E-03	4.48E-04	1.12E-04	5.42E-04
VF_{samb}	2.86E-05	1.49E-05	7.35E-06	1.65E-05
NAF	3.49E+04	6.70E+04	1.36E+05	6.04E+04
Exp. Pt. Concentration (mg/m^3)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Ambient Inhalation of Volatiles				
From Groundwater				
D_{cap}^{eff}	2.13E-05	1.77E-05	1.58E-05	1.52E-05
D_s^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_{ws}^{eff}	2.24E-03	1.91E-03	1.71E-03	1.65E-03
VF_{wamb}	7.62E-06	7.40E-06	6.68E-06	7.08E-06
NAF	1.31E+05	1.35E+05	1.50E+05	1.41E+05
Exp. Pt. Concentration (mg/m^3)	**3.28E-08**	**1.92E-08**	**8.01E-09**	**4.67E-08**
Residential Enclosed-Space Inhalation				
of Volatiles From Subsurface Soil				
D_{crack}^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_s^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
K_{sw}	1.07E+00	3.21E-01	9.00E-02	3.98E-01
VF_{seap} (1)	3.10E-02	9.56E-03	2.41E-03	1.15E-02
VF_{seap} (2)	1.15E-02	1.15E-02	1.15E-02	1.15E-02
VF_{seap} (min)	1.15E-02	9.56E-03	2.41E-03	1.15E-02
NAF	8.69E+01	1.05E+02	4.15E+02	8.69E+01
Exp. Pt. Concentration (mg/m^3)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Commercial Enclosed-Space Inhalation				
of Volatiles From Subsurface Soil				
VF_{seap} (1)	1.26E-02	3.88E-03	9.78E-04	4.68E-03
VF_{seap} (2)	5.61E-03	5.61E-03	5.61E-03	5.61E-03
VF_{seap} (min)	5.61E-03	3.88E-03	9.78E-04	4.68E-03
NAF	1.78E+02	2.58E+02	1.02E+03	2.14E+02
Exp. Pt. Concentration (mg/m^3)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Residential Enclosed-Space Inhalation				
of Volatiles From Groundwater				
D_{crack}^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_{ws}^{eff}	2.24E-03	1.91E-03	1.71E-03	1.65E-03
VF_{weap}	1.52E-02	1.51E-02	1.36E-02	1.45E-02
NAF	6.57E+01	6.63E+01	7.35E+01	6.88E+01
Exp. Pt. Concentration (mg/m^3)	**6.55E-05**	**3.92E-05**	**1.63E-05**	**9.59E-05**

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (2500 feet off-site)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Commercial Enclosed-Space Inhalation				
of Volatiles From Groundwater				
VF_{weap}	6.18E-03	6.12E-03	5.52E-03	5.90E-03
NAF	1.62E+02	1.63E+02	1.81E+02	1.70E+02
Exp. Pt. Concentration (mg/m^3)	**2.66E-05**	**1.59E-05**	**6.62E-06**	**3.89E-05**
Subsurface Soil Leaching to				
Groundwater				
LF_{sw}	1.07E-02	3.21E-03	9.00E-04	3.98E-03
NAF	9.36E+01	3.11E+02	1.11E+03	2.52E+02
Exp. Pt. Concentration (mg/L)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**

Run #5 - 2700 feet from source area

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (2700 feet off-site)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Field Measurements				
C_{soil} (mg/kg)	0	0	0	0
C_{gw} - leach from soil (mg/L)	0.000	0.000	0.000	0.000
C_{gw} - measured (mg/L)	0.0037	0.0022	0.0011	0.0057
C_{gw} - max (mg/L)	3.70E-03	2.20E-03	1.10E-03	5.70E-03
A (m^2)	100	100	100	100
L_s (cm)	580	580	580	580
L_{gw} (gw)	760	760	760	760
W (m)	20.0	20.0	20.0	20.0
h_{cap} (cm)	5.0	5.0	5.0	5.0
h_v (cm)	755.0	755	755	755
d_s (cm)	180.0	180	180	180
S_w (cm)	4000	4000	4000	4000
S_d (cm)	610	610	610	610
rho (gm/cm^3)	1.7	1.7	1.7	1.7
f_{oc} (g-carbon/g-soil)	0.01	0.01	0.01	0.01
phi wtr-vadose	0.12	0.12	0.12	0.12
phi air-vadose	0.26	0.26	0.26	0.26
phi total	0.38	0.38	0.38	0.38
phi wtr-cap	0.342	0.342	0.342	0.342
phi air-cap	0.038	0.038	0.038	0.038
phi wtr-crack	0.12	0.12	0.12	0.12
phi air-crack	0.26	0.26	0.26	0.26
Qr (cm^3/yr)	0.00E+00	0.00E+00	0.00E+00	0.00E+00
V_{gw} (cm/yr)	310	310	310	310
U_{air} (m/s)	2.25	2.25	2.25	2.25
delta air (m)	2.0	2.0	2.0	2.0
eta (cm^2-cracks/cm^2-total area)	0.01	0.01	0.01	0.01
L_{crack} (cm)	15.0	15.0	15.0	15.0
LDF (unitless)	100.0	100.0	100.0	100.0
Chemical-Specific Parameters				
H (at 20-C atm/mol	5.59E-03	6.37E-03	6.43E-03	7.04E-03
H' (unitless)	2.32E-01	2.65E-01	2.67E-01	2.93E-01
k_{oc} (mg/kg-carb/mg/L-wtr)	83	300	1100	240
k_s (cm^3-wtr/g-soil)	0.83	3	11	2.4
D^{air} (cm^2/s)	9.33E-02	8.38E-02	7.48E-02	7.40E-02
D^{water} (cm^2/s)	1.10E-05	9.40E-06	8.50E-06	8.50E-06
tau (sec)	936	1152	1404	1404
Residential-Specific Parameters				
ER (s^{-1} L/s)	0.00014	0.00014	0.00014	0.00014
L_b (cm)	200	200	200	200
t (sec)	9.50E+08	9.50E+08	9.50E+08	9.50E+08
Commercial-Specific Parameters				
ER (s^{-1} L/s)	0.00023	0.00023	0.00023	0.00023
L_b (cm)	300	300	300	300
t (sec)	7.90E+08	7.90E+08	7.90E+08	7.90E+08

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (2700 feet off-site)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Ambient Inhalation of Volatiles				
From Subsurface Soil				
D_{ei}	2.58E-02	2.31E-02	2.07E-02	2.04E-02
K_{as}	2.80E-01	8.83E-02	2.43E-02	1.22E-01
Dispersivity	1.52E-03	4.48E-04	1.12E-04	5.42E-04
VF_{samb}	2.86E-05	1.49E-05	7.35E-06	1.65E-05
NAF	3.49E+04	6.70E+04	1.36E+05	6.04E+04
Exp. Pt. Concentration (mg/m^3)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Ambient Inhalation of Volatiles				
From Groundwater				
D_{cap}^{eff}	2.13E-05	1.77E-05	1.58E-05	1.52E-05
D_s^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_{ws}^{eff}	2.24E-03	1.91E-03	1.71E-03	1.65E-03
VF_{wamb}	7.62E-06	7.40E-06	6.68E-06	7.08E-06
NAF	1.31E+05	1.35E+05	1.50E+05	1.41E+05
Exp. Pt. Concentration (mg/m^3)	**2.82E-08**	**1.63E-08**	**7.34E-09**	**4.03E-08**
Residential Enclosed-Space Inhalation				
of Volatiles From Subsurface Soil				
D_{crack}^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_s^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
K_{sw}	1.07E+00	3.21E-01	9.00E-02	3.98E-01
VF_{seap} (1)	3.10E-02	9.56E-03	2.41E-03	1.15E-02
VF_{seap} (2)	1.15E-02	1.15E-02	1.15E-02	1.15E-02
VF_{seap} (min)	1.15E-02	9.56E-03	2.41E-03	1.15E-02
NAF	8.69E+01	1.05E+02	4.15E+02	8.69E+01
Exp. Pt. Concentration (mg/m^3)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Commercial Enclosed-Space Inhalation				
of Volatiles From Subsurface Soil				
VF_{seap} (1)	1.26E-02	3.88E-03	9.78E-04	4.68E-03
VF_{seap} (2)	5.61E-03	5.61E-03	5.61E-03	5.61E-03
VF_{seap} (min)	5.61E-03	3.88E-03	9.78E-04	4.68E-03
NAF	1.78E+02	2.58E+02	1.02E+03	2.14E+02
Exp. Pt. Concentration (mg/m^3)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**
Residential Enclosed-Space Inhalation				
of Volatiles From Groundwater				
D_{crack}^{eff}	7.28E-03	6.54E-03	5.84E-03	5.77E-03
D_{ws}^{eff}	2.24E-03	1.91E-03	1.71E-03	1.65E-03
VF_{weap}	1.52E-02	1.51E-02	1.36E-02	1.45E-02
NAF	6.57E+01	6.63E+01	7.35E+01	6.88E+01
Exp. Pt. Concentration (mg/m^3)	**5.63E-05**	**3.32E-05**	**1.50E-05**	**8.28E-05**

APPENDIX B-1

Exposure Point Parameters and Calculation Spreadsheet (2700 feet off-site)

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes
Commercial Enclosed-Space Inhalation				
of Volatiles From Groundwater				
VF_{weap}	6.18E-03	6.12E-03	5.52E-03	5.90E-03
NAF	1.62E+02	1.63E+02	1.81E+02	1.70E+02
Exp. Pt. Concentration (mg/m^3)	**2.29E-05**	**1.35E-05**	**6.07E-06**	**3.36E-05**
Subsurface Soil Leaching to				
Groundwater				
LF_{sw}	1.07E-02	3.21E-03	9.00E-04	3.98E-03
NAF	9.36E+01	3.11E+02	1.11E+03	2.52E+02
Exp. Pt. Concentration (mg/L)	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**

APPENDIX C
Chemical Intake and Risk Calculations Spreadsheets

APPENDIX C-1

Chemical Intake and Risk Calculations
Groundwater Ingestion

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes	Total Risk
Future On-site Commercial Receptor					
Exposure Point Concentration	1.80E+00	1.10E+00	5.20E-01	2.78E+00	
Units	mg/L	mg/L	mg/L	mg/L	
Intake Rate Parameters					
IRw (L/day)	1.0	1.0	1.0	1.0	
Exposure Parameters					
EF (days/yr)	250	250	250	250	
ED (years)	25	25	25	25	
BW (kg)	70	70	70	70	
AT (years)	70	25	25	25	
Chemical Intake (mg/kg-day)	**6.29E-03**	**1.08E-02**	**5.09E-03**	**2.72E-02**	
SFo	2.90E-02				
RfDo		2.00E-01	1.00E-01	2.00E+00	
Carcinogenic Risk	**1.82E-04**				**1.82E-04**
Hazard Quotient		**5.38E-02**	**5.09E-02**	**1.36E-02**	**1.18E-01**
Current Off-site Residential Receptor (2700 feet down-gradient)					
Exposure Point Concentration	3.70E-03	2.20E-03	1.10E-03	5.70E-03	
Units	mg/L	mg/L	mg/L	mg/L	
Intake Rate Parameters					
IRw (L/day)	2.0	2.0	2.0	2.0	
Exposure Parameters					
EF (days/yr)	350	350	350	350	
ED (years)	30	30	30	30	
BW (kg)	70	70	70	70	
AT (years)	70	30	30	30	
Chemical Intake (mg/kg-day)	**4.34E-05**	**6.03E-05**	**3.01E-05**	**1.56E-04**	
SFo	2.90E-02				
RfDo		2.00E-01	1.00E-01	2.00E+00	
Carcinogenic Risk	**1.26E-06**				**1.26E-06**
Hazard Quotient		**3.01E-04**	**3.01E-04**	**7.81E-05**	**6.81E-04**

APPENDIX C-1

Chemical Intake and Risk Calculations
Groundwater Ingestion

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes	Total Risk
Future Off-site Residential Receptor (2500 feet down-gradient)					
Exposure Point Concentration	4.30E-03	2.60E-03	1.20E-03	6.60E-03	
Units	mg/L	mg/L	mg/L	mg/L	
Intake Rate Parameters					
IRw (L/day)	1.4	1.4	1.4	1.4	
Exposure Parameters					
EF (days/yr)	235	235	235	235	
ED (years)	9	9	9	9	
BW (kg)	70	70	70	70	
AT (years)	70	9	9	9	
Chemical Intake (mg/kg-day)	**7.12E-06**	**3.35E-05**	**1.55E-05**	**8.50E-05**	
SFo	2.90E-02				
RfDo		2.00E-01	1.00E-01	2.00E+00	
Carcinogenic Risk	**2.06E-07**				**2.06E-07**
Hazard Quotient		**1.67E-04**	**1.55E-04**	**4.25E-05**	**3.64E-04**

APPENDIX C-2

Chemical Intake and Risk Calculations
Inhalation of Vapors from Subsurface Soil and/or Groundwater

Current On-site Commercial Receptor (ambient)

Parameters	Benzene (C)	Toluene	Ethylbenzene	Xylenes	Benxene (N)	Total Risk
Exposure Point Concentration	6.12E-04	2.40E-03	8.11E-04	1.16E-02	6.12E-04	
Units (soil + water)	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	
Intake Rate Parameters						
IRa (m^3/day)	20.0	20.0	20.0	20.0	20.0	
Exposure Parameters						
EF (days/yr)	250	250	250	250	250	
ED (years)	25	25	25	25	25	
BW (kg)	70	70	70	70	70	
AT (years)	70	25	25	25	25	
Chemical Intake (mg/kg-day)	**4.28E-05**	**4.69E-04**	**1.59E-04**	**2.27E-03**	**1.20E-04**	
SFi	2.91E-02					
RfDi		4.00E-01	1.00E+00	8.60E-02	1.70E-03	
Carcinogenic Risk	**1.24E-06**					**1.24E-06**
Hazard Quotient		**1.17E-03**	**1.59E-04**	**2.64E-02**	**7.04E-02**	**9.82E-02**

Current Off-site Commercial Receptor (enclosed-space/120 feet down-gradient)

Exposure Point Concentration	6.18E-03	3.80E-03	1.60E-03	9.43E-03	6.18E-03	
Units (water)	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	
Intake Rate Parameters						
IRa (m^3/day)	20.0	20.0	20.0	20.0	20.0	
Exposure Parameters						
EF (days/yr)	250	250	250	250	250	
ED (years)	25	25	25	25	25	
BW (kg)	70	70	70	70	70	
AT (years)	70	25	25	25	25	
Chemical Intake (mg/kg-day)	**4.32E-04**	**7.44E-04**	**3.13E-04**	**1.85E-03**	**1.21E-03**	
SFi	2.91E-02					
RfDi		4.00E-01	1.00E+00	8.60E-02	1.70E-03	
Carcinogenic Risk	**1.26E-05**					**1.26E-05**
Hazard Quotient		**1.86E-03**	**3.13E-04**	**2.15E-02**	**7.11E-01**	**7.35E-01**

APPENDIX C-2

Chemical Intake and Risk Calculations
Inhalation of Vapors from Subsurface Soil and/or Groundwater

Current Off-site Residential Receptor (enclosed-space/1800 feet down-gradient)

Parameters	Benzene (C)	Toluene	Ethylbenzene	Xylenes	Benxene (N)	Total Risk
Exposure Point Concentration	1.25E-04	7.54E-05	3.26E-05	1.89E-04	1.25E-04	
Units (water)	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	
Intake Rate Parameters						
IRa (m^3/day)	15.0	15.0	15.0	15.0	15.0	
Exposure Parameters						
EF (days/yr)	350	350	350	350	350	
ED (years)	30	30	30	30	30	
BW (kg)	70	70	70	70	70	
AT (years)	70	30	30	30	30	
Chemical Intake (mg/kg-day)	**1.10E-05**	**1.55E-05**	**6.70E-06**	**3.88E-05**	**2.57E-05**	
SFi	2.91E-02					
RfDi		4.00E-01	1.00E+00	8.60E-02	1.70E-03	
Carcinogenic Risk	**3.20E-07**					**3.20E-07**
Hazard Quotient		**3.87E-05**	**6.70E-06**	**4.52E-04**	**1.51E-02**	**1.56E-02**

Future On-site Commercial Worker Receptor (enclosed-space)

Exposure Point Concentration	1.28E-01	6.28E-01	1.11E-01	3.30E+00	1.28E-01	
Units (soil + water)	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3	
Intake Rate Parameters						
IRa (m^3/day)	20.0	20.0	20.0	20.0	20.0	
Exposure Parameters						
EF (days/yr)	250	250	250	250	250	
ED (years)	25	25	25	25	25	
BW (kg)	70	70	70	70	70	
AT (years)	70	25	25	25	25	
Chemical Intake (mg/kg-day)	**8.95E-03**	**1.23E-01**	**2.17E-02**	**6.45E-01**	**2.51E-02**	
SFi	2.91E-02					
RfDi		4.00E-01	1.00E+00	8.60E-02	1.70E-03	
Carcinogenic Risk	**2.61E-04**					**2.61E-04**
Hazard Quotient		**3.07E-01**	**2.17E-02**	**7.50E+00**	**1.47E+01**	**2.26E+01**

APPENDIX C-3

Chemical Intake and Risk Calculations
Dermal Contact with Groundwater

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes	Total Risk

Current Off-site Residential Receptor (showering/2700 feet down-gradient)

Exposure Point Concentration	3.70E-03	2.20E-03	1.10E-03	5.70E-03	
Units (water)	mg/L	mg/L	mg/L	mg/L	
Intake Rate Parameters					
EV (events/day)	1.0	1.0	1.0	1.0	
B (unitless)	1.30E-02	5.40E-02	1.40E-01	1.60E-01	
Kp (cm/hr)	2.10E-02	4.50E-02	7.40E-02	8.00E-02	
tau (hr)	2.60E-01	3.20E-01	3.90E-01	3.90E-01	
Z (cm/event)	1.66E-02	4.29E-02	8.88E-02	9.75E-02	
Exposure Parameters					
EF (days/yr)	350	350	350	350	
ED (years)	33	33	33	33	
BW (kg)	70	70	70	70	
AT (years)	70	33	33	33	
t-event (hr/day)	0.26	0.26	0.26	0.26	
SA (cm^2)	23000	23000	23000	23000	
Chemical Intake (mg/kg-day)	**9.12E-06**	**2.97E-05**	**3.08E-05**	**1.75E-04**	
SFo	2.99E-02				
RfDd		1.60E-01	9.70E-02	1.84E+00	
Carcinogenic Risk	**2.73E-07**				**2.73E-07**
Hazard Quotient		**1.86E-04**	**3.17E-04**	**9.52E-05**	**5.98E-04**

APPENDIX C-3

Chemical Intake and Risk Calculations
Dermal Contact with Groundwater

Parameters	Benzene	Toluene	Ethylbenzene	Xylenes	Total Risk
Future Off-site Residential Receptor (showering/2500 feet down-gradient)					
Exposure Point Concentration	4.30E-03	2.60E-03	1.20E-03	6.60E-03	
Units (water)	mg/L	mg/L	mg/L	mg/L	
Intake Rate Parameters					
EV (events/day)	1.0	1.0	1.0	1.0	
B (unitless)	1.30E-02	5.40E-02	1.40E-01	1.60E-01	
Kp (cm/hr)	2.10E-02	4.50E-02	7.40E-02	8.00E-02	
tau (hr)	2.60E-01	3.20E-01	3.90E-01	3.90E-01	
Z (cm/event)	1.47E-02	3.89E-02	8.27E-02	9.11E-02	
Exposure Parameters					
EF (days/yr)	235	235	235	235	
ED (years)	33	33	33	33	
BW (kg)	70	70	70	70	
AT (years)	70	33	33	33	
t-event (hr/day)	0.167	0.167	0.167	0.167	
SA (cm^2)	20000	20000	20000	20000	
Chemical Intake (mg/kg-day)	**5.47E-06**	**1.86E-05**	**1.83E-05**	**1.11E-04**	
SFo	2.99E-02				
RfDd		1.60E-01	9.70E-02	1.84E+00	
Carcinogenic Risk	**1.63E-07**				**1.63E-07**
Hazard Quotient		**1.16E-04**	**1.88E-04**	**6.01E-05**	**3.65E-04**

Appendix C-4
Calculation of SSTL for Highest Risk Recptors

Receptor	**Carcinogens** Commercial (C)	**Carcinogens** Commercial (F)	**Non-Carcinogens** Commercial (F)	
Type of Intake	Inhalation	Inhalation	Inhalation	
Pathway	Enclosed-Space	Enclosed-Space	Enclosed-Space	
Source	Groundwater	Sub- Soil	Sub- Soil	
Chemical	Benzene (C)	Benzene (C)	Xylenes	Benzene (N)
Risk	1.00E-06	1.00E-04	1.00E+00	1.00E+00
Critical Toxicity (SFi or RfDi)	2.91E-02	2.91E-02	8.60E-02	1.70E-03
Intake	3.44E-05	3.44E-03	8.60E-02	1.70E-03
Exposure Multiplier	1.43E+01	1.43E+01	5.11E+00	5.11E+00
Exposure Point Concentration	4.92E-04	4.92E-02	4.39E-01	8.69E-03
NAF	1.78E+02	1.78E+02	2.14E+02	1.78E+02
Soil/Groundwater SSTL	0.088	8.76	93.9	1.55

Appendix D

California Regional Water Quality Control Board,
San Francisco Bay Region,
Order No. 96-053

SA

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

ORDER NO. 96-052

ADOPTION OF SITE CLEANUP REQUIREMENTS AND RESCISSION OF ORDER NO. 93-139 FOR:

GRUBB AND ELLIS REALTY INCOME TRUST, LIQUIDATING TRUST; STARK INVESTMENT COMPANY; CATELLUS DEVELOPMENT CORPORATION; STEVEN SONG, MICHAEL NEELY AND PERRY NEELY dba MIKE' S ONE HOUR CLEANERS; MILLERS OUTPOST SHOPPING CENTER ASSOCIATES, IMA FINANCIAL CORPORATION; KATHLEEN McCORDUCK, JOHN McCORDUCK, PAMELA McCORDUCK AND SANDRA McCORDUCK MARONA, FORTNEY H. STARK, JR.; CHARLES HARTZ dba PAUL' S SPARKLE CLEANERS

for the properties

LIVERMORE ARCADE SHOPPING CENTER
located at FIRST AVENUE AND "P" STREET, AND
MILLERS OUTPOST SHOPPING CENTER
located at RAILROAD AVENUE AND "P" STREET
LIVERMORE, ALAMEDA COUNTY

The California Regional Water Quality Control Board, San Francisco Bay Region (hereinafter Board), finds that:

1. **Site Location**: The Livermore Arcade Shopping Center (LASC), also known as Vintners Square Shopping Center, is located at the northwest corner of First Avenue and P street, Livermore, Alameda County, California. The Millers Outpost Shopping Center (MOSC) is located, adjacent to LASC, at the northwest corner of Railroad Avenue and P street, Livermore, Alameda County. The LASC and MOSC properties cover an approximate area of 17 acres. For the purposes of this Order, both the LASC and MOSC properties shall be hereinafter collectively referred to as the "site". The site is within the downtown Livermore area and is currently used for commercial purposes. The current land use north-northwest of the site is residential. The site location is shown in Figure 1.

2. **Site History**: The LASC is currently owned by Grubb and Ellis Realty Income Trust, Liquidating Trust (GERIT). Mike's One Hour Cleaners (Mike's Cleaners) is a dry cleaning facility at the LASC. Paul's Sparkle Cleaners (Paul's Cleaners), located approximately 450 feet northwest of and downgradient to Mike's Cleaners, is a dry

cleaning facility at MOSC. Tetrachloroethylene (PCE) was routinely used in the dry cleaning operations at both Mike's Cleaners and Paul's Cleaners. During the operations, there were instances of PCE spills and disposal of PCE wastes to the sanitary sewer drains that lead to soil and groundwater pollution at the site.

3. **Named Dischargers**: GERIT is a secondary discharger because it currently owns LASC. Stark Investment Company and Catellus Development Corporation are secondary dischargers because they are past owners of LASC. Steven Song, Michael Neely and Perry Neely are primary dischargers because they operated at Mike's Cleaners. MOSC associates is a limited partnership of which IMA Financial Corporation is the managing general partner. MOSC Associates is a secondary discharger because it currently owns MOSC. Kathleen McCorduck, John McCorduck, Pamela McCorduck, Sandra McCorduck Marona, Stark Investment Company, and Fortney H. Stark are secondary dischargers because they are past owners of the MOSC. Charles Hartz operated at Paul's Cleaners and is a primary discharger.

   The secondary dischargers will be responsible for compliance if the Board or Executive Officer finds the primary dischargers have failed to comply with the requirements of this Order. If additional information is submitted indicating that other parties caused or permitted any waste to be discharged on the site where it entered or could have entered waters of the State, the Board will consider adding that party's name to this Order.

4. **Regulatory Status**: This site is subject to the following Board order:

   Site Cleanup Requirements, Order No. 93-139, adopted October 20, 1993.

5. **Site Hydrogeology**: The site consists of several buildings that occupy the majority of the total surface area . The remaining area is currently covered by asphalt and/or concrete. The sediments encountered during drilling are the upper part of the Pleistocene Livermore Formation that consists of yellowish-brown clay, silt, sand, and gravel deposited in alluvial fans and marsh/deltaic environments. The groundwater beneath the site occurs within two distinct zones. An upper or shallow local unconfined water bearing zone occurs above a continuous silty-clay aquitard beneath which is the deeper aquifer. The shallow groundwater is about 30 feet below ground surface and has exhibited a thickness of less than 10 feet during drought periods. There are no reported uses of the shallow groundwater underlying the site. The shallow groundwater flows primarily toward the northwest direction with a hydraulic gradient of about 0.0097 ft/ft. The continuous silty-clay aquitard is about 70 feet below ground surface and 40 feet thick.

6. **Remedial Investigation**: Soil and groundwater investigations, conducted in 1990, revealed the presence of PCE, its degradation products, and petroleum hydrocarbons at LASC. Subsequent investigations clearly indicated that the petroleum hydrocarbons

originated from an off-site source located southeast of LASC. Based on a "Remedial Investigation" report, dated April 1992, and previous investigations, the maximum PCE groundwater concentration was 5800 ppb and the PCE groundwater plume extended to about 950 feet along the downgradient direction. Additional investigations revealed that Paul's Cleaners at MOSC has contributed to the PCE groundwater plume. The lateral and vertical extent of PCE and its degradation products in soil and groundwater beneath the site has been delineated by a soil-gas survey, numerous soil borings, and thirty two monitoring wells including two wells screened in the deeper aquifer.

Analysis of soil samples in 1995 indicated less than 1 ppm of PCE and its degradation products in soil at the site. The groundwater PCE concentrations at Mike's and Paul's cleaners have been reduced to approximately 100 ppb. Groundwater concentrations of TCE, cis-1,2 DCE and trans-1,2 DCE, which are degradation products of PCE, are 100 to 1000 times lower than that of PCE. The PCE groundwater pollution has migrated off-site as shown in Figure 2. The downgradient monitoring wells MW-14 and MW-15, at the periphery of the PCE plume, have consistently shown approximately 10 ppb of PCE since 1990. The data generally indicate that PCE concentrations decrease with depth in the shallow groundwater. PCE groundwater concentrations less than 5 ppb have been detected intermittently in monitoring well DMW-01 (Figure 2) which is screened in the deeper aquifer. The PCE detected in this monitoring well is likely a result of cross-contamination during its installation. However, PCE levels in the monitoring well have been less than 0.5 ppb during the past three monitoring events. No PCE has been detected in DMW-02 and the California Water Service Company Wells No. 03 and 08.

7. **Adjacent Sites**: The petroleum hydrocarbons at the site are restricted to the shallow groundwater beneath the south-eastern portion of LASC and originated from the adjacent Beacon gas station, located at 1619 First Avenue, Livermore, Alameda County . The investigation, cleanup and containment of the petroleum hydrocarbon pollution is under the regulatory oversight of the Alameda County Department of Environmental Health and is beyond the scope of this Order.

8. **Interim Remedial Measures**: A pilot scale soil vapor extraction (SVE) system was initiated at LASC in June 1992. The PCE removal rate of the SVE system was approximately 0.42 lbs/day. The pilot scale SVE system was subsequently expanded to include air sparging. The results of the pilot study indicated that SVE with appropriate air sparging is very effective in removing PCE from the subsurface soils and reducing the PCE groundwater concentrations. The pilot system was operated intermittently until the end 1993.

9. **Feasibility Study**: A "Feasibility Study/ Remedial Action Plan", dated July 1992, evaluated eight remedial alternatives such as no action, variations of groundwater extraction and treatment, variations of SVE/air sparging systems, and subsurface

bioremediation. The evaluation factors used were short-term and long-term effectiveness, implementability, protection of public health and the environment, costs, and community acceptability. The recommended alternative was SVE with air sparging during periods of high groundwater levels.

10. **Cleanup Plan**

a. Original Cleanup Plan: A remedial plan was proposed in the report "Remedial Plan/Preliminary Remedial Design", dated March 1993. This plan was an extension of the pilot scale interim remedial measure and consisted of SVE with carbon treatment and, as appropriate, air sparging to remediate the soil and groundwater pollution at the entire site. The full-scale SVE/air sparging system was installed in February-March 1994. The system was initially operated as a vapor extraction unit only due to low groundwater levels. In July 1994 the system was modified to conduct both vapor extraction and air sparging. Since then the system was continually enhanced by increasing the air pressures and flow rates, and by periodically changing locations of air injection and extraction. Additionally, groundwater extraction and treatment was performed since the first quarter of 1995. The progress of the remediation is documented in quarterly reports submitted to the Board. The SVE/air sparging system ceased operation in October-December 1995 when the inlet PCE vapor concentrations to the system were 1 ppm(v) or lower and PCE groundwater concentrations reached asymptotic levels. Groundwater extraction and treatment ceased in February 1996 after demonstration that the system no longer had any measurable impact on reducing PCE concentrations in groundwater.

b. Proposed Containment/Cleanup Plan: The dischargers have proposed a non-attainment area strategy to contain and manage the residual pollution at the site. The strategy is detailed in a draft report "Request for Designation of a Containment Zone", dated February 14, 1996, and consists of a containment zone risk management plan including a contingency plan to be implemented if trigger levels are exceeded. The remedial system has been successful in reducing the PCE and its degradation products in soil to less than 1 ppm. However, the groundwater cleanup goal of 5 ppb has not been met. As described above, the SVE/air sparging system was continually enhanced and subsequently operated in conjunction with groundwater extraction and treatment until the groundwater concentrations reached asymptotic levels. Thus, the dischargers have demonstrated that achieving the 5 ppb cleanup goal is technically infeasible. The PCE groundwater concentrations have been reduced from over 1000 ppb to near 100 ppb. The proposed non-attainment area is shown in Figure 3 and applies only to the shallow groundwater.

The containment zone risk management plan contains certain pollution management measures that prohibit the use of shallow groundwater, prohibit

the creation of potential vertical conduits between the shallow and deeper groundwaters, and require the preparation of appropriate health and safety plans for any activities involving exposure to groundwater, within the proposed non-attainment area. Water well drilling and building construction activities in the proposed non-attainment area are permitted by the Alameda Flood Control and Water Conservation District (Zone 7) and the City of Livermore, building permit section, respectively. The dischargers plan on obtaining letters from Zone 7 and the City of Livermore that indicate that the above pollution management measures have been incorporated into the water well drilling and building construction permitting processes. The proposed building restrictions are applicable only to construction/excavation activities that occur at or below the groundwater table which is approximately 30 feet below ground surface. Exceptions to the titles of the LASC and MOSC properties will be recorded with the Alameda County Recorder's Office that indicate the existence of a containment zone risk management plan.

11. **Risk Assessment**

a. Original Risk Assessment: A baseline health risk assessment report, dated April 1992, evaluated the human health risks associated with PCE in soil and groundwater at the site before starting remediation. The risk assessment concluded that the cancer risks were below the excess lifetime cancer risk of 1E-06 for soil ingestion, dermal absorption, and soil gas inhalation exposure routes. However, the incremental cancer risk due to groundwater ingestion was as high as 5E-03.

b. Non-attainment area related Risk Assessment : The dischargers conducted a post-cleanup risk assessment which is documented in the report "Health Risk Assessment", dated January 1996. The main constituents considered for the risk assessment were PCE and its degradation products TCE, cis-1,2 DCE, and trans-1,2 DCE. The current land use and the likely future use at the site are commercial. The risk assessment considered current and future exposure scenarios for the on-site commercial land use and off-site residential land use. The exposure route-pathways evaluated were inhalation of pollutants volatilizing from groundwater, inhalation and dermal absorption of pollutants from using groundwater for bath-shower purposes, dermal absorption of pollutants from using groundwater for irrigation purposes, and ingestion of groundwater. The risk assessment determined that PCE contributes to more than 90 % of the cancer risk and 70% of the non-cancer risk. The excess cancer risk and non-cancer risk from inhalation of pollutants volatilizing from groundwater are less than 1E-06 and 0.01 respectively, for current and future, residential and commercial scenarios. The total excess cancer and total non-cancer risk, from ingestion of groundwater and inhalation/dermal absorption of pollutants from using groundwater for bath-shower and irrigation purposes, are

2.6E-05 and 0.344 respectively.

For comparison, the Board considers the following risks to be acceptable at remediation sites: a hazard index of 1.0 or less for non-carcinogens, and an excess cancer risk of 10^{-4} or less for carcinogens.

12. **Basis for Cleanup Standards**

a. **General**: State Board Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California," applies to this discharge and requires attainment of background levels of water quality, or the highest level of water quality which is reasonable if background levels of water quality cannot be restored. Cleanup levels other than background must be consistent with the maximum benefit to the people of the State, not unreasonably affect present and anticipated beneficial uses of such water, and not result in exceedance of applicable water quality objectives.

State Board Resolution No. 92-49, "Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304," applies to this discharge. This order and its requirements are consistent with the provisions of Resolution No. 92-49, as amended.

b. **Beneficial Uses**: The Board adopted a revised Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) on June 21, 1995. This updated and consolidated plan represents the Board's master water quality control planning document. The revised Basin Plan was approved by the State Water Resources Control Board and the Office of Administrative Law on July 20, 1995, and November 13, 1995, respectively. A summary of regulatory provisions is contained in 23 CCR 3912. The Basin Plan defines beneficial uses and water quality objectives for waters of the State, including surface waters and groundwaters.

Board Resolution No. 89-39, "Sources of Drinking Water," defines potential sources of drinking water to include all groundwater in the region, with limited exceptions for areas of high TDS, low yield, or naturally-high contaminant levels. The shallow groundwater underlying the site is of limited yield with a widely fluctuating water level. During drought periods, shallow groundwater monitoring wells yielded much less than 200 gallons per day. The deeper groundwater underlying and adjacent to the site qualifies as a potential source of drinking water.

The Basin Plan designates the following potential beneficial uses of groundwater underlying and adjacent to the site:

o Municipal and domestic water supply
o Industrial process water supply
o Industrial service water supply
o Agricultural water supply

At present there is no known use of the shallow groundwater underlying the site for the above purposes. However, the deeper groundwater is known to be used for municipal and domestic purposes.

The existing and potential beneficial uses of surface waters in the Livermore - Amador Valley include:

o Groundwater recharge
o Water contact and non-contact recreation
o Wildlife habitat
o Fish migration and spawning
o Warm and cold freshwater habitat

c. **Basis for Groundwater Cleanup Standards**: The groundwater cleanup standards for the site are based on applicable water quality objectives and are the more stringent of EPA and California primary maximum contaminant levels (MCLs). Cleanup to this level will result in acceptable residual risk to humans.

d. **Basis for Soil Cleanup Standards**: The soil cleanup standards for the site are 1 mg/kg total VOCs and 10 mg/kg total SVOCs. Cleanup to this level is intended to prevent leaching of contaminants to groundwater and will result in acceptable residual risk to humans.

13. **Basis for Non-Attainment Area**

a. **Limits of Groundwater Remediation Technology**: The Board has over ten years of experience overseeing the cleanup of VOC-polluted groundwater at numerous Bay Area sites. The Board is also aware of experience elsewhere in the U.S. with such sites. This experience demonstrates that groundwater remediation technologies are effective for pollutant removal and migration control. However, the technologies are usually not effective in restoring beneficial uses of VOC-polluted groundwater, due to very stringent water quality objectives for many VOCs and due to prohibitively high costs and long time-frames to reach objectives. Groundwater pollutant concentrations typically reach an asymptotic level that is significantly above the applicable water quality objective. These findings were also part of the Board's consideration of Basin Plan groundwater amendments in late 1992. Although similar in concept to the Basin Plan amendments, this Order stands alone and does not depend upon the Basin Plan in the implementation of a non-attainment area.

b. **Non-Attainment Area**: The Board may designate a non-attainment area for areas of groundwater where water quality objectives cannot reasonably be achieved, after considering what is technologically and economically feasible within a reasonable time period. Water quality objectives must continue to be met at the boundary outside of the designated non-attainment area.

c. **Criteria**: In order to designate a non-attainment area, the Board considered the following:

i. The dischargers have completed adequate source control (removed tanks, sumps, floating product, and other sources; removed or isolated polluted soils), and

ii. The dischargers have fully implemented an approved groundwater cleanup program and groundwater concentrations have reached asymptotic levels, and

iii. No alternative that meets groundwater objectives is technically or economically feasible, and

iv. The dischargers have evaluated the risks to water quality, human health, and the environment associated with the non-attainment area, and

v. The dischargers have proposed a risk management plan to avoid excessive risk to water quality, human health, and the environment (including reasonable mitigation for any significant adverse impacts), and

vi. The dischargers will conduct monitoring adequate to document that water quality objectives are met outside the non-attainment area and that risks within the non-attainment area remain acceptable.

d. **Specific Rationale**: Water quality objectives cannot reasonably be achieved in the area designated on Figure 3 and the area meets the above criteria for designating non-attainment areas. Specifically,

i. Soil concentrations of PCE and its degradation products at the two source areas adjacent to Mike's Cleaners and Paul's Cleaners have been reduced to less than 1 ppm. Further, PCE groundwater concentrations in the source areas have been reduced from over 1000 ppb to near 100 ppb. Thus, adequate source removal has been accomplished.

ii. As described in Finding 10.a. above, an appropriate soil and groundwater remedial system consisting of SVE/air sparging and

groundwater extraction and treatment was implemented at the site. PCE groundwater concentrations have reached asymptotic levels. Further reduction in PCE groundwater concentrations is not technically feasible due to the high clay content and anisotropic nature of the shallow water bearing zone.

iii. Groundwater monitoring data indicate that PCE groundwater concentrations have stabilized due to pollution source removal and remediation. Groundwater modeling, for a 30 year period, using site specific groundwater flow characteristics, attenuation, and biological transformation predicts that significant migration of the PCE plume will not occur. Further, the silty-clay aquitard separating the shallow and deeper groundwaters is considered to be continuous throughout the non-attainment area, and the potential for vertical migration of PCE through the aquitard is negligible.

iv. As described in Finding 11.b. a human health risk assessment indicated that risks to human health due to the current and future pollutant concentrations within the non-attainment area are acceptable. As described in Finding 10.b. a containment zone risk management plan, as amended by this Order, shall be implemented to contain and manage the remaining risks within the non-attainment area.

14. **Reuse or Disposal of Extracted Groundwater**: Board Resolution No. 88-160 allows discharges of extracted, treated groundwater from site cleanups to surface waters only if it has been demonstrated that neither reclamation nor discharge to the sanitary sewer is technically and economically feasible.

15. **Basis for 13304 Order**: The dischargers have caused or permitted waste to be discharged or deposited where it is or probably will be discharged into waters of the State and creates or threatens to create a condition of pollution or nuisance.

16. **Cost Recovery**: Pursuant to California Water Code Section 13304, the dischargers are hereby notified that the Board is entitled to, and may seek reimbursement for, all reasonable costs actually incurred by the Board to investigate unauthorized discharges of waste and to oversee cleanup of such waste, abatement of the effects thereof, or other remedial action, required by this order.

17. **CEQA**: This action is an order to enforce the laws and regulations administered by the Board. As such, this action is categorically exempt from the provisions of the California Environmental Quality Act (CEQA) pursuant to Section 15321 of the Resources Agency Guidelines.

18. **Notification**: The Board has notified the dischargers, off-site property owners within

the proposed non-attainment area, and all interested agencies and persons of its intent under California Water Code Section 13304 to prescribe site cleanup requirements for the discharge, and has provided them with an opportunity to submit their written comments. The dischargers have published a notice in the *Valley Times*, Legal Notices Section, Page 4D, dated March 27, 1996, regarding the proposed pollution management measures within the non-attainment area.

19. **Public Hearing**: The Board, at a public meeting, heard and considered all comments pertaining to this discharge.

IT IS HEREBY ORDERED, pursuant to Section 13304 of the California Water Code, that the dischargers (or their agents, successors, or assigns) shall cleanup and abate the effects described in the above findings as follows:

A. **PROHIBITIONS**

1. The discharge of wastes or hazardous substances in a manner which will degrade water quality or adversely affect beneficial uses of waters of the State is prohibited.

2. Further significant migration of wastes or hazardous substances through subsurface transport to waters of the State is prohibited.

3. Activities associated with the subsurface investigation and cleanup which will cause significant adverse migration of wastes or hazardous substances are prohibited.

B. **CLEANUP PLAN AND CLEANUP STANDARDS**

1. **Implement Containment/Cleanup Plan**: The dischargers shall implement the containment/cleanup plan described in Finding 10.b., with the following amendments, in a manner that is acceptable to the Regional Board Executive Officer (the "Executive Officer"). The proposed containment zone risk management plan including the contingency plan is amended as follows:

   i. Pollution management measures that prohibit the use of shallow groundwater, prohibit the creation of potential vertical conduits between the shallow and the deeper groundwaters, and require the preparation of appropriate health and safety plans for any activities involving exposure to groundwater, shall be implemented within the proposed non-attainment area.

   ii. The trigger levels for monitoring wells MW-6, MW-13, MW-15, MW-26S, MW-26D, MW-28D, MW-31S, and MW-31D are 122 ppb, 42 ppb,

20 ppb, 873 ppb, 133 ppb, 30 ppb, 424 ppb, and 15 ppb respectively. The trigger levels are established as the mean plus two standard deviations of the PCE groundwater concentrations in the monitoring wells during the period 1990-1995.

iii. If the total concentration of PCE and its degradation products, as analyzed by US EPA method 8010 or its equivalent, in a monitoring well exceeds the appropriate trigger level or if the trend of the total concentration of PCE and its degradation products in a monitoring well exhibits a rate of increase which indicates that the appropriate trigger level will be exceeded before the next regular sampling event, the monitoring frequency for that well shall be increased to quarterly.

iv. If a trigger level is exceeded, the Executive Officer shall be notified within 30 days following the first observation of the exceedance.

v. If the total concentration of PCE and its degradation products is below the appropriate trigger level for two consecutive quarters, groundwater monitoring will return to the regular schedule.

vi. If the total concentration of PCE and its degradation products exceeds the appropriate trigger level for two consecutive quarters, groundwater extraction at appropriate locations shall commence, in a manner acceptable to the Executive Officer, within a period of 30 days following the second quarterly monitoring event.

vii. A technical report acceptable to the Executive Officer shall be submitted documenting the completion of any actions taken under the contingency plan within a period of 45 days following the return of groundwater monitoring to the regular schedule or after implementation of groundwater extraction.

2. **Groundwater Cleanup Standards**: Groundwater in monitoring well(s) to be installed at the boundary outside of the proposed non-attainment area, as required by task 2 of this Order, in monitoring well MW-14, and in the deep wells DMW-01, DMW-02, CWS-03 and CWS-08 shall not contain concentrations of pollutants in excess of the following limits.

Constituent	Cleanup Standard (ug/l)	Basis
PCE	5	MCL

TCE	5	MCL
cis-1,2 DCE	6	MCL
trans-1,2 DCE	10	MCL
vinyl chloride	0.5	MCL

3. **Contingency Plan if Cleanup Standards are exceeded**: The dischargers shall develop a contingency plan, as required by task 3 of this Order, to be implemented if the above cleanup standards are exceeded.

C. NON-ATTAINMENT AREA

1. **Establishment of Area**: A non-attainment area is established as shown in Figure 3 and applies only to the shallow groundwater above the silty-clay aquitard, which is about 70 feet below ground surface. Groundwater cleanup standards do not apply in this area. The dischargers are required to implement the containment/cleanup plan described in Finding 10.b., as amended by this Order, in a manner that is acceptable to the Executive Officer.

2. **Conditions**: Establishment of the non-attainment area is subject to the procurement of letters from zone 7 and the City of Livermore as described in Finding 10.b. If the dischargers are unable to obtain these letters, they may propose alternate institutional constraints, acceptable to the Executive Officer, to implement the pollution management measures described in Finding 10.b.

D. TASKS

1. IMPLEMENTATION OF INSTITUTIONAL CONSTRAINTS

COMPLIANCE DATE: (July 1, 1996)

Submit a technical report acceptable to the Executive Officer documenting that letters from Zone 7 and the City of Livermore have been obtained which indicate that the pollution management measures, described in Finding 10.b., have been incorporated into the well drilling and building construction permitting processes OR Submit a technical report acceptable to the Executive Officer documenting procedures to be used to implement the pollution management measures described in Finding 10.b. with a time schedule for the implementation of the procedures. The technical report shall document that Exceptions to the titles of the LASC and MOSC properties, that indicate the existence of a containment zone risk management plan, have been recorded

with the Alameda County Recorder's Office.

2. **MONITORING PLAN OUTSIDE THE NON-ATTAINMENT AREA**

COMPLIANCE DATE: (August 1, 1996)

Submit a workplan acceptable to the Executive Officer to implement groundwater monitoring at the boundary outside of the non-attainment area. The plan should include the number, location, and depths of screening intervals of monitoring wells to be installed and a time schedule for installation.

3. **CONTINGENCY PLAN IF CLEANUP STANDARDS ARE EXCEEDED**

COMPLIANCE DATE: (June 3, 1996)

Submit a technical report acceptable to the Executive Officer which describes a contingency plan to be implemented if cleanup standards are exceeded in monitoring well(s) to be installed as per task 2 above, in monitoring well MW-14, and in the deep wells DMW-01, DMW-02, CWS-03 and CWS-08. The report should include all steps to be taken with a time schedule for their implementation.

4. **FIVE-YEAR STATUS REPORT**

COMPLIANCE DATE: *(May 1, 2001)*

Submit a technical report acceptable to the Executive Officer evaluating the effectiveness of the approved containment/cleanup plan, including the designated non-attainment area. The report should include:

a. Summary of effectiveness in controlling contaminant migration and protecting human health and the environment
b. Comparison of contaminant concentration trends with cleanup standards
c. Evaluation of risk management plan associated with non-attainment area
d. Recommendations on continuation of groundwater monitoring and the pollution management measures.

5. **EVALUATION OF NEW HEALTH CRITERIA**

COMPLIANCE DATE: 90 days after requested by Executive Officer

Submit a technical report acceptable to the Executive Officer evaluating the effect on the approved containment/cleanup plan of revising one or more cleanup standards in response to adoption of revised drinking water standards, maximum contaminant levels, or other health-based criteria.

6. EVALUATION OF NEW TECHNICAL INFORMATION

COMPLIANCE DATE: 90 days after requested by Executive Officer

Submit a technical report acceptable to the Executive Officer evaluating new technical information which bears on the approved containment/cleanup plan and cleanup standards for this site. In the case of a new cleanup technology, the report should evaluate the technology using the same criteria used in the feasibility study. Such technical reports shall not be requested unless the Executive Officer determines that the new information is reasonably likely to warrant a revision in the approved containment/cleanup plan, cleanup standards, or risk reduction.

7. **Delayed Compliance**: If the dischargers are delayed, interrupted, or prevented from meeting one or more of the completion dates specified for the above tasks, the dischargers shall promptly notify the Executive Officer and the Board may consider revision to this Order.

E. PROVISIONS

1. **No Nuisance**: The storage, handling, treatment, or disposal of polluted soil or groundwater shall not create a nuisance as defined in California Water Code Section 13050(m).

2. **Good O&M**: The dischargers shall maintain in good working order and operate as efficiently as possible any facility or control system installed to achieve compliance with the requirements of this Order.

3. **Cost Recovery**: The dischargers shall be liable, pursuant to California Water Code Section 13304, to the Board for all reasonable costs actually incurred by the Board to investigate unauthorized discharges of waste and to oversee containment/cleanup of such waste, abatement of the effects thereof, or other actions, required by this Order. If the site addressed by this Order is enrolled in a State Board-managed reimbursement program, reimbursement shall be made pursuant to this Order and according to the procedures established in that program. Any disputes raised by the dischargers over reimbursement amounts or methods used in that program shall be consistent with the dispute resolution

procedures for that program.

4. **Access to Site and Records**: In accordance with California Water Code Section 13267(c), the dischargers shall permit the Board or its authorized representative:

   a. Entry upon premises in which any pollution source exists, or may potentially exist, or in which any required records are kept, which are relevant to this Order.

   b. Access to copy any records required to be kept under the requirements of this Order.

   c. Inspection of any monitoring or remediation facilities installed in response to this Order.

   d. Sampling of any groundwater or soil which is accessible, or may become accessible, as part of any investigation or remedial action program undertaken by the dischargers.

5. **Self-Monitoring Program**: The dischargers shall comply with the Self-Monitoring Program as attached to this Order and as may be amended by the Executive Officer.

6. **Contractor / Consultant Qualifications**: All technical documents shall be signed by and stamped with the seal of a California registered geologist, a California certified engineering geologist, or a California registered civil engineer.

7. **Lab Qualifications**: All samples shall be analyzed by State-certified laboratories or laboratories accepted by the Board using approved EPA methods for the type of analysis to be performed. All laboratories shall maintain quality assurance/quality control (QA/QC) records for Board review. This provision does not apply to analyses that can only reasonably be performed on-site (e.g. temperature).

8. **Document Distribution**: Copies of all correspondence, technical reports, and other documents pertaining to compliance with this Order shall be provided to the following agencies:

   a. City of Livermore, Building Permits Section
   b. County of Alameda, Zone 7

   The Executive Officer may modify this distribution list as needed.

9. **Reporting of Changed Owner or Operator**: The dischargers shall file a technical report on any changes in site occupancy or ownership associated with the LASC and MOSC properties.

10. **Reporting of Hazardous Substance Release**: If any hazardous substance is discharged in or on any waters of the State, or discharged or deposited where it is, or probably will be, discharged in or on any waters of the State, the dischargers shall report such discharge to the Regional Board by calling (510) 286-1255 during regular office hours (Monday through Friday, 8:00 to 5:00).

    A written report shall be filed with the Board within five working days. The report shall describe: the nature of the hazardous substance, estimated quantity involved, duration of incident, cause of release, estimated size of affected area, nature of effect, corrective actions taken or planned, schedule of corrective actions planned, and persons/agencies notified.

    This reporting is in addition to reporting to the Office of Emergency Services required pursuant to the Health and Safety Code.

11. **Rescission of Existing Order**: This Order supercedes and rescinds Order No. 93-139. In the event that this Order is not adopted by the Board, Order No. 93-139 shall continue to be effective.

12. **Periodic SCR Review**: The Board will review this Order periodically and may revise it when necessary.

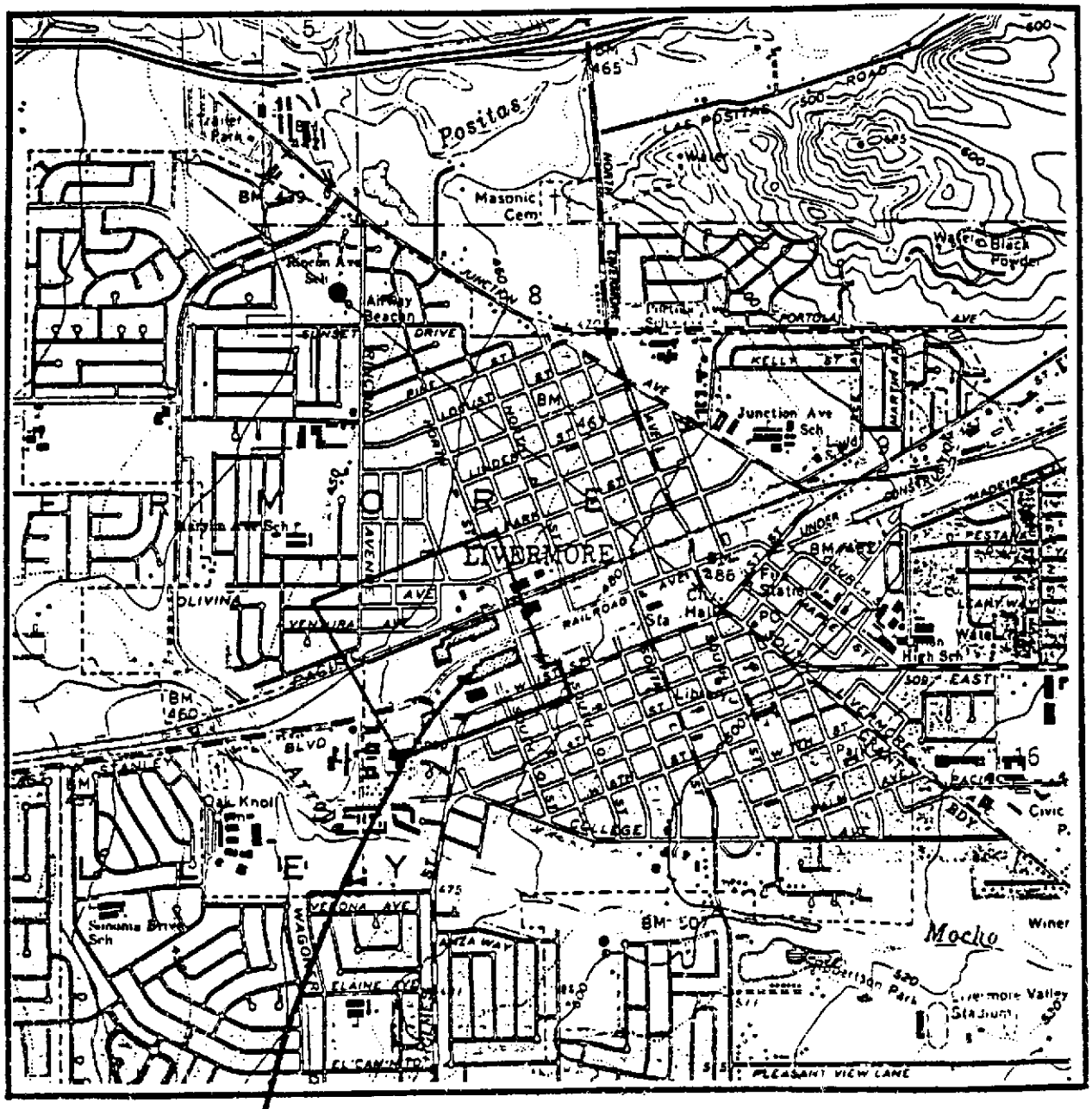
I, Loretta K. Barsamian, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, San Francisco Bay Region, on April 17, 1996.

Loretta K. Barsamian
Executive Officer

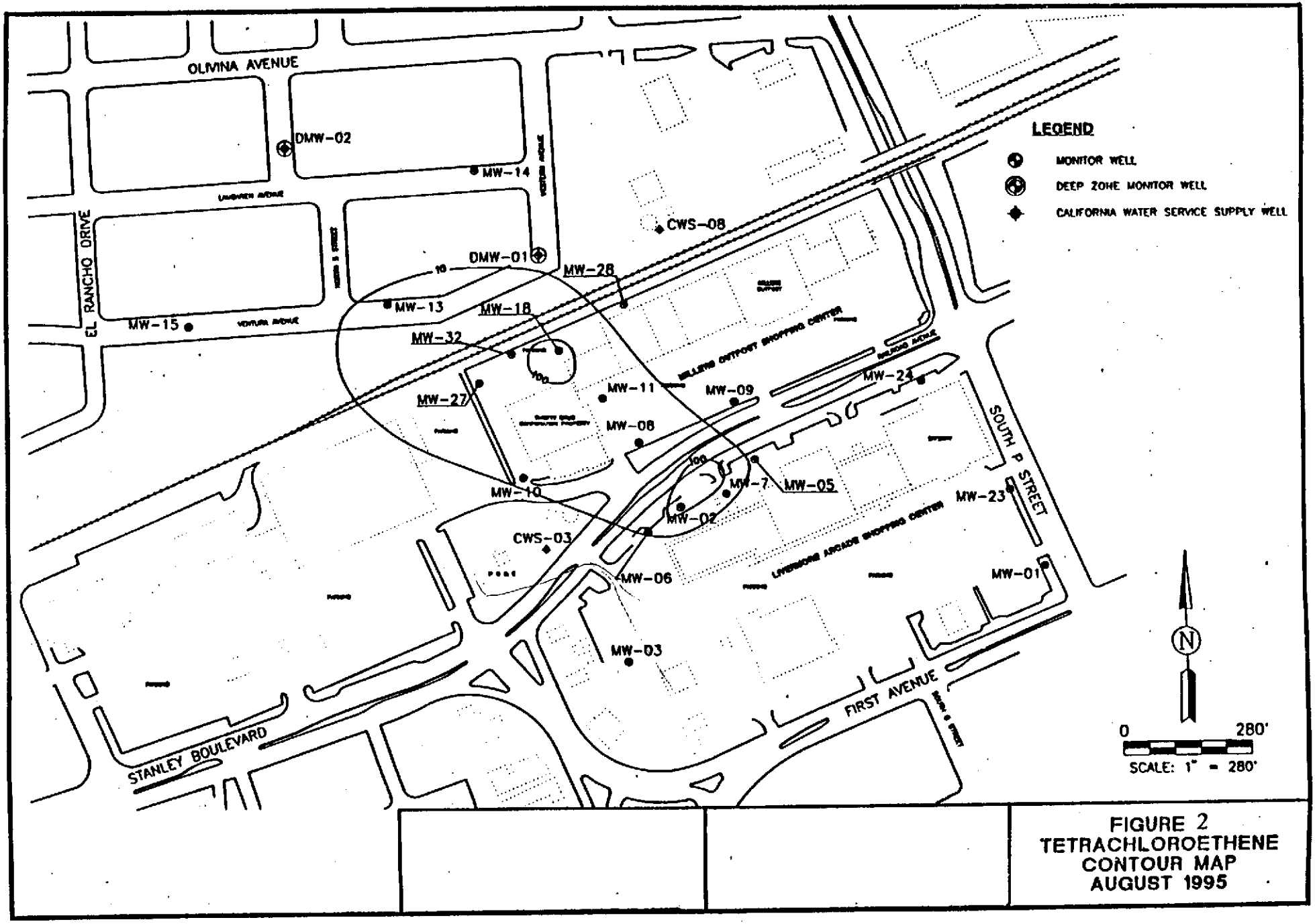
FAILURE TO COMPLY WITH THE REQUIREMENTS OF THIS ORDER MAY SUBJECT YOU TO ENFORCEMENT ACTION, INCLUDING BUT NOT LIMITED TO: IMPOSITION OF ADMINISTRATIVE CIVIL LIABILITY UNDER WATER CODE SECTIONS 13268 OR 13350, OR REFERRAL TO THE ATTORNEY GENERAL FOR INJUNCTIVE RELIEF OR CIVIL OR CRIMINAL LIABILITY

Attachments: Figures
Self-Monitoring Program

Figure 1 Site Map



Source: USGS Livermore Quadrangle, Alameda County, 1961, Photorevised 1980.


OLIVINA AVENUE
DMW-02
MW-14
EL RANCHO DRIVE
DMW-01
MW-28
MW-13
MW-18
MW-15
VENTURA AVENUE
MW-32
CWS-08
MW-27
MW-11
MW-09
MW-24
MW-08
SOUTH P STREET
MW-10
MW-7
MW-05
MW-23
MW-02
CWS-03
MW-06
MW-01
MW-03
STANLEY BOULEVARD
FIRST AVENUE
LEGEND
MONITOR WELL
DEEP ZONE MONITOR WELL
CALIFORNIA WATER SERVICE SUPPLY WELL
N
0
280'
SCALE: 1" = 280'
FIGURE 2
TETRACHLOROETHENE
CONTOUR MAP
AUGUST 1995

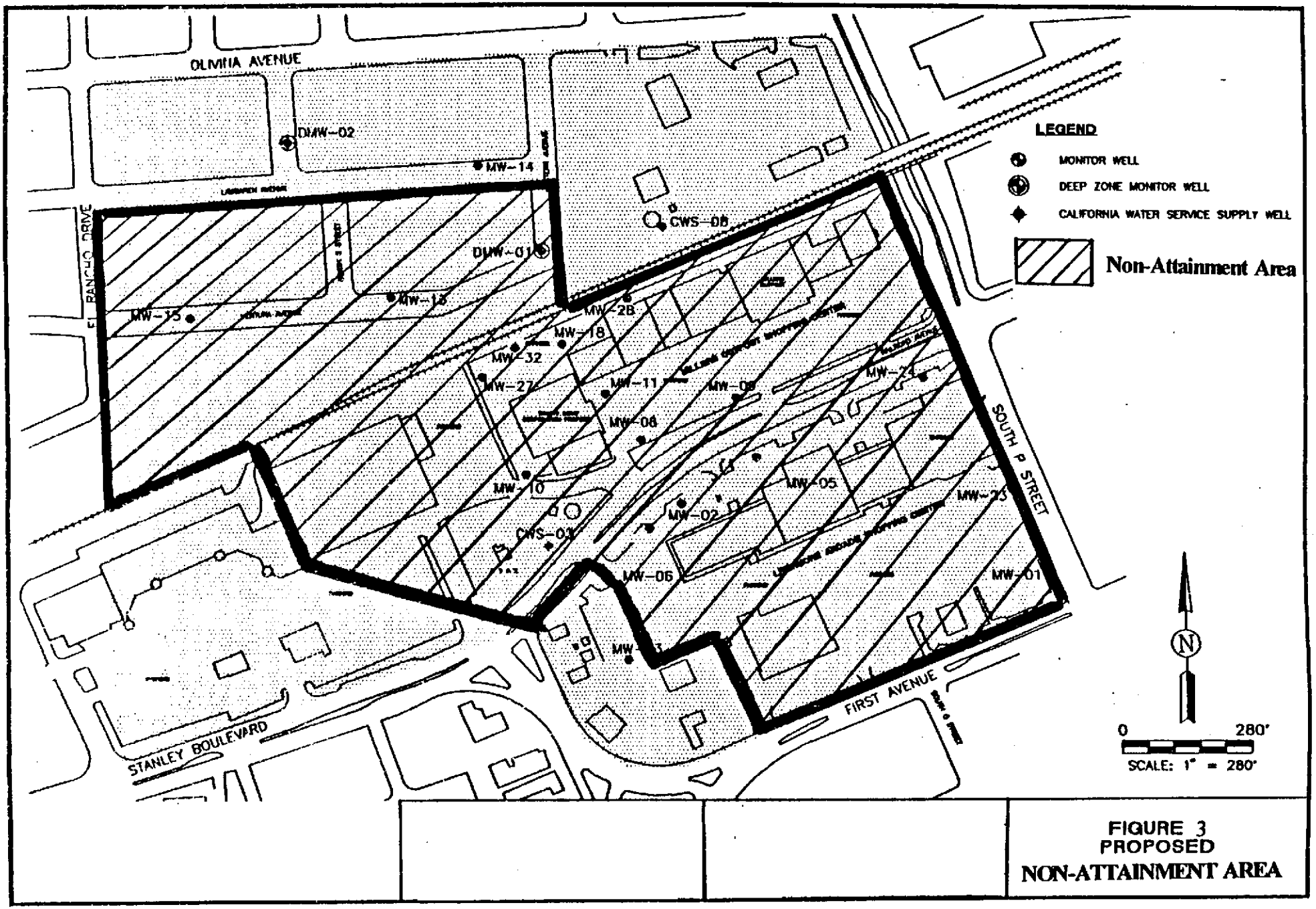


FIGURE 3
PROPOSED
NON-ATTAINMENT AREA

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

SELF-MONITORING PROGRAM FOR:

GRUBB AND ELLIS REALTY INCOME TRUST, LIQUIDATING TRUST; STARK INVESTMENT COMPANY; CATELLUS DEVELOPMENT CORPORATION; STEVEN SONG, MICHAEL NEELY AND PERRY NEELY dba MIKE' S ONE HOUR CLEANERS; MILLER' S OUTPOST SHOPPING CENTER ASSOCIATES, IMA FINANCIAL CORPORATION; KATHLEEN McCORDUCK, JOHN McCORDUCK, PAMELA McCORDUCK AND SANDRA McCORDUCK MARONA; FORTNEY H. STARK, JR.; CHARLES HARTZ dba PAUL' S SPARKLE CLEANERS

for the properties

LIVERMORE ARCADE SHOPPING CENTER
located at FIRST AVENUE AND "P" STREET, AND
MILLER' S OUTPOST SHOPPING CENTER
located at RAILROAD AVENUE AND "P" STREET
LIVERMORE, ALAMEDA COUNTY

1.**Authority and Purpose**: The Board requests the technical reports required in this Self-Monitoring Program pursuant to Water Code Sections 13267 and 13304. This Self-Monitoring Program is intended to document compliance with Board Order No. 96- 052 (site cleanup requirements).

2.**Monitoring**: The dischargers shall measure groundwater elevations semi-annually in all monitoring wells, and shall collect and analyze representative samples of groundwater according to the following table:

Well #	Sampling Frequency	Analyses	Well #	Sampling Frequency	Analyses
MW-6	SA	8010	MW-31S	SA	8010
MW-13	SA	8010	MW-31D	SA	8010
MW-14	SA	8010	DMW-01	SA	8010
MW-15	SA	8010	CWS-03*	SA	8010
MW-26S	SA	8010	CWS-08*	SA	8010

MW-26D	SA	8010			
MW-28D	SA	8010			

*Whenever wells are in operation, but no more than one sample per 6 months

Key: SA = Semi-Annually 8010 = EPA Method 8010 or equivalent

The dischargers shall sample any new monitoring wells semi-annually and analyze groundwater samples for the same constituents as shown in the above table. The dischargers may propose changes in the above table; any proposed changes are subject to Executive Officer approval.

3. **Semi-annual Monitoring Reports**: The dischargers shall submit semi-annual monitoring reports to the Board no later than 30 days following the end of the monitoring period (e.g. report for first semi-annual monitoring period of the year would be due July 30). The first semi-annual monitoring report shall be due on July 30, 1996. The reports shall include:

   a. Transmittal Letter: The transmittal letter shall discuss any violations during the reporting period and actions taken or planned to correct the problem. The letter shall be signed by the dischargers' principal executive officer or his/her duly authorized representative, and shall include a statement by the official, under penalty of perjury, that the report is true and correct to the best of the official's knowledge.

   b. Groundwater Elevations: Groundwater elevation data shall be presented in tabular form, and a groundwater elevation map should be prepared for each monitored water-bearing zone. Historical groundwater elevations shall be included in the second semi-annual report each year.

   c. Groundwater Analyses: Groundwater sampling data shall be presented in tabular form, and an isoconcentration map should be prepared for one or more key contaminants for each monitored water-bearing zone, as appropriate. The report shall indicate the analytical method used, detection limits obtained for each reported constituent, and a summary of QA/QC data. Historical groundwater sampling results shall be included in the second semi-annual report each year. The report shall describe any significant increases in contaminant concentrations since the last report, and any measures proposed to address the increases. Supporting data, such as lab data sheets, need not be included (however, see record keeping - below).

   d. Groundwater Extraction: If applicable, the report shall include groundwater extraction results in tabular form, for each extraction well and for the site as a

whole, expressed in gallons per minute and total groundwater volume for the quarter. The report shall also include contaminant removal results, from groundwater extraction wells and from other remediation systems (e.g. soil vapor extraction), expressed in units of chemical mass per day and mass for the quarter. Historical mass removal results shall be included in the second semi-annual report each year.

e. Status Report: The semi-annual report shall describe relevant work completed during the reporting period (e.g. site investigation, interim remedial measures) and work planned for the following quarter.

5. **Violation Reports**: If the dischargers violate requirements in the Site Cleanup Requirements, then the dischargers shall notify the Board office by telephone as soon as practicable once the dischargers have knowledge of the violation. Board staff may, depending on violation severity, require the dischargers to submit a separate technical report on the violation within five working days of telephone notification.

6. **Other Reports**: The dischargers shall notify the Board in writing prior to any site activities, such as construction or underground tank removal, which have the potential to cause further migration of contaminants or which would provide new opportunities for site investigation.

7. **Record Keeping**: The dischargers or their agent shall retain data generated for the above reports, including lab results and QA/QC data, for a minimum of six years after origination and shall make them available to the Board upon request.

8. **SMP Revisions**: Revisions to the Self-Monitoring Program may be ordered by the Executive Officer, either on his/her own initiative or at the request of the dischargers. Prior to making SMP revisions, the Executive Officer will consider the burden, including costs, of associated self-monitoring reports relative to the benefits to be obtained from these reports.

I, Loretta K. Barsamian, Executive Officer, hereby certify that this Self-Monitoring Program was adopted by the Board on April 17, 1996.

Loretta K. Barsamian
Executive Officer