3/22/93

Remedial Plan/Preliminary Remedial Design for Livermore Arcade Site Livermore, California

March 22, 1993

Prepared for:

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1.0 Introduction

Grubb and Ellis Realty Income Trust, Liquidating Trust proposes to employ vapor extraction with carbon treatment and, as appropriate, air sparging to remediate soil and groundwater at the Livermore Arcade site. A pilot test of this technology has demonstrated its applicability to this site.

Soil-vapor extraction combined with air sparging succeeded in reducing groundwater concentrations of PCE in the most contaminated portions of the site to the MCL of 5 parts per billion (ppb), from original concentrations over 1,000 ppb. While some contaminant rebound has occurred in that area following system shutoff, with levels returning to 100 ppb in the most contaminated areas, it is anticipated that the proposed remedial action will result in compliance with the 5 ppb MCL throughout most, if not all, of the shallow aquifer. This cleanup level will ensure a substantial margin of safety for the deeper aquifer, which has not been contaminated from this source, based upon all data developed to date.

The purpose of this document is to present the rationale for the selection of the proposed remedy, in compliance with state and federal cleanup protocols, including California Health and Safety Code Section 25356.1, the 1989 California Bond Expenditure Plan, State Water Resources Control Board Resolutions 89-39 (sources of drinking water), 92-49 (cleanup levels for polluted sites), and 68-16 (anti-degradation policy), Regional Board Resolution 88-160, the applicable Water Quality Control Plan, applicable provisions of the California Code of Regulations, Title 23, Chapter 15, and the National Contingency Plan, 40 C.F.R. Part 300.

The following are contained in this submission:

- Design of a complete remediation system for the site
- Discussion of the differences between the final design and the conceptual design presented in the July 1992 Feasibility Study
- Engineering drawings and system descriptions to implement final construction
- Operating plan to accomplish the remediation
- Monitoring plan to document the efficacy of the remedial action
- Criteria for determining completion of remediation

The reader is referred to the following H⁺GCL documents for more discussion of these remedial methods and their applicability to the site:

October 12, 1990, Subsurface Investigation

April 1992, Remedial Investigation

July 1992, Feasibility Study

November 24, 1992, Letter to Lester Feldman, RWQCB

Relevant portions of these documents, referenced in this text, are presented in the appendices.

Public review of this document will be provided by publication of a notice of availability and brief summary of the proposed plan in a major local newspaper. The proposed plan and supporting analysis and information will be available upon request to any interested person, and written and oral comments will be received on the proposed plan and supporting information for a period of thirty days. A public meeting will be held near the site if interested parties so request.

2.0 Background Information

2.1 Extent of Contamination

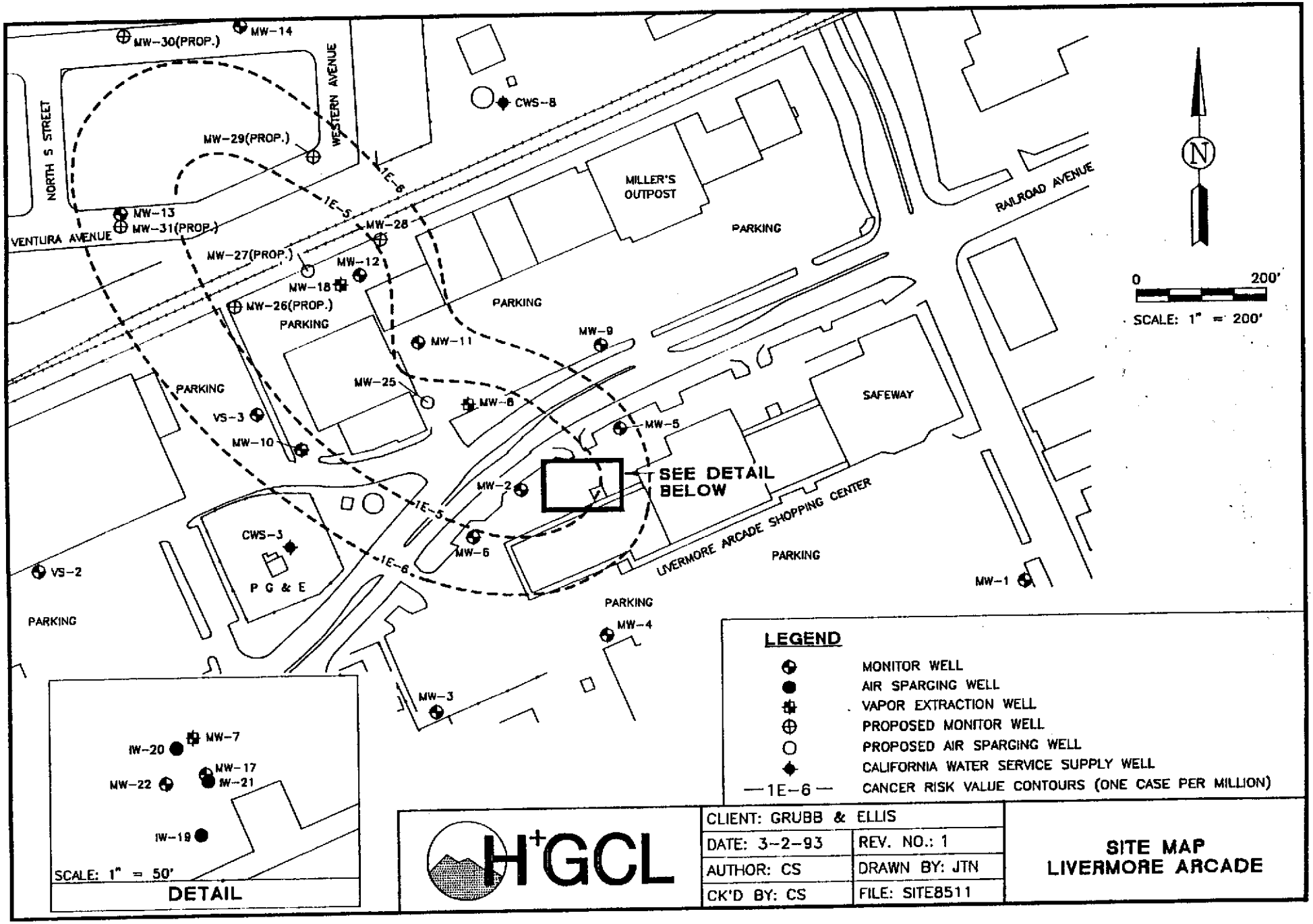
Tetrachloroethene (PCE) is known to be the major contaminant at the Arcade site. A soil boring sample from MW-17 indicated that traces of cis-1,2-dichloroethane are also present in the soil. A soil-vapor survey performed on the monitor wells indicated that PCE, and trichloroethane and associated degradation products may be present in the soil as well. Toluene, o, p, and m xylene are present in soil vapor but the source of these compounds is believed to be off-site USTs. The vapor pressures of these compounds are above 1 millimeter (mm) mercury and can be readily removed by the volatilization treatment processes of soil-vapor extraction and concurrent air injection.

Water samples obtained from the monitor wells before groundwater receded during the drought show that the groundwater contamination extended 900 feet down-gradient to MW-14. On July 25, 1991, 1 part per billion (ppb) of PCE was found in groundwater from that well. The highest levels of PCE encountered in groundwater samples were 1,300 ppb from MW-17 on June 6, 1992, and 537 ppb from MW-18 on October 14, 1992, after the decline in the water table at this site. More detailed information regarding the chemistry of soil and groundwater is presented in section 4.7 of the RI report (appendix A). A site map showing the locations of existing and proposed monitor wells is shown in figure 1 and plate 1. Figure 1 also shows the outline of the PCE groundwater plume as the $1E^{-6}$ cancer risk contour.

It is assumed that the soil contamination does not exceed the boundaries of the groundwater contamination as it existed before the groundwater receded. Two soil borings were drilled, one near the source of VOCs (MW-17) and another down-gradient (MW-18). The soil boring samples from MW-17 showed VOCs ranging from 42 feet to 65 feet below ground surface (bgs) in that area. The soil boring samples from MW-18 showed contamination ranging from 46 feet to 55.5 feet bgs. In both areas, soil contamination was absent in the fine-grained clay aquitard that underlies the shallow water-bearing zone. These newer boreholes help to confirm our hypothesis that the plume geometry has not changed significantly since the water table decline.

Soil-vapor samples were obtained from the monitor wells to better ascertain the horizontal extent of contamination. These samples showed the vapor contamination to extend down-gradient to MW-13, west to MW-10, and east to MW-9, as expected.

Figure 1


MW-30(PROP.)
MW-14
NORTH S STREET
WESTERN AVENUE
CWS-8
MW-29(PROP.)
1E-6
1E-5
MILLER'S OUTPOST
RAILROAD AVENUE
MW-13
MW-31(PROP.)
VENTURA AVENUE
MW-28
PARKING
MW-27(PROP.)
MW-12
MW-18
MW-26(PROP.)
PARKING
PARKING
MW-11
MW-9
MW-25
MW-8
SAFEWAY
PARKING
VS-3
MW-10
MW-5
SEE DETAIL BELOW
MW-2
1E-5
LIVERMORE ARCADE SHOPPING CENTER
CWS-3
MW-6
PARKING
VS-2
1E-6
MW-1
P G & E
PARKING
PARKING
MW-4
MW-3
0
200'
SCALE: 1" = 200'
N
IW-20
MW-7
MW-17
MW-22
IW-21
IW-19
SCALE: 1" = 50'
DETAIL
LEGEND
MONITOR WELL
AIR SPARGING WELL
VAPOR EXTRACTION WELL
PROPOSED MONITOR WELL
PROPOSED AIR SPARGING WELL
CALIFORNIA WATER SERVICE SUPPLY WELL
1E-6
CANCER RISK VALUE CONTOURS (ONE CASE PER MILLION)
H+GCL
CLIENT: GRUBB & ELLIS
DATE: 3-2-93
REV. NO.: 1
AUTHOR: CS
DRAWN BY: JTN
CK'D BY: CS
FILE: SITE8511
SITE MAP
LIVERMORE ARCADE

Aquifer tests were also conducted as part of the RI/FS process. These tests demonstrated that the hydraulic conductivity of the shallow water-bearing zone is 0.58 feet/year to 1.29 feet/year. Because the hydraulic gradient is 0.008 in the zone, a groundwater velocity of only 1 to 3 feet per year is calculated. Shallower portions of this zone, which are presently above the water table, have much greater conductivity. A more detailed discussion of the aquifer tests is provided in section 4.5.4 of the RI report (appendix A).

Based upon (1) the distribution of contaminants prior to the decline of the potentiometric surface, (2) the soil-vapor concentrations in monitor wells, (3) the low velocity of the groundwater, and (4) the concentration of PCE in MW-17 and MW-18, we believe the groundwater plume geometry has not materially changed, although PCE concentrations in groundwater may have been impacted by the decline of groundwater.

The reader is also referred to sections 5.3, 5.4 and 5.5 of the RI report (appendix A) for a more detailed discussion of the contamination plume geometry and migration.

2.2 Feasibility Study

The draft Feasibility Study (FS) and Remedial Action Plan (July 9, 1992) identified eight remedial technologies that may be applicable to the site. Of these eight, two alternatives involving groundwater extraction were eliminated. Because less than 10 feet of saturated thickness is observed in the shallow water-bearing zone, and this fine-grained unit does not readily yield water, groundwater extraction would not be an effective remedial response. Subsurface bioremediation was also eliminated because significant groundwater extraction is a required component of subsurface bioremediation, rendering it also an ineffective alternative.

The following are the remaining five feasible alternatives that were evaluated:

- No action with groundwater monitoring
- Vapor extraction with carbon treatment
- Vapor extraction with direct discharge
- Air sparging and vapor extraction with carbon treatment
- Air sparging and vapor extraction with direct discharge

The *no action alternative* was judged unacceptable because of the excessive cost of long term monitoring and the uncertainty of contaminant isolation. Alternatives that provide direct discharge of extracted vapors to the atmosphere were also judged to be unacceptable because of local limitations on air emissions.

Detailed evaluation of the alternatives concluded that *vapor extraction with carbon treatment* is the technology of choice in this situation. The FS also stated that air sparging should be added to the remedial system in the event that water levels rise, to enhance the effectiveness of vapor extraction. The FS report is presented in appendix B; sections 2.5, 3.2 and 3.4 are relevant to the previous discussion of alternatives.

2.3 Pilot Study

A vapor extraction/air sparging treatment unit for pilot testing was constructed and installed in the service area behind the Livermore Arcade Shopping Center. The results of the pilot tests provided final design information and indicated adjustments that needed to be made to the original remediation plan. A second similar treatment unit is planned for the Miller's Outpost Shopping Center.

The vapor-extraction pilot test conducted at the Arcade site over a 6-month period demonstrated a performance far beyond original expectations. H⁺GCL chose monitoring well MW-17, positioned in the middle of the highest level of PCE contamination at the site, as the primary location to conduct the pilot test. We maintained that removal of contamination to acceptable levels at this location would demonstrate the effectiveness of vapor extraction in all other areas of the site as well. Monitor well water levels measured during the pilot test period are presented in table 1. Groundwater sample results are presented in table 2 and extracted vapor sample results are presented in table 3.

The pilot test program exceeded expectations in two respects. First, the radius of influence from the pilot test vapor-extraction (VE) well was much larger than predicted in the FS. Short-term testing and computer modeling conducted during the FS predicted a 40-foot radius of influence. After 1,070 hours of VE pilot testing, vacuum measurements in adjacent monitor wells demonstrated that the VE well was inducing subsurface flow toward the well from areas more than 200 feet distant. We believe that the continued extraction of vapors and the declining water level reduced the moisture content of the subsurface soils and, as a result, substantially increased the air permeability of the subsurface. Additionally, as described in the RI and FS, the shallow water-bearing zone is characterized by thin layers

Table 1
Water Elevations
Livermore Arcade
(Units = AMSL)

	Date	MW-7	MW-17	MW-18	MW-22	IW-19	IW-20	IW-21	MW-23	MW-24
Vapor Extraction	05/19/92	409.31	409.41	405.41						
	06/04/92	407.47	408.43	404.55						
	07/02/92	404.35	406.85	402.59						
	07/21/92	401.91	401.24	400.53						
	08/26/92	399.98	396.94	395.55						
	09/04/92					WI	WI	WI	WI	WI
Air Sparging with Vapor Extraction	09/21/92					73.50 dry				
	09/22/92				70.69					
	09/23/92		394.30	394.90			71.93	70.93		
	10/06/92		390.54	394.82	71.00	dry	74.25	dry		
	10/14/92		394.58	394.75	71.12					
	11/03/92		393.19	394.86						
	11/09/92		392.20							
	11/14/92			394.61						
	12/01/92		392.91		393.40					
	01/19/93	406.56	405.52	403.99	404.56		404.94	405.84		

NOTES: WI = Well Installed

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Table 2
Groundwater Sampling Results
Livermore Arcade
(Units = ppm)

Parameter	Date Sampled	MW-7	MW-17	MW-18	MW-22	IW-20	IW-21
PCE	06/04/92	0.120	1.300	0.170			
	07/02/92	0.230	0.780	0.240			
	07/21/92	0.178	0.616	0.264			
	09/04/92					WI	WI
	09/22/92				0.007		
	09/23/92		0.202	0.535		0.018	0.027
	10/14/92		0.343	0.537	0.005		
	11/03/92		< 0.005				
	11/09/92		0.033				
	12/01/92		0.021		0.007		
	01/19/93		0.140		0.381		
Benzene	06/04/92	1.000	0.870				
	07/02/92	1.500	0.240				
	07/21/92	1.730	0.101				
	09/04/92					WI	WI
	09/23/92		ND			ND	ND
	10/14/92		< 0.005				
	01/19/93		< 0.005				
TPH-G	06/04/92	10.000	6.000	ND			
	07/02/92	4.000	1.000	ND			
	09/04/92					WI	WI
	09/23/92		0.327	ND		0.178	ND
	10/14/92		< 0.050	< 0.050	< 0.050		
	12/01/92		0.050		< 0.050		
	01/19/93		< 0.050				

NOTES: ND = Not detected
WI = Well Installed

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Table 3
Vapor Extraction Results
Livermore Arcade
(Units = ppm)

Parameter	Date Sampled	MW-2	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11	MW-12	MW-13	MW-17
PCE	03/02/92	0.977		25.300	772.000	2.910	0.570		4.280	292.000	5.390	10.800
	05/19/92											142.000
	06/01/92											177.000
	06/11/92											194.000
	06/25/92											196.000
	07/02/92											158.000
	07/21/92											132.000
	08/26/92											75.000
	09/08/92											79.000
	09/21/92											65.900
	09/25/92											52.600
	10/01/92											35.600
	10/08/92											12.200
	10/14/92	12.100	ND	32.600	28.000	3.030	ND		1.050	263.000	2.600	12.200
	10/23/92											15.500
	11/02/92											11.300
	11/16/92	6.700	ND	23.200	31.200	4.030	ND		0.401	71.300	1.610	8.290
	01/18/93			21.800	56.400							5.610
TCE	03/02/92	ND		ND	3.070	ND	258.000	ND	ND	ND	ND	ND
	10/14/92	ND	ND	ND	0.190	ND	ND	ND	ND	ND	ND	0.160
	11/16/92	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	01/18/93				0.140							
Benzene	06/11/92											1.000
	06/25/92											1.700
	07/02/92											0.860
	07/21/92											1.120
	08/26/92											0.580
	09/08/92											0.620
	09/21/92											ND
	09/25/92											ND
	10/01/92											ND

Table 3
Vapor Extraction Results
Livermore Arcade
(Units = ppm)

Parameter	Date Sampled	MW-2	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11	MW-12	MW-13	MW-17
Benzene	10/08/92											ND
	10/23/92											ND
	11/02/92											ND
	11/16/92											ND
	11/25/92											ND
	12/01/92											ND
	01/18/93											ND
TPH-G	06/11/92											1501.100
	06/25/92											3239.000
	07/02/92											3707.000
	07/21/92											4097.000
	08/26/92											3037.000
	09/08/92											3065.000
	09/21/92											2123.000
	09/25/92											1312.000
	10/01/92											1048.000
	10/08/92											201.490
	10/23/92											471.000
	11/02/92											303.000
	11/16/92											100.000
	11/25/92											114.700
	12/01/92											214.000
	01/18/93											150.000

NOTES: ND = Not detected
WI = Well Installed

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of sand and gravel encased in fine-grained clay and silt. Pressure differences are transmitted greater distances under these conditions than if the subsurface soils and alluvium were homogeneous. Table 4 presents the vacuum and flow measurements collected during the pilot test, which indicate an expanding zone of influence.

Second, the observed decline of PCE concentrations in groundwater and subsurface vapors was more pronounced than predicted. Prior to initiation of the pilot test, the PCE concentration in groundwater from MW-17 was 1,300 ppb. On September 23, after extraction of approximately 1,500,000 cubic feet of vapor-laden air, the PCE concentration in groundwater from MW-17 dropped to 200 ppb. On June 11, 1992, during the initial stages of the pilot test, vapor samples from MW-17 showed PCE concentrations in excess of 190 ppm. On September 25, 1992, the PCE concentration in vapors from MW-17 had declined to about 50 ppm. Figure 1 graphically displays this decline of VOC concentrations. Clearly, vapor extraction is capable of removing PCE from the subsurface soils and alluvium and reducing PCE concentrations.

On September 17, 1992, air sparging (AS) wells were installed around MW-17 to evaluate the effectiveness of adding air to the groundwater. Although the saturated thickness of the unit had declined to levels where AS would have a limited effect, the pilot test proceeded. After only 24 days (576 hours of operation), analyses of groundwater samples from MW-17 showed that PCE concentrations declined to less than 5 ppb. We had anticipated that a longer period of operation would be required to meet maximum contaminant levels (MCLs) for groundwater. Subsequent valves have "rebounded" to more than 100 ppb. However, it must be remembered that the pilot test took place in the most contaminated part of the site where rebound effects are anticipated to be greatest.

In addition to vapor samples taken directly from MW-17, vapor samples were also collected from the air stream (1) entering the first carbon canister, (2) between the two canisters and (3) exiting the last canister. PCE levels in extracted air, with the system in operation, were typically much higher than those from samples collected directly from MW-17. For example, on July 21, 1992, a sample from MW-17 yielded 132 parts per million (ppm) PCE while a sample of extracted air under operation yielded a level of 4,000 ppm, which was the highest level measured during the pilot test. To conservatively evaluate the effectiveness of remediation, concentrations measured from the extracted air before it enters the carbon canisters is considered representative of actual soil conditions. The concentration results described below are of vapor samples taken from extracted air during system operation. Table 5 presents the results of these vapor samples and figure 2 is a graphical presentation of these results.

Table 4
Pilot Test Performance Vapor Extraction Well MW-17
Livermore Arcade

Distance: Date	Inches 0'	5'	10'	15'	25'	35'	50'	75'	mw-2 100'	mw-5 105'	mw-6 183'	mw-8 240'	mw-9 280'	mw10	mw11 320'	mw12	Flow (CFM)	Extraction (Hours)
	(Vacuum in inches of water)																	
04/29/92	>60.0	0.15	0.09	0.03	0.02	0.01	0.00	0.00										5.0
04/30/92	>60.0	0.14	0.10	0.04	0.04	0.01	0.00	0.00										29.0
05/05/92	65	0.17	0.00		0.00	0.00	0.00	0.00										53.0
05/06/92	70	0.28	0.14		0.08	0.00	0.00	0.00										77.0
05/07/92	70	0.26	0.14		0.08	0.00	0.00	0.00										101.0
05/08/92	70	0.31	0.14		0.00	0.00	0.00	0.00										125.0
05/19/92	74	0.33	0.21	0.09	0.11	0.05	0.03	0.00										149.0
05/26/92																	7.6	165.0
05/29/92	75	0.35	0.16	0.06	0.05	0.04	0.00	0.00									7.6	170.0
06/01/92																	7.6	190.0
06/04/92																	7.4	225.0
06/09/92	85	0.82	0.44	0.13	0.16	0.10	0.06	0.00									7.2	257.4
06/11/92		0.86	0.52	0.12	0.15	0.11	0.05	0.00									7.2	285.5
06/25/92	75	0.94	0.51	0.16	0.17	0.12	0.08	0.02									11.0	322.0
07/02/92																	13.6	404.0
07/08/92																	15.5	474.3
07/21/92	74	1.70	0.91	0.29	0.35	0.03	0.20	0.08									20.1	644.8
08/07/92																	20.1	644.8
08/26/92	70	2.00	1.20	0.93	0.43	0.35	0.26	0.16									34.9	880.0
09/02/92	76	2.10	1.40	0.98	0.50	0.38	0.32	0.18									32.7	970.3

Table 4
Pilot Test Performance Vapor Extraction Well MW-17
Livermore Arcade

Distance:	Inches 0'	5'	10'	15'	25'	35'	50'	75'	mw-2 100'	mw-5 105'	mw-6 183'	mw-8 240'	mw-9 280'	mw10	mw11 320'	mw12	Flow (CFM)	Extraction (Hours)
Date	(Vacuum in inches of water)																	
09/04/92																	32.7	970.3
09/08/92	72	2.10	1.40	0.98	0.50	0.38	0.32	0.18									34.9	1023.7
09/16/92	70	1.80	1.10	0.95	0.34	0.25	0.20	0.10	0.10		0.01						32.7	1056.8
9/17/-am	70	2.00	1.20		0.43	0.36	0.30	0.19	0.15	0.05	0.02	0.05	0.02		0		34.9	1070.0
9/17/-pm	70	1.80	1.00		0.26	0.16	0.13	0.06	0.06	0.03	0.00	0.01	0		0		39.2	1077.0
A.S.+ V.E. 09/18/92	70	1.50	0.82	0.60	0.10	+0.04	+0.03	+0.06	+0.03								39.2	1089.5
A.S.+ V.E. 09/21/92																	39.2	1090.0
09/22/92																	39.2	1102.8
09/23/92																	39.2	1117.0
09/25/92	70	1.50	0.84		0.14												39.2	1144.4
09/28/92	70	1.40	0.69		0.05	+0.17	+0.15	+0.13	+0.09								48.0	1161.0
10/01/92	70	1.60	0.79	0.80	0.03	+0.08	+0.06	+0.13	+0.06	0.00	+0.05	-0.02	+0.01		+0.08		43.6	1206.7
10/05/92	70	1.30	0.71	0.80	+0.01	+0.12	+0.05	+0.12	+0.07	0.00	+0.04	0.00	+0.02		+0.06		48.0	1263.6
10/06/92	70																48.0	1278.1
10/08/92	70																48.0	1308.0
10/14/92	70	1.40	0.72	0.77	+0.06	+0.05	+0.01	+0.05	+0.06	0.00	+0.04						48.0	1393.5
10/20/92	70	1.40	0.70	0.74	+0.05	+0.03	+0.06	+0.04	+0.07	0.01	+0.06	+0.01	+0.05	+0.04	+0.05	+0.01		
10/23/93	70																	1512.8
10/29/93																		
11/02/92																		1655.7

Table 5
Activated Carbon System Performance
Livermore Arcade

Date	Inlet PCE Vapor Conc. (ppm)	Drums	Flow CFM	Hours	Size of Drum
04/29/92		1 & 2		5.0	2-200
05/18/92					
05/19/92	105		7.3	149.0	
05/19/92	144				
05/29/92			7.6	170.0	
06/01/92	180		7.6	190.0	
06/11/92	1501		7.2	285.5	
06/25/92	3435		11.0	322.0	
07/02/92	5		13.6	404.0	
07/02/92	3900				
07/06/92		Off		474.3	
07/08/92		3 & 4	15.5	474.3	2-200
07/21/92			20.1	644.8	
07/21/92	4097	Off			
08/07/92		5 & 6	20.1	644.8	2-200
08/24/92		Off		879.0	
08/26/92	290	7 & 8	34.9	880.0	2-200
09/02/92	146	Off	32.7	970.3	
09/04/92	117	9 & 10	32.7	970.3	2-400
09/08/92	3130			1023.0	
09/10/92	1740		34.9	1045.8	
09/11/92	1741			1060.0	
09/12/92	1310				
09/15/92	1210				
09/16/92	1253				
09/17/92	1210		32.7	1057.0	
09/18/92	1150		32.7	1085.6	
09/21/92	2200		39.2	1088.4	
09/21/92	153		39.2	1088.4	
09/22/92				1102.8	
09/23/92			39.2		
09/25/92	1365		39.2	1144.4	
09/28/92	1310		39.2	1161.0	
10/01/92		11 & 12	48.0	1204.7	2-400
10/05/92	701		43.6	1263.6	
10/06/92					
10/08/92	200		48.0	1308.0	
10/08/92	213		48.0		
10/09/92	205		48.0	1322.0	
10/13/92	260		48.0	1380.4	
10/14/92			48.0	1393.5	
10/20/92			48.0	1478.3	
10/22/92			48.0	1497.8	
10/23/92	471		37.0	1512.8	
10/29/92					
10/30/92					
11/02/92	303			1656.0	
11/03/92	99.1		37.0	1670.0	
11/05/92	240		37.0		
11/06/92		Off		1712.4	
11/09/92	76	13 & 14		1712.4	2-400
11/10/92				1749-Off	
11/13/92		Off		1749.0	
11/15/92	108		49.0	1750.0	

Table 5
Activated Carbon System Performance
Livermore Arcade

Date	Inlet PCE Vapor Conc. (ppm)	Drums	Flow CFM	Hours	Size of Drum
11/16/92	121		49.0	1750.0	
11/18/92	70				
11/19/92	72			1768.0	
11/20/92	23		52.0	1782.0	
11/21/92				1796.0	
11/22/92				1810.0	
11/23/92				1821.7	
11/24/92				1836.0	
11/25/92		14 & 15		1849.8	
12/01/92	595		57.0	1851.9	
12/02/92	214		57.0	1862.2	
12/08/92	214		59.0	1948.3	
12/14/92	99		40.0	2037.9	
12/14/92		Off			
01/18/93	155.6	On			
01/18/93	155.6		40.0	2038.0	
01/19/93	155		40.0	2039.0	
01/20/93	200			2053.8	
01/21/93	109			2068.2	
01/22/93	104			2083.6	
01/23/93	119			2097.4	
01/24/93	108			2110.6	
01/25/93	67.3			2128.0	
02/01/93	25.5			2230.4	
02/08/93	13.25			2325.0	
02/18/93	42.05		8.7	2480.0	
02/18/93	42.05		8.7	2480.0	
03/01/93					
03/08/93					
03/15/93					

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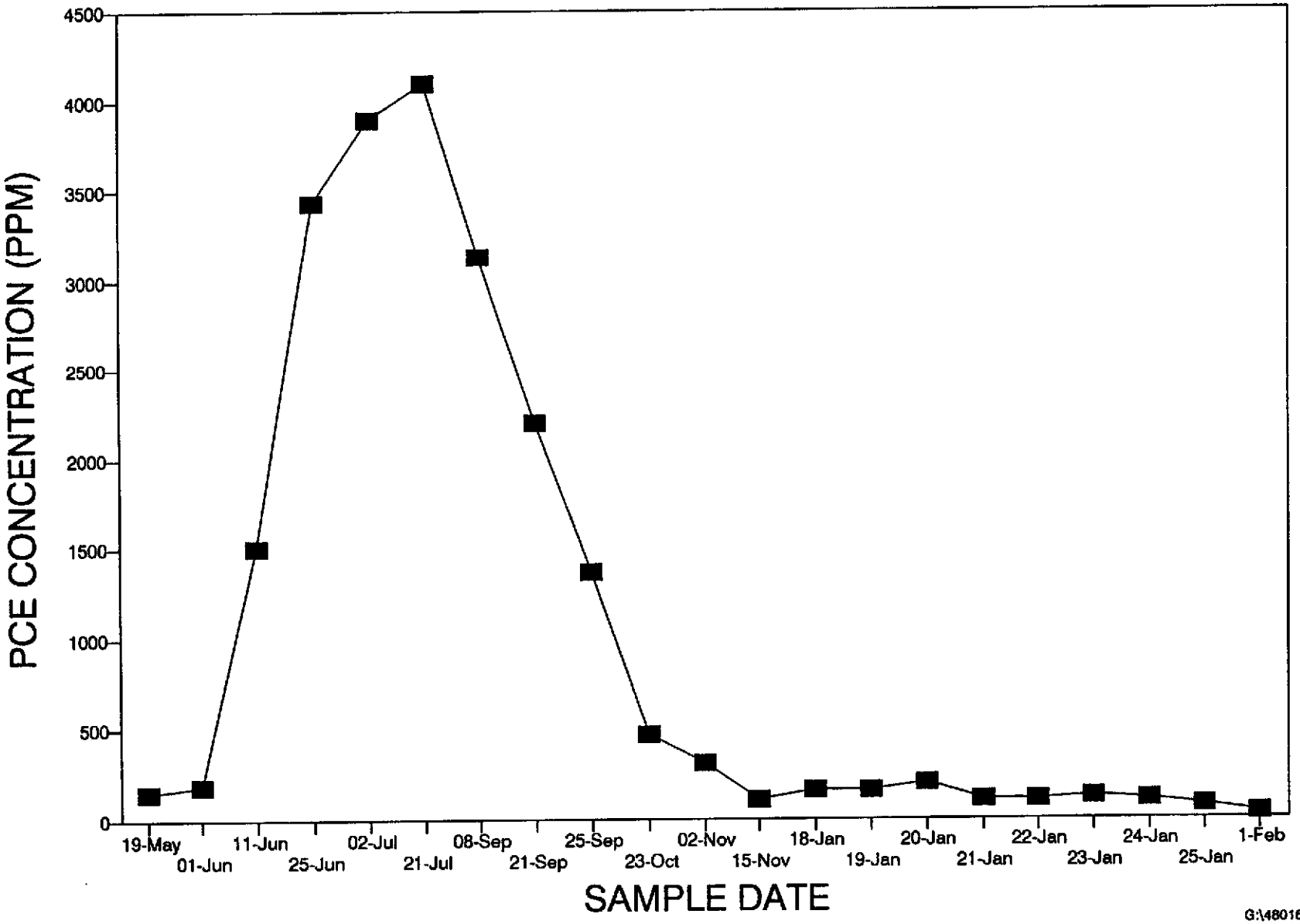
Figure 2

LIVERMORE ARCADE
PCE IN EXTRACTED SOIL VAPOR
MW-17



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The system operated until November 20, when the PCE concentration in extracted vapor was only 23 ppm. The system was then shut down to determine if subsurface PCE concentrations would rise, as is common with VE/AS systems.

The system was re-started on December 1, 1992, 12 days after system shut-down. At that time, the PCE concentration in groundwater from MW-17 was 20.8 ppb, and the PCE concentration in extracted air was 595 ppm. This indicates that rebound of PCE concentration is a concern at the site. The system was shut down again on December 14, 1992, to again measure the rebound of PCE concentrations in groundwater and vapor. A vapor sample taken at that time showed a PCE concentration of 99 ppm. The system remained shut down for one month in order to measure the rebound over a longer period.

The system was restarted again on January 18, 1993, and samples collected on January 19, 1993, revealed a groundwater PCE concentration of 100 ppb from MW-17 and a PCE concentration in extracted vapor of 155 ppm. An air sample was collected on February 18, 1993, with a concentration of 42 ppm and the system was again shut down on February 25, 1993. This evaluation revealed that less organic material was being removed from the subsurface than had been removed in previous VE operations. For example, during the first months of system operation, PCE concentrations in vapor of several thousand ppm were measured, whereas for the last several months of system operation, PCE concentrations in vapor were less than 200 ppm.

It is evident that operation of the pilot VE system has removed most of the PCE in the subsurface near Mike's Cleaners and it may be possible, based on additional sampling, that the practical cleanup level has already been reached. The recent precipitation events in northern California have resulted in a dramatic rise in water levels at the site. Groundwater samples collected from MW-17 since the dramatic rise occurred show PCE concentrations remain at the 100 to 200 ppb, an order of magnitude less than samples obtained prior to the pilot testing program. However, benzene concentrations remain at the pre-pilot test levels (152 ppb).

Because the PCE concentration in groundwater is found to be above the MCL of 5 ppb and at least 20 feet of saturated thickness is observed, air sparging will be resumed along with vapor extraction. This program should quickly reduce the PCE concentration in the groundwater near the remedial system. If the water levels fall, air sparging cannot operate effectively, and it may not be possible to reduce the PCE remaining in the groundwater to 5 ppb. Further monitoring will determine whether additional treatment will be appropriate. Without a sustained high water level, continued operation of the system at this location may provide little additional environmental benefit. The high benzene levels from off-site locations will not be remediated on a regional scale by our proposed system. The benefit of

restoring a small portion of the shallow zone which is contaminated with benzene on a regional scale must also be evaluated. Appendix C summarizes all chemical data collected during the pilot testing program.

2.4 Re-Evaluation of Alternatives

The draft Feasibility Study and Remedial Action Plan presented an evaluation of five alternatives that appeared to be appropriate for this site and provided a cost comparison of the alternatives. The costs presented were for comparison only, since actual cleanup requirements had not yet been established. The same cost bases were used for all of the alternatives, and the relative cost differences were used to determine the most cost effective alternative. Costs incurred to December 31, 1992 are not included in this comparison.

Currently, a detailed cost estimate for the selected alternative has been developed using the latest available knowledge of the site and the cleanup and monitoring requirements. This cost estimate is higher than that presented in the draft Feasibility Study and Remedial Action Plan. This represents an increase in the cost bases, which affect the other alternatives as well and includes all costs already incurred. The relative cost differences remain essentially the same and the previously selected alternative remains the most appropriate choice. Following is a current re-evaluation of the five alternatives that were presented:

- Alternative 1: No action with long-term monitoring
  Based on conversations with the San Francisco Bay Region of the Regional Water Quality Control Board (RWQCB), this alternative is not acceptable. For comparison purposes, however, the current estimate of monitoring costs is shown in table 6. These costs, based on the latest understanding of monitoring requirements, are greater than those presented in the draft Feasibility Study and Remedial Action Plan.

- Alternative 2: Vapor extraction with carbon treatment
  This is the basic selected technology that will effectively remove contaminant vapors from the unsaturated soil zone. Air sparging may be added as an enhancement in the event of rising water levels. The cost estimate for this alternative has increased because of the addition of a second treatment unit and increased monitoring costs that better reflect actual monitoring requirements. The draft Feasibility Study and Remedial Action Plan estimated a cleanup time requirement of two years for this alternative. This would be a feasible time period if groundwater continues to recede and all

Table 6

No-Action Alternative with Groundwater Monitoring for 30 Years

Site Investigation (24 monitor wells/data analyses)		$83,000.00
Permitting		$12,000.00
Additional Monitor Wells (7 shallow, 1 deep)		$100,000.00
Annual Groundwater Monitoring	$40,170.00	
Present Worth Monitoring (30 yrs, 8%, pwf=11.258)		$452,000.00
Total Cost: No-Action Alternative with Groundwater Monitoring		$647,000.00

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contaminated soil were fully accessible to vapor extraction. For final cost estimating purposes, a conservative period of five years has been selected, with the actual time required for cleanup expected to be less. If groundwater should rise, air sparging (alternative 4) will be used to reduce the required treatment time to the shortest possible period. The revised cost estimate for this alternative without air sparging is presented in table 7.

- Alternative 3: Vapor extraction without treatment
  This system is unacceptable to the Bay Area Air Quality Management District (BAAQMD) and, therefore, a revised cost estimate for this alternative is not included.

- Alternative 4: Air sparging and vapor extraction with carbon treatment
  This is the same technology as alternative 2, with air sparging added as an enhancement to vapor extraction. Air sparging is very effective in treating contaminated groundwater, with the released vapors collected by the vapor-extraction system. This is effective, however, only where sufficient water is available. Total treatment time can then be greatly reduced as compared to vapor extraction alone. At this site, however, groundwater table has dropped and may be accessible for treatment by air sparging only seasonally. As the groundwater recedes, less water is available for sparging but more soil is made available for vapor extraction. Treatment continues, but perhaps at a slower rate than if air sparging were fully effective. The draft Feasibility Study and Remedial Action Plan indicated a cleanup time requirement of one year for this alternative. This time period would be feasible if groundwater were fully accessible to air sparging. However, the groundwater has fluctuated and may not be fully accessible, which will require an extension of time for treatment. For final cost estimating purposes, a conservative period of three years has been selected, as shown in table 8. Air sparging will be used as often as practical to reduce the required treatment time to the shortest possible period. A saturated thickness of at least 20 feet is required for air sparging to be effective under this alternative.

- Alternative 5: Air sparging and vapor extraction without treatment
  This system is unacceptable to the BAAQMD and, therefore, a revised cost estimate for this alternative is not included.

Table 7

Soil-Vapor Extraction with Carbon Treatment for 5 Years

Site Investigation (24 monitor wells/data analyses)		$83,000.00
Permitting		$12,000.00
Vapor Extraction System for Zone 1		$51,000.00
Vapor Extraction System for Zone 2		$58,000.00
Vapor Extraction System for Zone 3		$16,000.00
Air Inlet System for Zone 1		$8,000.00
Air Inlet System for Zone 2		$13,000.00
Air Inlet System for Zone 3		$12,000.00
Additional Monitor Wells (7 shallow, 1 deep)		$100,000.00
Annual Operation & Maintenance	$59,000.00	
Annual Air Monitoring (weekly)	$27,000.00	
Annual Groundwater Monitoring (quarterly)	$40,000.00	
Present Worth Annual Costs (5 yrs, 8%, pwf=3.993)		$503,000.00
Total Cost: Soil-Vapor Extraction with Carbon Treatment		$856,000.00

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Table 8

Soil-Vapor Extraction and Air Sparging with Carbon Treatment for 3 Years

Site Investigation (24 monitor wells/data analyses)		$83,000.00
Permitting		$12,000.00
Vapor Extraction System for Zone 1		$51,000.00
Vapor Extraction System for Zone 2		$58,000.00
Vapor Extraction System for Zone 3		$16,000.00
Air Sparging/Air Inlet System for Zone 1		$46,000.00
Air Sparging/Air Inlet System for Zone 2		$58,000.00
Air Sparging/Air Inlet System for Zone 3		$50,000.00
Additional Monitor Wells (7 shallow, 1 deep)		$100,000.00
Annual Operation & Maintenance	$59,000.00	
Annual Air Monitoring (weekly)	$27,000.00	
Annual Groundwater Monitoring (quarterly)	$40,000.00	
Present Worth Annual Costs (3 yrs, 8%, pwf=2.577)		$325,000.00
Total Cost: Soil-Vapor Extraction/Air Sparging with Carbon		$799,000.00

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It is clear from this evaluation that soil-vapor extraction, with a contingency for air sparging during periods of high groundwater levels, is the most appropriate and lowest cost alternative that would be acceptable to the regulating agencies. The original cost estimates are described in section 4.3 of the Feasibility Study (appendix B).

The proposed remedy meets all five primary balancing criteria under the National Contingency Plan – it has the maximum long-term effectiveness and permanence, directly reduces toxicity mobility and volume of PCE to extent feasible, is effective in the short term, is highly implementable, and has comparable costs to other alternatives. The proposed cleanup also appears most acceptable to the community, is the most protective of human health and the environment, and is cost-effective.

The remedy has also been demonstrated to be capable of meeting ARARs for PCE, specifically the 5 ppb MCL. Rebound effects and other implementation considerations could limit the short term achievement of this ARAR in the most contaminated areas of the shallow groundwater, but the proposed cleanup will produce the best, most rapid cleanup that is technically practicable from an engineering perspective.[1] In the longer term, active cleanup as proposed, combined with the natural remediation effects of biodegradation and contaminant dilution through groundwater fluctuations, are anticipated to achieve of the 5 ppb MCL throughout the shallow aquifer.

The proposed cleanup will ensure that all actual sources of drinking water (i.e., the lower aquifer) will remain below the 5 ppb level for PCE, but cannot ensure that regional benzene contamination is isolated from this lower zone.

[1]As a result, if the 5 ppb MCL is not achieved at all locations through the proposed cleanup approach, a waiver would be appropriate under 40 C.F.R. § 300.430(f)(1)(ii)(C).

3.0 Remediation System Description

The remediation system consists of vapor-extraction wells, air sparging wells, air inlet wells, air treatment units, monitor wells and the associated pipes and pumps required to integrate all the units. Maximum flexibility has been designed into the system to respond to anticipated and unanticipated changes in the remedial program.

3.1 Proposed Modifications to Conceptual Design Presented in Feasibility Study

We propose minor modifications of our previous plan for the site. In order to increase efficiency, we propose to utilize some existing wells as air inlet wells to provide for controlled entry of air into the unsaturated zone near the source of PCE. The well seals will be removed to allow an unrestricted flow of air into the wells, as they experience a vacuum under the influence of the vapor-extraction system. Float valves will be installed on the top of the casings to prevent flood water from entering the wells and the units will be secure to prevent tampering.

Selective air entry at the edges of the contaminant plume will influence the movement of subsurface vapors, concentrating flow in the zone of highest contamination. An air inlet well on the western edge of the plume should reduce the intrusion of volatile petroleum hydrocarbons from off-site sources.

The original conceptual design presented in the FS called for the movement of a single portable soil-vapor extraction (SVE/AS) system from well to well. The final design provides for two trailer-mounted treatment units, each of which contains a vapor-extraction blower and an air-sparging blower, which are capable of moving among several treatment wells, if required. One unit will be at a fixed location behind Mike's Cleaners at the Livermore Arcade, and one unit will alternate between a location behind Paul's Cleaners and a location adjacent to MW-8 at the Miller's Outpost Shopping Center.

An air sparging system will be installed that utilizes a unique method of introducing air into the saturated zone. Appendix D describes this system which operates on the same basic principles as the sparging system employed for the pilot test.

Operational changes to the proposed remedial system are discussed in a later section of this document. The locations of all proposed and existing wells are mapped in plate 1. Descriptions of our preliminary designs were presented in section 3.2 of the Feasibility Study (appendix B) and in our November 30, 1992, letter to Lester Feldman (appendix E).

3.2 System Wells

Several existing wells are planned for use as vapor extraction, air inlet, and air sparging wells. Existing wells MW-7, MW-8 and MW-18 will be used for vapor extraction. Other existing wells that may optionally be used for soil-vapor extraction are (from south to north) MW-17, MW-2, MW-11, and MW-12. Air inlet wells are initially planned to be existing wells MW-5 and MW-6. Other wells that may optionally be used for air inlet are MW-2, MW-9, MW-10, and MW-11, and proposed wells MW-26 and MW-28. Three existing wells are initially proposed for air sparging, IW-19, IW-20, and IW-21, located near Mike's Cleaners. MW-25, MW-26, MW-27 and MW-28 proposed new monitor wells, may optionally be used for air sparging at the Miller's Outpost Shopping Center. These will be dual purpose wells, constructed for groundwater monitoring as well as air sparging. Existing wells MW-1, MW-3, MW-4, MW-13, MW-14, MW-15, MW-16, MW-23 and MW-24 are not planned for use in the remedial action unless the water level rises sufficiently for use as monitor wells.

Several additional remedial action wells are proposed at the site. This final design calls for one new deep monitor well, four new treatment system/monitor wells, and a contingency for three additional shallow groundwater monitor wells. The four new treatment system wells are proposed as follows:

- MW-25, between MW-8 and MW-10, for groundwater monitoring and potential use as an air sparging well
- MW-26, northwest corner of the Miller's Outpost Shopping Center, west of MW-18, for groundwater monitoring and potential use for air sparging/air inlet
- MW-27, northwest of MW-18, for groundwater monitoring and potential use for air sparging, air inlet or vapor extraction
- MW-28, northeast of MW-18, for groundwater monitoring and air sparging/air inlet

If groundwater samples collected from MW-26, MW-27, and MW-28 show PCE concentrations in excess of MCLs, we must expand the remediation plan to ensure that the groundwater plume does not contaminate down-gradient water supplies. At this time, we propose the following three groundwater monitor wells as a contingency:

- MW-29, approximately 300 feet north of MW-12, within the down-gradient plume
- MW-30, approximately 250 feet west of MW-14, below the down-gradient plume
- MW-31 to replace MW-13, which is dry, within the down-gradient plume

The exact location and the overall benefit of these wells will be evaluated after receipt of analytical results from sampling all groundwater wells. If groundwater levels rise and permit the use of the previously installed well network, these wells will not be required.

The deep monitor well will be used to verify the cleanliness of the deep aquifer and ensure VOCs do not approach the nearby California Water Service supply wells. The deep well, MW-32, will be located after installation and sampling of monitor wells discussed above. H⁺GCL will seek approval of the location from the RWQCB prior to well installation.

Plate 1 is a site drawing that shows the locations of existing and proposed wells. Plate 2 presents the layout of the vapor extraction, air sparging and monitor/air inlet wells with the estimated radius of influence created by each extraction well. Pilot testing has demonstrated that a vapor extraction rate of 48 cubic feet per minute (ft^3/min) from a single well results in a radius of influence of more than 200 feet. This radius is displayed for proposed extraction wells MW-7, MW-8 and MW-18. We know that the MW-17 air extraction well creates a 200-foot radial area of lower pressure, and that this lower pressure is measurable at MW-5 and MW-6. Therefore, it is clear that air flow paths will be concentrated within the plume area between the extraction wells and the air inlet wells.

The typical designs for wells to be used for groundwater monitoring, vapor extraction, air inlet, and air sparging are presented in appendix E, along with other system design drawings.

3.3 Treatment Units

The treatment system will consist of two identical units: one to serve the Livermore Arcade Shopping Center site and the other to serve the Miller's Outpost Shopping Center site. Each unit is built into a 10- by 6-foot Wells Cargo enclosed trailer. Three treatment zones will be served by these units: the areas (1) behind the Livermore Arcade Shopping Center, (2) in front of the Miller's Outpost Shopping Center and (3) behind the Miller's Outpost Shopping Center.

A 5-hp Rotron DR 707 regenerative blower is mounted in the trailer and provides the air flow for vapor extraction. It provides a flow of 48 ft^3/min at a vacuum of 70 inches of water under actual field conditions at the site. This blower is fitted with an air filter and moisture trap for its protection.

The outlet air from the vacuum blower passes through a water-jacketed heat exchanger to reduce the temperature and humidity of the air before it enters the carbon canisters. Water for the heat exchanger will be taken from MW-17 for the zone 1 sub-system and from a self-contained radiator for the zone 2 and zone 3 installations. A temperature sensor is installed on the heat exchanger outlet to protect the carbon canisters from overheating. This sensor, along with a similar sensor located between the two carbon canisters, will shut off the vapor-extraction blower if the high temperature limit is reached.

The air passes through two 400-pound activated carbon canisters connected in series, one serving as the primary unit and the other as a backup unit. Air samples will be collected from the access port between the two canisters on a weekly basis to monitor the treatment effectiveness and to determine when breakthrough of the primary canister may be expected to occur, necessitating replacement of the carbon. During pilot testing at the Livermore Arcade site, carbon replacement was required approximately monthly. The system will be operated to avoid breakthrough in either unit. If breakthrough occurs in the primary unit, the backup unit will treat the air until the carbon in the primary unit is replaced. After the spent carbon is replaced in the primary unit, it will be connected as the backup unit. The former backup unit, which will have been partially used, will serve as the primary unit. With this operating procedure, the backup unit should never become overloaded nor should contaminant breakthrough ever occur.

The air sparging blower located in the trailer is a 5-hp Roots RAI rotary positive displacement blower that generates a flow of 20 ft^3/min at 10 pounds per square inch (psi) under actual field conditions at the site. This blower is fitted with an inlet air filter for its protection and an outlet silencer for noise reduction. Inlet air for this blower may be taken from the ambient air or from the exhaust of the vapor-extraction system. Interlocked controls are provided so the air sparging blower cannot normally be operated without concurrent operation of the vapor-extraction blower, thereby preventing the uncontrolled movement of injected air.

3.4 System Piping

Trenches will be dug as required in the driveway areas of both shopping centers for the piping that will connect the treatment units to the wells. Trenches will be kept to a minimum by moving the treatment trailer to the center of the zone to be treated. Rigid PVC pipe or flexible hose will connect the wells to the treatment systems for both vapor extraction and air sparging.

The system for zone 1, which contains the source of contamination, has already been installed for the pilot study and will only require modification of the well heads at MW-5 and MW-6 for air inlet. In zone 2, the treatment trailer will be placed near well MW-8, and no trenching will be required unless contingency plans must be implemented to provide for air sparging. MW-9 and MW-10 may be modified for air inlet. Zone 3 will likewise not require significant trenching initially, with the treatment unit to be placed near vapor-extraction well MW-18, directly behind Paul's Cleaners. Trenching would be required to add air sparging if the contingency plan is implemented. Also, MW-26 and MW-27 may be converted for air inlet. After results of the initial operation are reviewed, the treatment system may be expanded by utilizing more wells for vapor extraction, air sparging, or air inlet.

4.0 Operating Plan

To achieve maximum effectiveness, the groundwater remediation system will be operated according to the plan described in this section.

4.1 Treatment Zones

Two separate mobile treatment units will be used at the site to provide three zones of in situ treatment: an up-gradient zone, a mid-gradient zone, and a down-gradient zone. One unit will be permanently located at the Livermore Arcade Shopping Center in the service area behind Mike's Cleaners to serve zone 1. The other unit will alternate between two locations at the Miller's Outpost Shopping Center: one site adjacent to MW-8 (zone 2) and one site in the service area behind Paul's Cleaners (zone 3). Details of each zone are described below, and their locations are shown on plate 3.

- Zone 1

  Location: Service area behind the Livermore Arcade Shopping Center
  Air sparging well: IW-20 (IW-19 and IW-21 optional)
  Vapor-extraction wells: MW-7, (MW-2 and MW-17 optional)
  Air inlet wells: MW-5, MW-6, (MW-2 optional)
  Treatment unit: Behind Mike's Cleaners
  Monitor well: MW-17

- Zone 2

  Location: Parking lot in front of Miller's Outpost Shopping Center
  Optional air sparging well: MW-25 (dual completion air sparging/monitoring well)
  Vapor-extraction wells: MW-8, (MW-11 optional)
  Optional air inlet wells: MW-9, MW-10, MW-11
  Treatment unit: Adjacent to MW-8
  Monitor well: MW-25 (dual completion air sparging/monitoring well)

- Zone 3

  Location: Service area behind Miller's Outpost Shopping Center
  Optional air sparging well: MW-27 (dual completion air sparging/monitor well)
  Vapor-extraction wells: MW-27, (MW-12 optional)
  Optional air inlet wells: MW-26, MW-28
  Treatment unit: behind Paul's Cleaners
  Monitor well: MW-18

The wells listed above will be used at the beginning of operations. However, over time, optional wells may be utilized, or the operation may be modified to create changes in flow patterns as required to provide optimum treatment. Of the above wells, MW-25, MW-26, MW-27 and MW-28 are proposed and have not yet been installed. They will initially be used for groundwater monitoring and may later be incorporated into the treatment system. Groundwater samples will also be obtained from MW-28 prior to incorporation into the treatment system. The vapor-extraction wells and air inlet wells are interchangeable, providing a high degree of system flexibility.

4.2 System Operation

The system will be closely monitored over the first six weeks of operation to determine the parameters for establishing long term operating criteria. After the initial testing period, long term operation will be monitored on a weekly basis and adjustments made periodically as warranted.

4.2.1 Initial Testing

The system in zone 1 will first be operated for one week using vapor extraction alone. At the beginning and end of this period, vacuum measurements will be taken in nearby wells; air samples will be collected from the vapor well for laboratory or on-site analysis. For the second week of operation, unsaturated zone passive air injection will be added through air inlet wells and similar measurements will be taken. Air sparging will be added for the third week of operation, if the saturated thickness of the aquifer is at least 20 feet. Similar measurements and samples will be taken. Results of these initial tests will be used to make operating adjustments, if required.

4.2.2 Zone 1 Operation

Zone 1 is expected to normally operate with MW-5 and MW-6 as air inlet wells and MW-7 or MW-17 for vapor extraction. It is intended for the vapor-extraction wells to remove vapors at the center of the plume while the air inlet process shrinks the PCE plume boundary. This passive air injection will also create a barrier against the infiltration of gasoline vapors into the treatment system. IW-21 will be used for air sparging, initially with IW-19 and IW-21 added at a later date.

4.2.3 Zone 2 Operation

Zone 2 is expected to normally operate with only MW-8 for vapor extraction. If sufficient contaminant reduction is not observed using MW-8 alone, MW-25 may be used for air sparging and MW-9 and MW-10 for passive air injection. Since zones 2 and 3 will use the same treatment unit, it is planned to alternate operation between zone 2 and zone 3 on a scheduled basis. Pulsing of the system in this manner has proven effective in decreasing the cost and time of soil and groundwater remediation. This mode of operation allows the subsurface environment to equilibrate between applications of vacuum thereby temporarily increasing VOC soil-vapor concentrations and resulting in increased extraction efficiency.

4.2.4 Zone 3 Operation

Zone 3 is expected to normally operate with only MW-27 for vapor extraction. If sufficient contaminant reduction is not observed using MW-27 alone, MW-26 and MW-28 may be used for passive air injection. Air sparging will be added, if necessary; MW-27 will be designed for use as a dual use air extraction/monitor well.

Since the PCE plume extends down-gradient from zone 3, care must be taken not to cause down-gradient movement of the plume by excessive air injection in the soil and groundwater. If air sparging is added, measurements will be taken during the first weeks of operation to determine the cones of influence of vapor extraction and air injection occurring in zone 3. Operating procedures controlling the movement of injected air will then be adjusted to ensure that the vapor-extraction system prevents accelerated down-gradient movement of contaminated groundwater or PCE vapors.

Since zones 2 and 3 will use the same treatment unit, it is planned to alternate operation between zone 2 and zone 3 on a scheduled basis. Alternating the systems in this manner

may be effective in allowing the environment to equilibrate between applications of air pressure and vacuum.

4.3 Schedule of Implementation

Immediately after approval of this plan, Grubb and Ellis will

- Obtain the necessary permits and access agreements to allow construction of the planned remedial system at the Miller's Outpost Shopping Center.

After receipt of executed permits and access agreements, H⁺GCL will accomplish the following:

- Drill MW-25, MW-26, MW-27, and MW-28 for groundwater monitoring (unless water levels have risen permitting use of the existing well network) and optional use in the treatment system
- Collect groundwater samples from the groundwater monitoring network (MW-17, MW-22, MW-25, MW-26, MW-27, MW-28, and MW-18) and analyze these samples for PCE and related products
- Install the electrical supply required for zones 2 and 3
- Connect and operate the remediation system trailers at zones 1, 2, and 3 (zones 2 and 3 will alternate using the same treatment unit)
- Recommend a location and design for the deep monitor well

The site investigation in the vicinity of Paul's Cleaners has not been as detailed as in the area of Mike's Cleaners. Although we anticipate that soil-vapor extraction and air sparging will be comparably effective in that area, we recommend a more detailed investigation in the area of Paul's Cleaners to determine any necessary refinements of the remedial plan in that zone.

After receipt of groundwater analyses, we will evaluate the need for additional monitor wells and present our recommendations to the RWQCB. We will also give a tour of the site for RWQCB staff at any time.

5.0 Monitoring Plan

A well-planned monitoring program and contingency plan are required to address the uncertainties that accompany remedial programs. The proposed monitoring plan is described below in detail.

The remediation strategy proposed in this document involves vapor extraction, passive air injection and, if groundwater levels rise, limited air sparging. The movement of air in the subsurface will create a set of physical and chemical responses. The following schedule is proposed for the first year to measure these responses:

- Prior to implementing the full-scale remedial action, all presently existing groundwater monitor wells and the water supply wells will be sampled and analyzed for PCE; groundwater elevations will be determined.
- Additional monitor wells, as proposed in this plan, will be installed as necessary to provide an adequate monitoring network.
- On a weekly basis, the volume of air removed from the extraction wells and injected into air sparging wells will be recorded.
- On a weekly basis, the concentration of volatile organic compounds in the air discharge from the vapor-extraction wells will be determined. Field staff will collect gas samples for on-site photoionization detector (PID) analyses.
- On a quarterly basis, samples from the water supply wells will be analyzed for PCE.
- On a quarterly basis, groundwater elevations in all monitor wells will be determined.
- On a quarterly basis, groundwater samples from all monitor wells will be analyzed for PCE.

After one year, the frequency of these measurements will be re-evaluated and recommendations for modifying this monitoring plan will be presented to the RWQCB.

6.0 Remediation Criteria

6.1 Shallow Zone

The pilot test has demonstrated that vapor extraction, while effective in removing PCE from the subsurface, may not permanently reduce PCE concentrations in shallow zone groundwater to the MCL of 5 ppb. The pilot test also demonstrated that air sparging is an effective remedial technology for groundwater restoration. As water levels rise, the possibility of reaching the MCL will be improved, and the effectiveness of air sparging will increase. Based upon the results of the pilot testing program and our understanding of the site, the remediation criteria for the shallow zone is outlined below.

Air sparging and vapor extraction in the shallow zone will continue, pursuant to the plan outlined herein, until at least one of the following criteria are met:

1. PCE concentrations in groundwater meet the 5 ppb MCLs outlined in correspondence from the RWQCB.

2. Total volatile organic compound levels in extracted vapors are less than 100 ppm and PCE concentrations are less than 10 ppm for three consecutive months of system operation and the underlying deep aquifer is not contaminated by PCE or its degradation products.

Under scenario number 1, all health-based risks will have been reduced to acceptable levels, and it will be appropriate to cease operation of the remedial system and proceed to post-operational monitoring. Under scenario 2, some health-based risk may remain in the shallow zone, but the technical feasibility of reducing the risk further by vapor extraction would be highly problematic. These levels presented in scenario 2 represent a practical capability limit of the vapor-extraction system. These concentrations are also well below the regulatory limits of 15 pounds per day (lb/day) for total volatile components and 0.5 lb/day for PCE for discharge to the atmosphere, thus the vapors do not pose a risk.

Previous pump tests have show that the shallow water-bearing zone does not yield sufficient quantities of water to wells to warrant its use as an aquifer in this area, and there are no water supply wells completed within this shallow zone in the vicinity of the Livermore Arcade site. Underlying this shallow zone, however, is a regional aquifer that is utilized as a water supply source for Livermore, and protection of this underlying deep aquifer is critical. We agree that reduction of PCE concentrations in shallow groundwater to MCLs

will virtually guarantee that the underlying aquifer is protected; however, we maintain that protection of the underlying aquifer can be maintained by the following:

- Removing as much PCE from the shallow zone as is technically feasible through vapor extraction and air sparging
- Monitoring the underlying aquifer
- Designing and implementing a remedial program for the regional aquifer if such a program is warranted (discussed below)

In the event that cleanup throughout the shallow aquifer to 5 ppb does not occur, the proposed remedy would nonetheless satisfy the criteria for adoption of alternative compliance points (i.e., in the deeper aquifer only) or to modify cleanup standards, as suggested in recent amendments to the Basin Plan for the San Francisco Bay Region, adopted by the Regional Board on October 21, 1992 (State Board approval pending), as well as a waiver from applicable, relevant and appropriate requirements under 40 C.F.R. § 300.430 (f)(1)(ii)(C). This conclusion is based on the following factors:

- The shallow groundwater is in low-yielding, fine-grained sediments and no significant pollutant migration will occur to underlying or adjacent aquifers.
- Nearly total source removal from the subsurface soils will occur to limit future migration and recontamination.
- There are no other alternatives that would produce a more effective cleanup of the shallow aquifer at the site.
- A secure plan is proposed for containing and managing any remaining risks, specifically on-going monitoring of both the shallow and deeper aquifer. Due to the built condition of the site and its vicinity, effective access controls are already in place.
- An aggressive cleanup program will be operated for a period of time necessary to understand the hydrogeology of the site and pollutant dynamics.
- the cleanup protocol provides for reaching asymptotic levels of groundwater pollutant concentrations using the best available technology.

As addressed by Resolution 92-49, to the extent that background levels will not be reached, the cleanup will be to the maximum extent feasible, be consistent with maximum benefit to the people of the state, will not unreasonably affect present and anticipated beneficial uses of the water and will be consistent with the applicable basin plan.

6.2 Regional Aquifer

There is no evidence that the regional aquifer has been impacted by the PCE release at the Livermore Arcade; the RI and FS presented facts relating to this conclusion. A monitor well will be installed between the edge of the PCE plume and one of the municipal water supply wells adjacent to the site to corroborate this conclusion.

We maintain, as stated in previous documents, that the aquitard separating the shallow zone from the regional aquifer effectively limits the vertical migration of PCE. Although PCE may migrate from the shallow zone into the regional aquifer, the rate of flow is expected to be so small that PCE concentrations will never be detected in deep wells.

Previous documents also demonstrate that the PCE release began in the early 1980s and the geometry of the plume was established at that time. A decline of groundwater levels in the mid 1980s dewatered the coarse-grained portion of the shallow zone, and groundwater was and is hosted in the fine-grained unit penetrated by the existing groundwater monitoring wells. Recent rains have caused groundwater levels to rise once again, and it is apparent that the shallow groundwater level will continue to fluctuate over time. This is additional evidence that the shallow zone is isolated from the deep zone and the perched groundwater does not readily move downward. The calculated velocity of groundwater in the saturated portion of the shallow zone is 3 feet per year, effectively immobilizing the plume since the early 1980s. The velocity of groundwater in the regional aquifer is expected to be significantly greater than the shallow zone.

Based upon the discussion above, we maintain that if PCE is not detected in the proposed deep monitor well, the regional aquifer is effectively protected against degradation from the PCE release. Removing PCE from the shallow zone groundwater will reduce the source; but, because of the hydrogeological conditions of this zone, it may not be technically possible to permanently reduce the PCE levels to 5 ppb in the shallow aquifer. However, remediation as proposed in the shallow aquifer will ensure compliance with the MCL in the deeper aquifer with a high degree of confidence.

7.0 Revised Non-Binding Preliminary Allocation of Responsibility

Following the publication of the Draft Feasibility Study, Remedial Action Plan in July 1992, additional factors have become known bearing on the allocation of cleanup costs. First, a second plume of PCE has been identified in the vicinity of Paul's Cleaners in the adjacent Millers Outpost Center. Two new responsible parties, the operator of Paul's Cleaners and the owner of the Millers Outpost Center (IMA Financial Corporation) have therefore been identified. Since the plumes from Mike's Cleaners and Paul's Cleaners are overlapped and indivisible, these parties are jointly and severally liable for cleanup costs at the combined site.

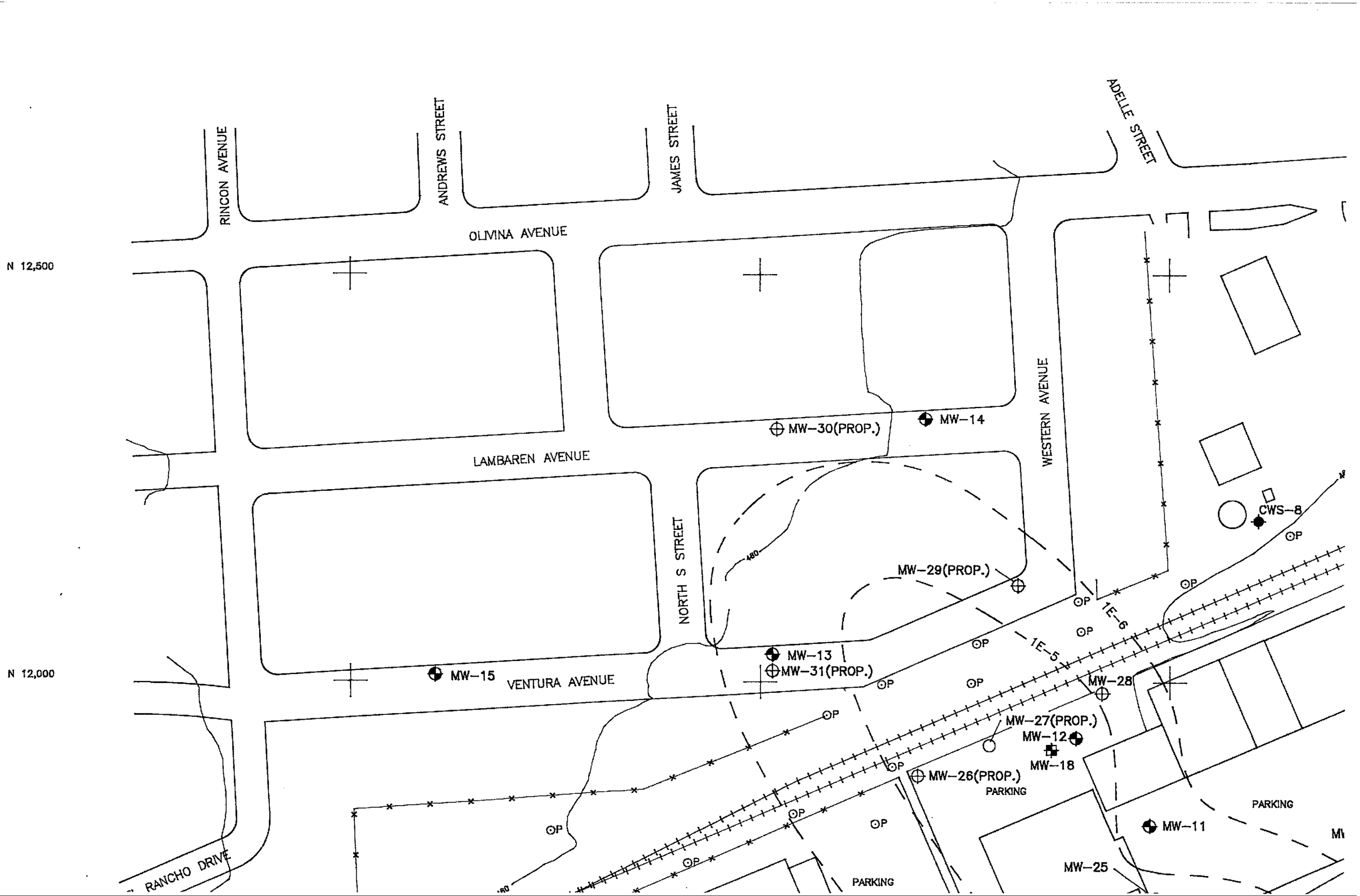
In addition, the companies responsible for supplying and installing the dry cleaning equipment at Mike's Cleaners, which reportedly leaked in the early 1980s, have been identified as Multimatic, Inc. and Western State Design, respectively. These parties should bear all or a portion of the share previously allocated to the Neelys.

As discussed in section 2.0, remedial costs are comparable in Zone 1 (Livermore Arcade), Zone 2 (Millers Outpost mid-gradient) and Zone 3 (Millers Outpost down-gradient), with somewhat lower costs in Zone 3. Subsurface concentrations near Paul's Cleaners, however, have been at lower levels than those found near Mike's Cleaners. Pending further evaluation of the contribution of PCE from Paul's Cleaners, it would appear that up to approximately 40 percent of the overall cleanup costs may be apportioned to parties responsible for releases from that source. As a result, a revised preliminary allocation of liability is as follows:

- Neelys, Multimatic, Western, Catellus and/or Stark, or their insurers: 60 to 80 percent
- Paul's and/or IMA Financial: 20 to 40 percent

Notwithstanding this proposed allocation, liability of these responsible parties remains joint and several for the entirety of the investigation, cleanup and other response costs. As with the previous preliminary allocation, a more precise allocation can be made if a more detailed release history from Mike's Cleaners and Paul's Cleaners becomes available.

In addition, the previous proposal to allocate any liability as between Catellus and/or Stark on a 15/85 to 50/50 basis still appears appropriate. Similarly, no facts have been provided that would undermine Grubb & Ellis' third party defense to liability, or that would warrant including the current operator of Mike's Cleaners, Steven Song, as a responsible party.


RINCON AVENUE
ANDREWS STREET
JAMES STREET
ADELLE STREET
OLIVINA AVENUE
N 12,500
MW-30(PROP.)
MW-14
LAMBAREN AVENUE
WESTERN AVENUE
CWS-8
NORTH S STREET
MW-29(PROP.)
1E-6
1E-5
MW-13
MW-31(PROP.)
MW-15
VENTURA AVENUE
N 12,000
MW-28
MW-27(PROP.)
MW-12
MW-18
MW-26(PROP.)
PARKING
MW-11
MW-25
RANCHO DRIVE

NORTH P STREET

⊙P

⊙P

⊙P

⊙P

470

MILLER'S OUTPOST

PARKING

RAILROAD AVENUE

RAILROAD AVE.

MW7

IW-20

TREATMENT UNIT

MW-17

MW-22

MW-2

IW-21

IW-19

DETAIL A

SCALE: 1" = 20'

N 11,500

N 11,000

VS-3

MW-10

IW-20

MW-2

MW-22

VS-1

VS-2

CWS-3

MW-6

1E-5

1E-6

P G & E

PARKING

PARKING

MW-3

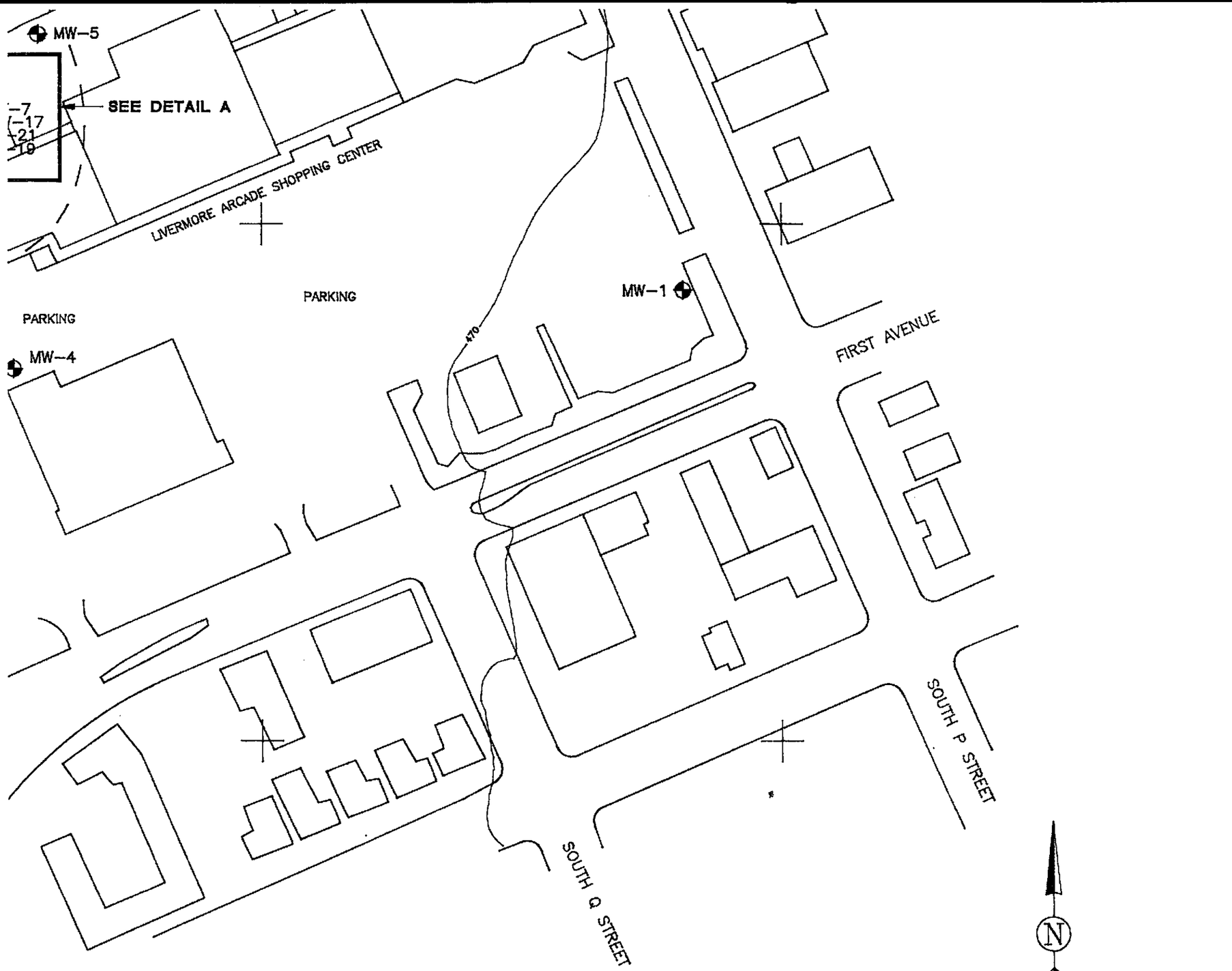
STANLEY BOULEVARD

FENTON STREET

VALLEY MEMORIAL HOSPITAL

PARKING

HIGHWAY 84



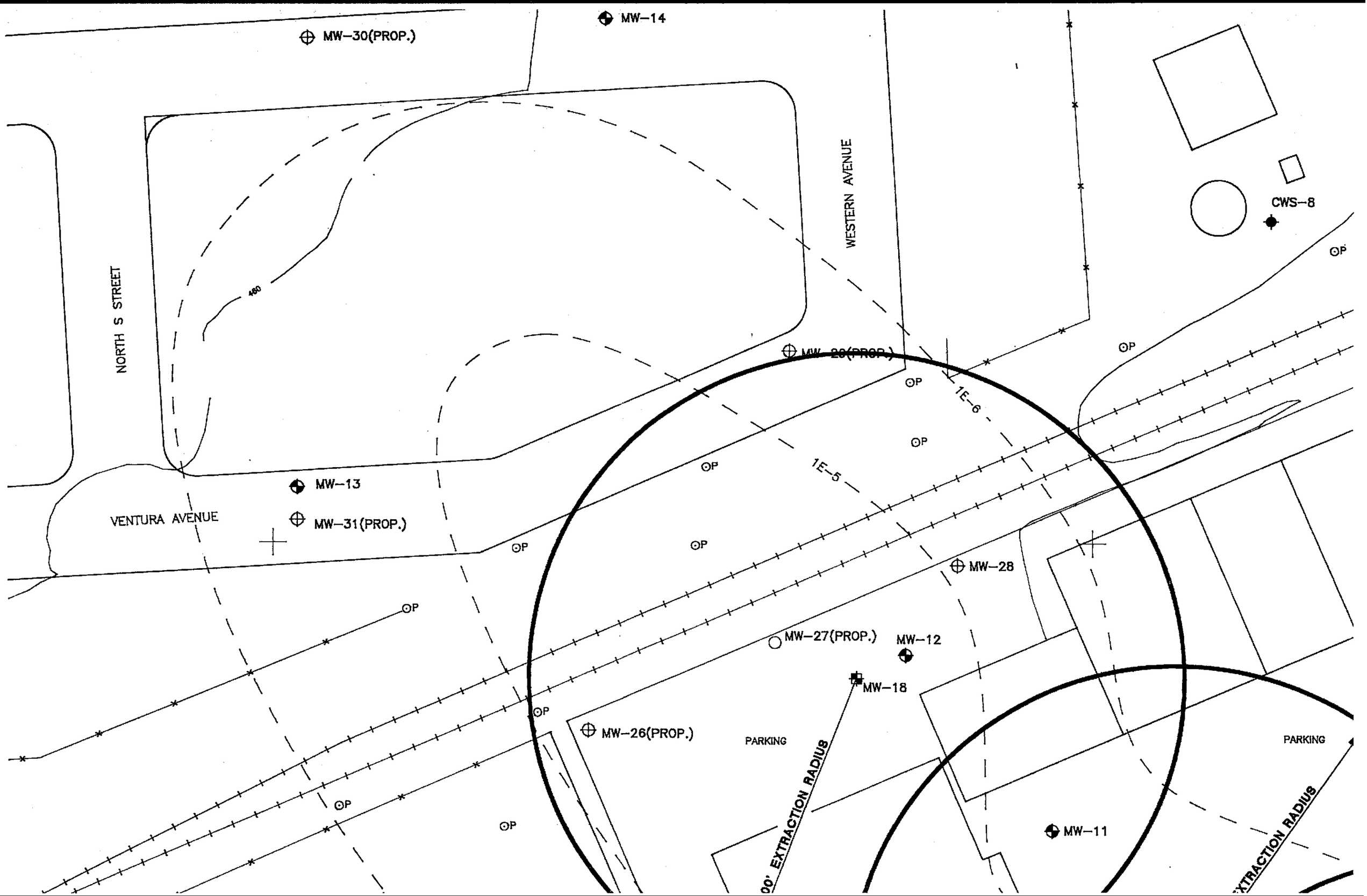
LEGEND

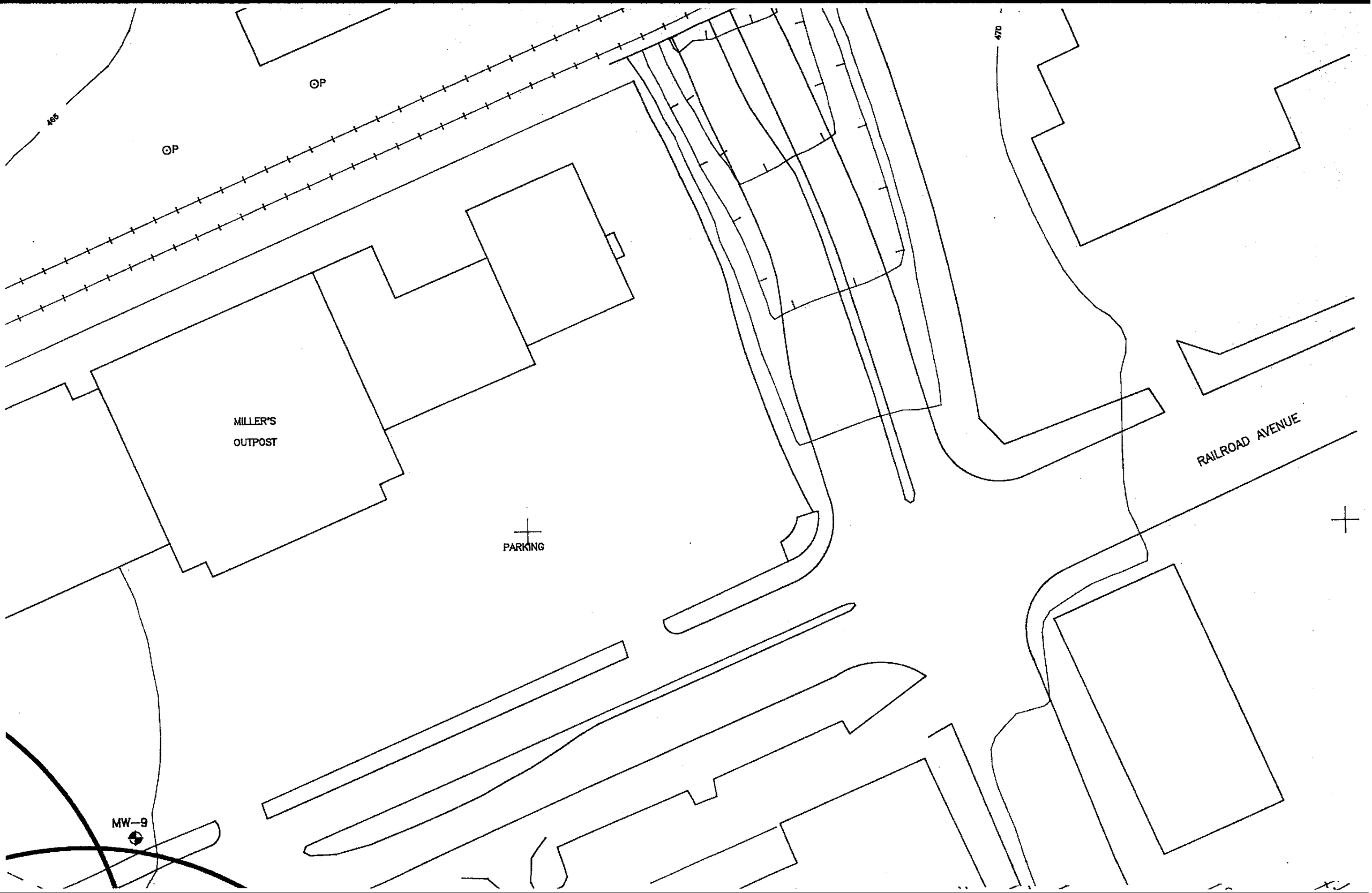
- MONITOR WELL
- AIR SPARGING WELL
- VAPOR EXTRACTION WELL
- PROPOSED MONITOR WELL
- PROPOSED AIR SPARGING WELL
- CALIFORNIA WATER SERVICE SUPPLY WELL
- —1E–6— CANCER RISK VALUE CONTOURS (ONE CASE PER MILLI

H⁺GCL

PLATE 1
LIVERMORE ARCADE – SITE MAP

CLIENT: GRUBB & ELLIS	
DATE: 3–5–93	REV. NO.: CS


MW-14
MW-30(PROP.)
NORTH S STREET
WESTERN AVENUE
460
CWS-8
MW-20(PROP.)
1E-6
1E-5
MW-13
VENTURA AVENUE
MW-31(PROP.)
MW-28
MW-27(PROP.)
MW-12
MW-18
MW-26(PROP.)
PARKING
PARKING
MW-11
EXTRACTION RADIUS
EXTRACTION RADIUS


465
470
⊙P
⊙P
MILLER'S
OUTPOST
PARKING
RAILROAD AVENUE
MW-9

PARKING

VS–3

MW–25

MW–8

MW–10

⊙P

MW–2

1E–5

MW–6

CWS–3

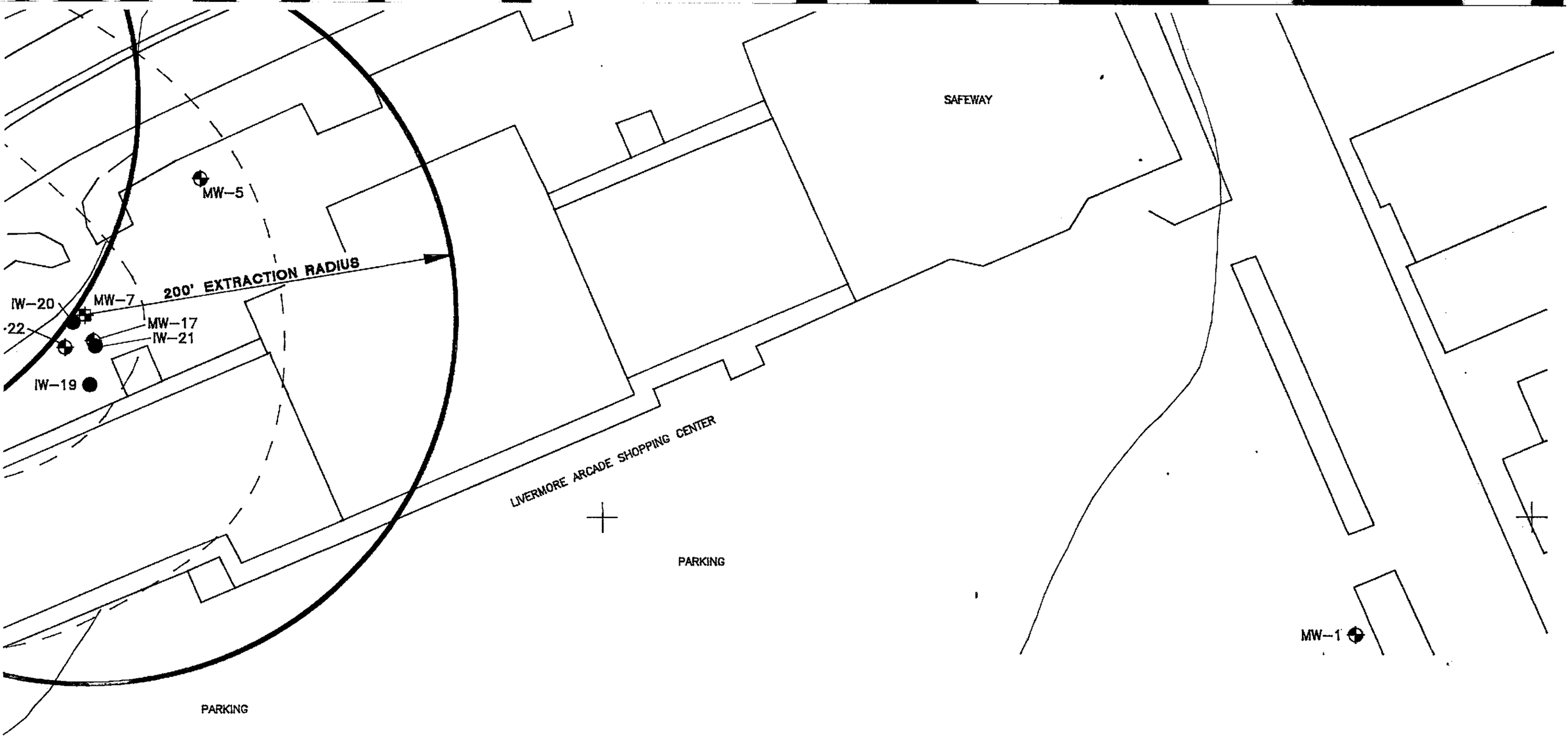
1E–C

VS–2

P G & E

PARKING

MW–3



LEGEND

- MONITOR WELL
- AIR SPARGING WELL
- VAPOR EXTRACTION WELL
- PROPOSED MONITOR WELL
- PROPOSED AIR SPARGING WELL
- CALIFORNIA WATER SERVICE SUPPLY WELL
- —1E–6— CANCER RISK VALUE CONTOURS (ONE CASE PER MILLION)

H+GCL

PLATE 2
LIVERMORE ARCADE
RADIUS OF INFLUENCE FOR EXTRACTION AND INJECTION

CLIENT: GRUBB & ELLIS	
DATE: 3–5–93	REV. NO.: CS