SOILS AND GROUNDWATER CONTAMINANT INVESTIGATION FOR THE MARKETPLACE SITE IN EMERYVILLE, CALIFORNIA

Prepared for:

Alameda County
Hazardous Materials Unit

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TABLE OF CONTENTS

Section		Page
1.	EXECUTIVE SUMMARY	1-1
2.	MARKETPLACE HISTORY AND PREVIOUS CONTAMINANT INVESTIGATION RESULTS	2-1
3.	CURRENT CONTAMINANT INVESTIGATION AND RESULTS	3-1
4.	DISCUSSION OF ALL PAST AND PRESENT CONTAMINATION CHARACTERIZATION RESULTS	4-1
5.	RECOMMENDATIONS	5-1
	APPENDIX A. Draft Work Plan	
	APPENDIX B. Laboratory Reports	

LIST OF FIGURES

Figure		Page
1.	Marketplace Project Site Detailing Boring Locations	2-2
2.	Former Tank Locations and Previous Boring Locations	2-3
3.	Isopach Contours of the Asphaltic Substance	4-2

LIST OF TABLES

Table		Page
1.	Heavy Metals in Soil from New Borings at the Marketplace Site in Emeryville, California	3-2
2.	Halogenated Organics in Soil from New Borings at the Marketplace Site in Emeryville, California	3-6
3.	Oil and Grease in Soil from New Borings at the Marketplace Site in Emeryville, California	3-7
4.	Heavy Metals in Groundwater from Wells at the Marketplace Site	3-8
5.	Halogenated Organics in Groundwater from Wells at the Marketplace Site	3-9
6.	Estimated Thickness of Asphaltic Substance in Borings at the Marketplace Site	4-3

1. EXECUTIVE SUMMARY

This report summarizes past and current contamination investigations of the Marketplace site in Emeryville, California. This site historically contained paint and asphaltic roof products manufacturing facilities. A current issue to be resolved concerns the disposition of oil and grease ladened soil in the northern and central sectors of the site. Oil and grease originated from crude petroleum which was refined to tar at the former roof products manufacturing facility.

This report also recommends encapsulation of the tar which is mixed into soil in the northern and central sectors. Encapsulation is consistent with the nonhazardous classification of the oil and grease and is the lowest cost, feasible and effective alternative. Alternative mitigation actions are addressed in Section 5.

All soils on the site can potentially be encapsulated during proposed site development. The proposed concrete foundations, paved parking areas, and landscaped areas filled with 18 inches of clean loam would serve as an effective encapsulation layer.

Section 4 discusses all past and current test results for the Marketplace site. In particular, the subject of tar is addressed because previous tests may have been mistakenly interpreted as indicating the presence of spilled diesel fuel. Tar and diesel contain certain higher boiling point hydrocarbons, both detectable by the infrared spectroscopy method used previously.

2. MARKETPLACE HISTORY AND PREVIOUS CONTAMINANT INVESTIGATION RESULTS

The history of the Marketplace former roofing materials manufacture has been well documented in the Draft Work Plan (Appendix A). Paint manufacturing, which commenced on site in the 1920s, is also well documented in the Draft Work Plan (Appendix A).

PREVIOUS CONTAMINANT INVESTIGATION

The original exploratory borings were drilled at 12 locations (refer to Figure 1) during July 29, 1981 through August 6, 1981. Boring locations were selected nonrandomly to correspond with potential areas of contamination. Groundwater monitoring wells were installed in Boring No. 4, 5, 10, and 12. The four wells were sampled on January 20, 1982 under the supervision of RWQCB personnel.

Four or five groups of subsurface storage tanks have been identified, which were subjects of the previous study and again are subjects of the current study. Group A tanks, located on the northeast property line (refer to Figure 2) contained crude asphalt. Group B, C, and D tanks (refer to Figure 2) contained solvents used in paint manufacture. A fifth tank group was located in the southeast corner of the site. All tanks were subsurface, concrete tanks.

At the direction and supervison of DOHS staff, backhoe excavations were performed in Tank Groups A, B, and C and three borings were performed in Tank Group D. No signs of unfilled, void tanks or residual materials were discovered, although minor uncertainty remained about Tank Group D owing to the extent of search.

Previous Soil Samples. A total of 26 solid samples from the 12 borings were collected. Twelve of these 26 were discretionary based upon visual or olfactory indications; 12 were selected from the upper five feet of fill as specified in the original protocol; and two were special samples of a black tarry substance (which could be crude asphalt used by the roof material manufacturer.

All samples were screen tested for purgeable organics (including aromatics and halocarbons) and for total identifiable chlorinated hydrocarbons. All samples also were selectively tested for seven to eight heavy metals; the metals tested always included copper, lead, nickel and zinc for all of the 26 solid samples. Mercury was not tested in any of the samples.

Previous Soil Test Results. Lead, copper, and zinc did not exceed the current California TTLC in any of the 26 solids samples. Soil samples from Boring No. 8 and 10 contained 74 percent to 88 percent of the TTLC for lead. Polychlorinated biphyenyls (PCBs) were detected in four borings (No. 4, 5, 7, and 8). PCBs concentrations ranged from 0.12 ppm (Arochlor 1260) in Boring No. 5 (7.0 to 8.0 foot depth) to 33 ppm (Arochlor 1242 and Arochlor 1260) in Boring No. 8 (2.0 to 3.0 foot depth). Minor chlordane (pesticide) was detected in Boring No. 2, at the concentration of 0.5 to 1.0 ppm. Other results were insignificant (no contaminant detected or, if detected, not at a concentration of concern).

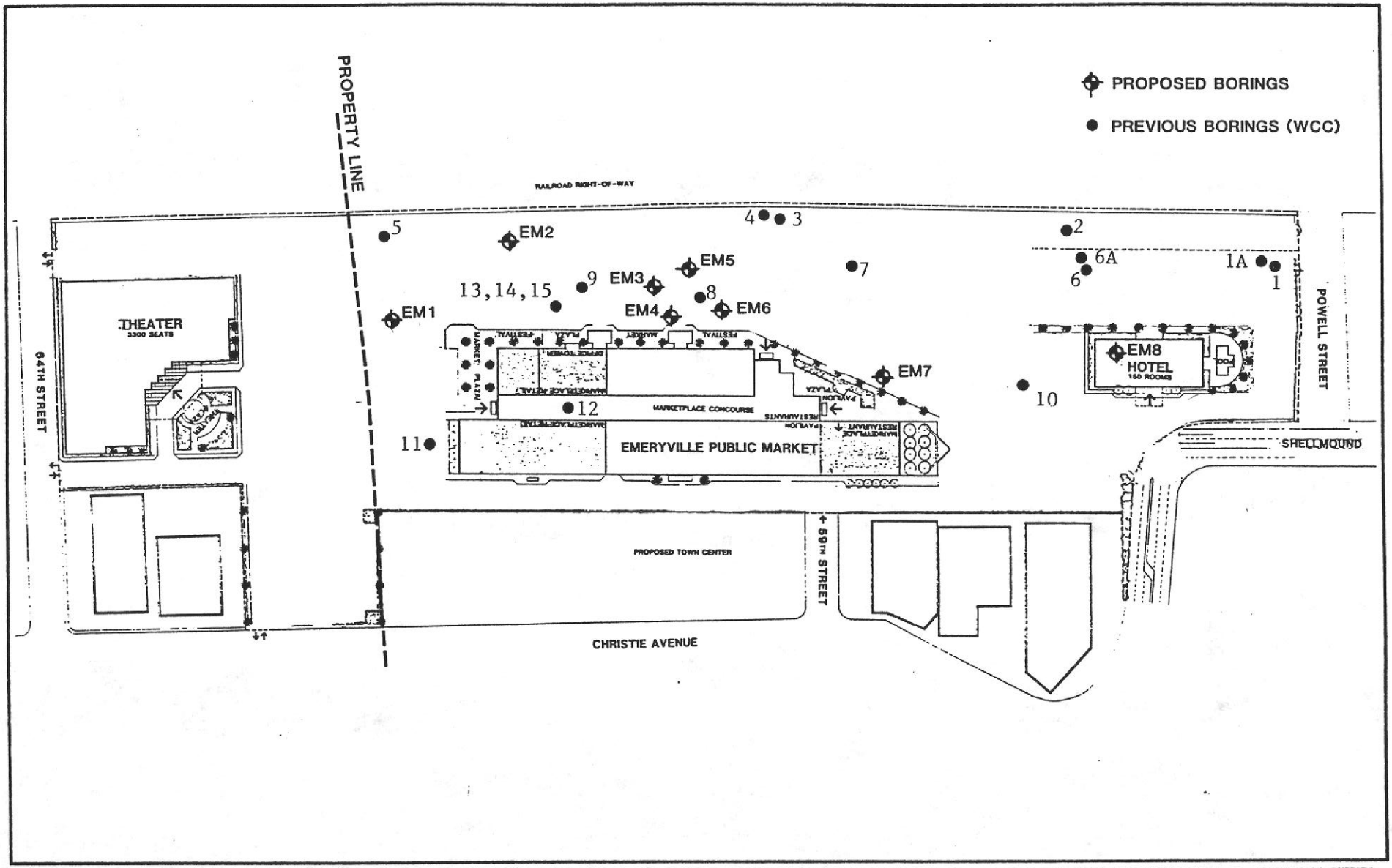
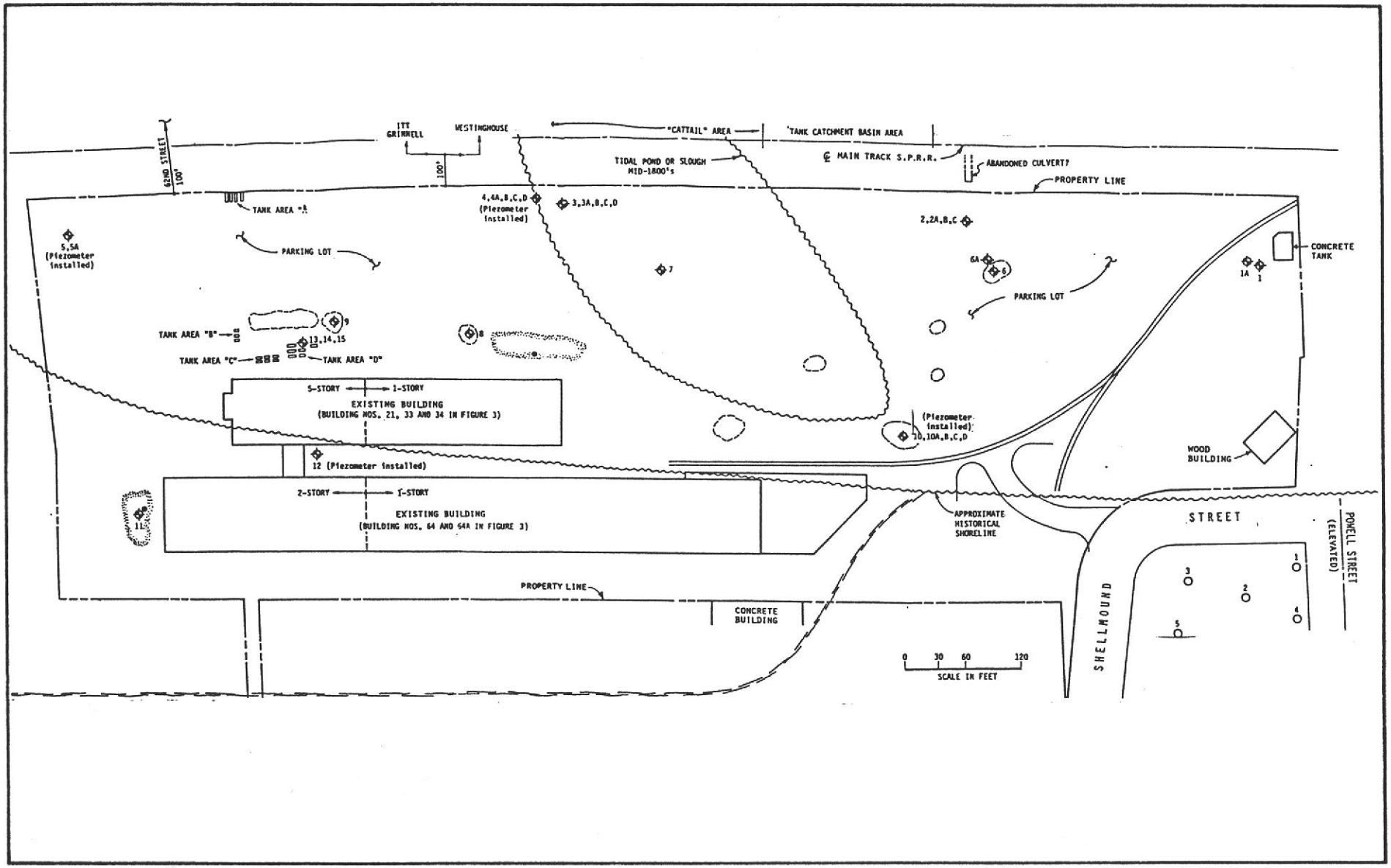


FIGURE 1. MARKETPLACE PROJECT SITE DETAILING BORING LOCATIONS



earth metrics

SCALE
1" = 140'

FIGURE 2. FORMER TANK LOCATIONS AND PREVIOUS BORING LOCATIONS

Previous Water Test Results. Two purgeable organics (EPA Method 624), tetrahydrofuron and methylethyl keytone, were detected at 0.34 ppm and 0.23 ppm, respectively. These were not considered to constitute a hazard. Metals concentrations were below the U.S. EPA Safe Drinking Water Standards. Other results were insignificant.

Groundwater from Well No. 8 contained trace amounts (in the parts per billion range) of priority organics as follows:

Priority Organics	µg/liter (PPB)
Acenaphthene	4
Benzo (a) anthracene	2
Chrysene	2
Fluorene	9
Fluoranthene	4
Napthalene	30
Phenanthrene	5
Pyrene	5

Some of the above priority organics also were detected on the adjacent Nielsen site (in Boring No. 5).

3. CURRENT CONTAMINANT INVESTIGATION AND RESULTS

The current investigation was designed to supplement the archival data available from the previous site contaminant investigation. A Draft Work Plan was submitted to the Alameda County Hazardous Materials Unit, on November 10, 1987, describing the proposed supplemental borings, groundwater sampling, and EPA test protocols.

Previous groundwater monitoring wells in Borings No. 4, 5, and 12 (refer to Figure 1) were redeveloped and sampled on December 1 and 2, 1987. Well keys were provided by the well installers, Woodward Clyde Consultants.

CURRENT INVESTIGATION

Eight new exploratory borings were drilled, at locations shown in Figure 1, on November 12, 1987. New borings are identified by the "EM" prefix. New boring locations were selected nonrandomly to correspond with the vicinity of previous Boring No. 8, northeast portion of the subject site near previous Boring No. 5, and south central portion of the subject site. The latter two portions of the site represent areas that were relatively less explored in the previous site contaminant investigation.

Current Soil Samples. A total of 18 soil samples were collected from the eight new borings. Soil samples were collected from up to three depth levels. All eighteen were tested for the full California metals list of nineteen metals. Eight soil samples were tested for total halogenated organics (EPA Method 9022). Based upon visual and olfactory observations, six soil samples (from Borings EM1, EM2, EM4 and EM8) also were tested for oil and grease. All test results are summarized in Tables 1, 2, and 3.

Current Soil Test Results. Lead, copper, zinc, and mercury were found to exceed the current California TTLC in the soil samples from Boring EM8. Chlorinated hydrocarbons were not detected at the concentration of 0.5 ppm or above. This means that compounds like PCBs (Arochlor 1248) or DDT, if present, could not exceed the concentration of approximately 1.0 ppm.

Oil and grease concentrations in the soil samples from borings EM1 and EM2 exceeded 4,000 ppm. Borings EM1 and EM2 are located adjacent to a former use labeled as a "refinery." Oil and grease in Boring EM4 exceeded 1,000 ppm. Boring EM4 is located approximately in the path of the former pipeline used to convey refined asphalt to the former factory building.

Current Water Test Results.

(Coming)

TABLE 1. HEAVY METALS IN SOIL FROM NEW BORINGS AT THE MARKETPLACE SITE IN EMERYVILLE, CALIFORNIA

METAL	TTLC (MG/KG)	SITE EM1 1.5 FT (MG/KG)		SITE EM1 3.5 FT (MG/KG)		SITE EM1 5 FT (MG/KG)		SITE EM1 10 FT (MG/KG)		SITE EM2 1.5 FT (MG/KG)	
AG	500	<0.4	N	<0.4	N	<0.4	N	<0.4	N	<0.4	N
AS	500	<12.0	D	<4.0	N	<3.9	N	<4.0	N	<4.0	N
BA	10000	127.3		145.6		99.9		118.5		93.3	
BE	75	<0.2	N	<0.7	D	<0.2	N	<0.7	D	<0.2	N
CD	100	2.5		3.1		2.2		2.2		2.2	
CO	8000	7.8		10.3		7.5		7.9		6.4	
CR	2500	33.6		56.7		39.8		50.1		21.1	
CU	2500	37.3		41.3		102.9		44.3		24.2	
HG	20	<1.0	N	<1.0	N	<1.0	N	<1.0	N	<1.0	N
MN		370.2		361.0		287.1		286.6		213.9	
MO	3500	<1.0	N	<1.0	N	<1.0	N	<1.0	N	<1.0	N
NI	2000	31.4		41.1		33.9		31.1		25.2	
PB	1000	49.2		67.9		47.1		63.2		30.4	
SB	500	<10.0	N	<10.0	N	<9.9	N	<10.0	N	<10.0	N
SE	100	<4.0	N	<4.0	N	<3.9	N	<4.0	N	<4.0	N
SN		<6.6	D	26.7		12.8		19.5		<2.0	N
TL	700	<10.0	N	<10.0	N	<9.9	N	<10.0	N	<10.0	N
V	2400	25.9		25.8		20.0		22.3		19.5	
ZN	5000	93.3		142.3		85.0		104.6		66.0	

D = Detected
N = Not Detected
** = Exceeds TTLC
MG/KG: Milligrams per Kilogram

SOURCE: EARTH METRICS INCORPORATED, 1987

TABLE 1. HEAVY METALS IN SOIL FROM NEW BORINGS AT THE MARKETPLACE SITE IN EMERYVILLE, CALIFORNIA

METAL	TTLC (MG/KG)	SITE EM2 3.5 FT (MG/KG)		SITE EM2 6.5 FT (MG/KG)		SITE EM3 1.5 FT (MG/KG)		SITE EM3 3 FT (MG/KG)		SITE EM4 2.5 FT (MG/KG)	
AG	500	<0.4	N	<0.4	N	<0.4	N	<0.4	N	<1.3	D
AS	500	<4.0	N	<4.0	N	<12.9	D	<12.9	D	14.3	
BA	10000	133.6		131.4		92.9		517.8		98.6	
BE	75	<0.7	D	<0.7	D	<0.7	D	<0.7	D	<0.7	D
CD	100	3.3		3.5		6.2		3.2		13.1	
CO	8000	12.0		11.6		10.4		8.4		17.3	
CR	2500	32.2		30.9		59.1		39.1		146.2	
CU	2500	14.2		14.9		176.2		52.4		615.6	
HG	20	<1.0	N	<1.0	N	<1.0	N	<1.0	N	<1.0	N
MN		373.0		443.8		506.6		375.0		1594.5	
MO	3500	<1.0	N	<1.0	N	6.2		<3.3	D	18.2	
NI	2000	31.3		31.4		80.2		47.1		167.3	
PB	1000	<1.0	N	<1.0	N	30.5		85.2		60.0	
SB	500	<9.9	N	<10.0	N	<10.0	N	<10.0	N	<9.9	N
SE	100	<4.0	N	<4.0	N	<4.0	N	<4.0	N	<40.0	N
SN		<2.0	N	<2.0	N	12.8		<6.6	D	41.3	
TL	700	<9.9	N	<10.0	N	<10.0	N	<10.0	N	<9.9	N
V	2400	29.9		31.3		23.4		31.6		32.1	
ZN	5000	39.9		42.6		73.3		137.8		79.1	

D = Detected
N = Not Detected
** = Exceeds TTLC
MG/KG: Milligrams per Kilogram

SOURCE: EARTH METRICS INCORPORATED, 1987

TABLE 1. HEAVY METALS IN SOIL FROM NEW BORINGS AT THE MARKETPLACE SITE IN EMERYVILLE, CALIFORNIA

METAL	TTLC (MG/KG)	SITE EM5 3.5 FT (MG/KG)		SITE EM5 5 FT (MG/KG)		SITE EM6 1.5 FT (MG/KG)		SITE EM6 3 FT (MG/KG)		SITE EM6 5 FT (MG/KG)	
AG	500	<0.4	N	<0.4	N	<1.2	D	<1.3	D	<0.4	N
AS	500	<4.0	N	<4.0	N	<3.9	N	<13.2	D	<4.0	N
BA	10000	75.0		264.3		119.0		141.7		86.3	
BE	75	<0.7	D	1.4		<0.7	D	<0.7	D	<0.7	D
CD	100	1.3		5.3		5.9		9.9		5.8	
CO	8000	5.1		16.5		8.0		20.6		6.9	
CR	2500	15.9		56.7		125.0		141.8		60.7	
CU	2500	15.5		29.4		140.3		310.5		75.5	
HG	20	<1.0	N	<1.0	N	<1.0	N	<1.0	N	<1.0	N
MN		271.6		1436.2		2533.9		3102.4		519.0	
MO	3500	<1.0	N	<3.3	D	5.8		9.5		<3.3	D
NI	2000	22.5		110.8		54.1		99.8		42.8	
PB	1000	5.8		<1.0	N	20.0		45.0		14.4	
SB	500	<10.0	N	<10.0	N	<9.8	N	<9.9	N	<10.0	N
SE	100	<4.0	N	<12.4	N	<3.9	N	<40.0	N	<4.0	N
SN		<2.0	N	<2.0	N	8.4		20.3		<6.6	D
TL	700	<10.0	N	<10.0	N	<9.8	N	<9.9	N	<10.0	N
V	2400	16.1		41.8		45.9		49.9		46.5	
ZN	5000	38.0		64.8		75.6		124.5		63.9	

D = Detected
N = Not Detected
** = Exceeds TTLC
MG/KG: Milligrams per Kilogram

SOURCE: EARTH METRICS INCORPORATED, 1987

TABLE 1. HEAVY METALS IN SOIL FROM NEW BORINGS AT THE MARKETPLACE SITE IN EMERYVILLE, CALIFORNIA

METAL	TTLC (MG/KG)	SITE EM7 3 FT (MG/KG)		SITE EM8 3 FT (MG/KG)		SITE EM8 5 FT (MG/KG)		MAXIMUM VALUE ALL SITES (MG/KG)	MAXIMUM % OF TTLC ALL SITES (MG/KG)
AG	500	<0.4	N	20.4		<0.4	N	20.4	4.1%
AS	500	<4.0	N	19.2		<4.0	N	19.2	3.8%
BA	10000	45.3		377.2		29.4		517.8	5.2%
BE	75	<0.2	N	<0.2	N	<0.2	N	1.4	1.9%
CD	100	1.3		24.8		2.7		24.8	24.8%
CO	8000	4.3		6.5		8.9		20.6	.3%
CR	2500	29.6		133.3		34.0		146.2	5.8%
CU	2500	7.7		46819.0	**	72.8		46819	1872.8%
HG	20	<1.0	N	40.1	**	<1.0	N	40.1	200.5%
MN		191.2		264.3		214.6		3102.4	--
MO	3500	<1.0	N	<1.0	N	<1.0	N	18.2	.5%
NI	2000	24.1		61.7		35.3		167.3	8.4%
PB	1000	<1.0	N	2129.9	**	7.6		2129.9	213.0%
SB	500	<9.9	N	<10.0	N	<10.0	N	0	.0%
SE	100	<4.0	N	<39.8	N	<4.0	N	0	.0%
SN		<2.0	N	140.7		<2.0	N	140.7	--
TL	700	<9.9	N	<10.0	N	<10.0	N	0	.0%
V	2400	18.0		23.9		22.8		49.9	2.1%
ZN	5000	22.4		24317.3	**	77.5		24317.3	486.3%

D = Detected
N = Not Detected
** = Exceeds TTLC
MG/KG: Milligrams per Kilogram

SOURCE: EARTH METRICS INCORPORATED, 1987

TABLE 2. HALOGENATED ORGANICS IN SOIL FROM NEW BORINGS PERFORMED AT THE MARKETPLACE SITE IN EMERYVILLE, CALIFORNIA (PPM)

BORING NO.	SAMPLING DEPTH (FEET)	CHLORINE	BROMINE	IODINE
EM1	3.5 - 4.0	<0.5	<0.1	0.13
EM2	3.5 - 4.0	<0.5	<0.1	<0.05
EM3	3.0 - 4.0	<0.5	<0.27	0.07
EM4	2.5 - 3.0	<0.5	ND (0.10)	0.05
EM5	5.0	<0.5	ND (0.10)	<0.05
EM6	7.0	<0.5	ND (0.10)	<0.05
EM7	5.0	<0.5	ND (0.10)	ND (0.05)
EM7	10.0	<0.5	ND (0.10)	ND (0.05)

ND Not detected at the detection limit
( ) Indicates the detection limit in parts per million

Source: Earth Metrics Incorporated, 1987.

TABLE 3. OIL AND GREASE IN SOIL FROM NEW BORINGS AT THE MARKETPLACE SITE IN EMERYVILLE, CALIFORNIA (PPM)

BORING NO.	SAMPLING DEPTH (FEET)	OIL AND GREASE
EM1	3.5 - 4.0	3,960
EM1	5.0 - 5.5	8,100
EM2	3.5 - 4.0	5,831
EM4	2.5 - 3.0	1,233
EM8	3.0 - 3.5	95
EM8	5.0 - 5.5	<6

Source: Earth Metrics Incorporated, 1987.

TABLE 4. HEAVY METALS IN GROUNDWATER FROM WELLS AT THE MARKETPLACE SITE (PPM)

METAL	EPA SAFE DRINKING WATER STANDARD	WELL NO. 4	WELL NO. 5	WELL NO. 12
AG	0.05			
AS	0.05			
BA	1.0			
BE	N/A			
CD	0.01			
CO	N/A			
CR	0.05			
CU	1.0			
HG	0.002			
MN	0.05			
MO	N/A		(TO BE COMPLETED)	
NI	N/A			
PB	0.05			
SB	N/A			
SE	0.01			
SN	N/A			
TL	N/A			
V	N/A			
ZN	5.0			

D = Detected
N = Not Detected
N/A= Not Applicable No Standard has been established.

Source: Earth Metrics Incorporated, 1987.

TABLE 5. HALOGENATED ORGANICS IN GROUNDWATER FROM WELLS AT THE MARKETPLACE SITE (PPB)

HALOGENS	WELL NO. 4	WELL NO. 5	WELL NO. 12
Total Halogenated Organics (EPA Method _ _ _)		(to be completed)	
Detection Limit is 5 ppb.			
Source: Earth Metrics Incorporated, 1987.			

4. DISCUSSION OF ALL PAST AND PRESENT CONTAMINATION CHARACTERIZATION RESULTS

METALS

State of California metals criteria have been relaxed since 1982. Previous metals concentrations reported by Woodward-Clyde Associates may have exceeded the former criteria, but do not exceed the current metals limits. Supplemental testing by Earth Metrics substantiate the previous metals test results, showing generally low metals concentrations. One area (Boring No. EM8) could be a small pocket of metals contamination. Metals in soil from Boring No. EM8 that exceeded the TTLC include copper, mercury, lead and zinc.

REFINED ASPHALT

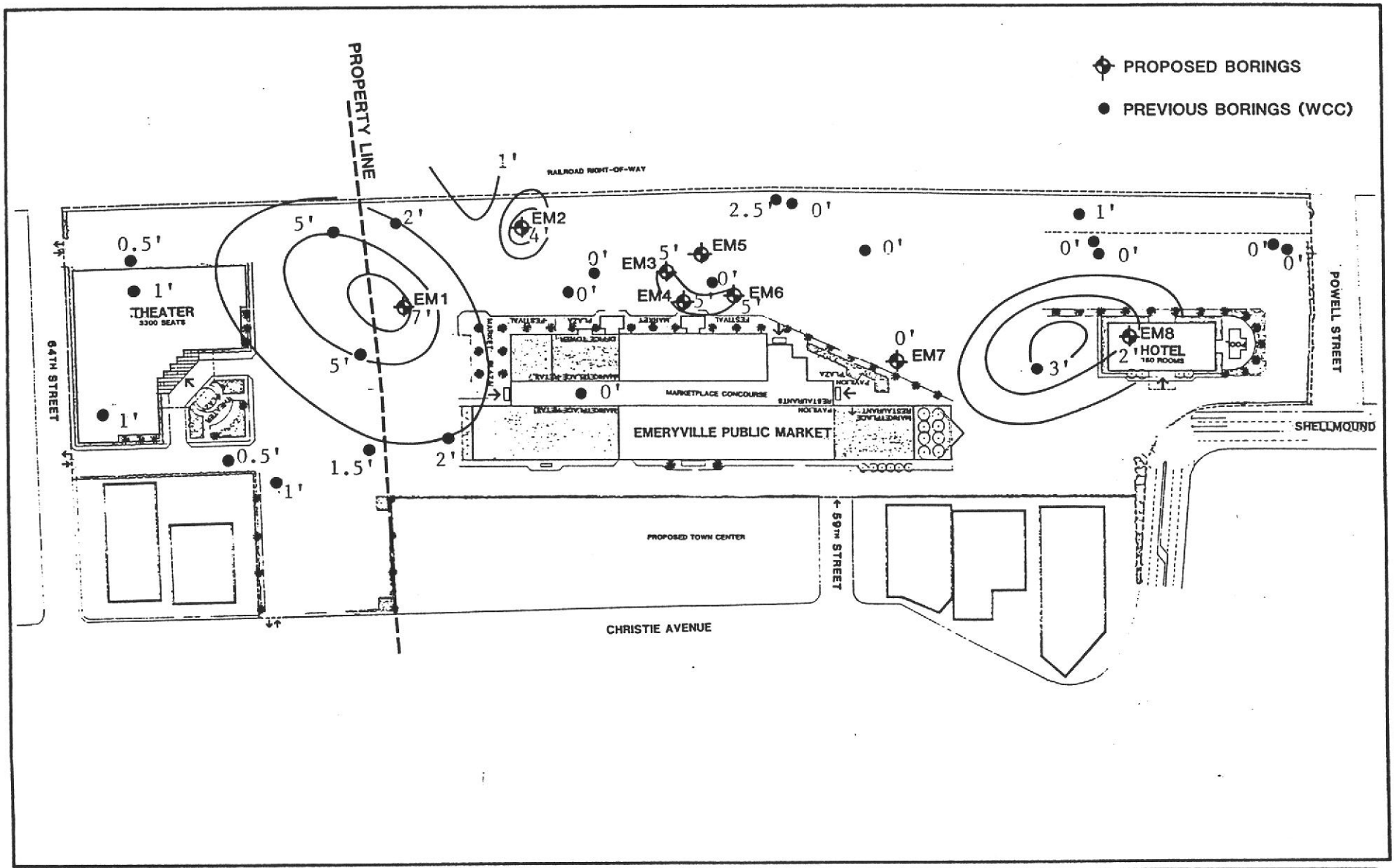
The isopach map (refer to Figure 3) illustrates an estimate of the thickness of asphaltic substance over the entire site. These thicknesses are based on the boring logs (see Table 6). Thicknesses are extrapolated between borings.

Since the old refinery complex was located in the northeastern corner of the site, it is probable that most of the dumping and spillage would have occurred in this area. It is not known how deposition occurred around the proposed hotel site or other areas. Since the refined asphalt was conveyed by pipeline from the refinery complex to a former building located near the two existing buildings, some spillage may have occurred at pipeline termini where the accumulations are shown around these existing buildings.

It is possible that the hardened "tar" like substance that has exuded from the pavement is actually the refined asphalt that has undergone a hardening process with weathering by the elements and integration into the soil matrix.

WATER

(to be completed)



earth metrics

SCALE
1" = 160'

FIGURE 3. ISOPACH CONTOURS OF THE ASPHALTIC SUBSTANCE

TABLE 6. ESTIMATED THICKNESS OF ASPHALTIC SUBSTANCE IN BORINGS AT THE MEARKETPLACE SITE

PREVIOUS BORING NO.	TAR THICKNESS (FEET)	CURRENT BORING NO.	TAR THICKNESS (FEET)
1	0	EM1	7+
2	1		
3	0	EM2	4
4	2.5		
5	2	EM3	0.5
6	0		
7	0	EM4	0.5
8	0		
9	0	EM5	0
10	3		
11	2	EM6	0.5
12	0	EM7	0
13	0	EM8	2

Source: Earth Metrics Incorporated, 1987.

5. RECOMMENDATIONS

The following recommendations address tar and metals in the Marketplace soil. Water test results from resampling and retesting of Wells No. 4, 5, and 12 have not been received from Fireman's Fund Environmental Lab at the time of preparation of this draft report.

OIL AND GREASE

The tar material is not a hazardous material, according to the available test results and applicable State of California Title 22 criteria defining hazardous waste. Tar may have been confused previously with residual diesel fuel, because EPA Method 418.1 detects "high boiling point" hydrocarbons.

Several optional mitigation measures are available for the tar. Earth Metrics recommends "encapsulation" in place with asphalt pavement, concrete foundation slabs, or 18 inches of clean imported loam in landscaped areas. This recommendation is consistent with the apparent nonhazardous classification of the material. This recommendation is the least cost alternative.

Other alternatives are: excavation and off site removal in a Class II or III landfill; or biodegradation. Because the tar is not localized, but extends into the Marketplace site, excavation and removal would be difficult and costly. Based upon the isopach contours, at least 1,000 cubic yards would have to be hauled. The biodegradation alternative could be explored in cooperation with the Alternative Technologies Branch of DOHS.

METALS

Copper, mercury, lead, and zinc in Boring No. EM8 exceeded their respective TTLCs. Boring No. EM8 is located at the junction of two railroad spurs; the historic source of soil contamination is unknown. The soil contamination is shallow, being limited to the first five feet in depth. Soil contamination and its potential extent outward from Boring No. EM8 will be verified by further investigation.

APPENDIX A.

DRAFT WORK PLAN

FOR

SOILS CONTAMINATION CHARACTERIZATION

OF

MARKETPLACE SITE

IN

EMERYVILLE, CALIFORNIA

Prepared for:

County of Alameda

November 10, 1987

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TABLE OF CONTENTS

Section		Page
1.	SITE HISTORY AND EXISTING ENVIRONMENT	1-1
2.	EVALUATION OF EXISTING DATA	2-1
3.	DETERMINATION OF ANALYTES OF INTEREST	3-1
3.1	Anticipated Waste Characteristics	3-1
3.2	Suspected Routes of Human Exposure	3-1
3.3	Recommended and Anticipated Hazardous Constituents	3-5
4.	SAMPLING STRATEGIES AND EQUIPMENT	4-1
4.1	Sampling Strategies	4-1
4.2	Sampling Equipment	4-3
5.	PROPOSED WORK PLAN	5-1
5.1	Recommended Monitoring Wells	5-1
5.2	Soil Sampling and Laboratory Tests	5-1

LIST OF FIGURES

Figure		Page
3.1	Overview of Effects and Interaction at a Representative Hazardous Waste Site	3-3
5.1	Marketplace Project Site Detailing Previous Sample Locations and Proposed Soil Boring Locations	5-2

LIST OF TABLES

Table		Page
1.1	Chronology of Reclamation and Development of the Subject Site	1-3
2.1	Previous Soil Analysis Results from Borings Performed by Woodward-Clyde Consultants, Marketplace Site, Emeryville, California	2-1
2.2	Previous Surface Tar Analysis Results as Provided by Woodward-Clyde Consultants	2-2
2.3	Previous Water Analysis Results as Obtained from Monitoring Wells (WCC-1982)	2-3
2.4	Stratum Statistical Analysis of Metals	2-4
3.1	Federal Maximum Recommended Hazardous Constituents	3-2
3.2	Title 22 - California Environmental Health and Safety Code - Hazardous Substances and Quantities - Inorganics	3-6
3.3	Title 22 - California Environmental Health and Safety Code - Hazardous Substances and Quantities - Organics	3-7

1. SITE HISTORY AND EXISTING ENVIRONMENT

EXISTING USE OF SITE

The subject site is located in the City of Emeryville west of SPRR ROW, east of Highway 80 and north of Powell Street (see Figure 5.1).

The Marketplace is partially developed at present and incorporates restaurants, shops and offices housed in two buildings previously used for paint manufacturing, storage and warehousing. The additional two buildings include a small wooden office building located at the southwest corner of the site adjacent to Shellmound Street and an abandoned 19 foot high concrete tank structure located at the southeast corner of the site. West of the site, for the most part, is paved with asphaltic concrete.

A "Grading and Drainage" plan is on file with the City of Emeryville for the present Marketplace Development ("Emeryville Market," Street 1B, George S. Nolte and Associates, October, 1973, Rev. 11/20/73). Whether or not this plan was followed in the construction process is not known. However, it appears that the plan intended to direct the grading process such that the parking lot would have a "crown" axis, or anticline, through the approximate north/south trending centerline of the parking lot, so that drainage would flow to the storm drains that are along the east and west sides of the site.

HISTORIC LAND RECLAMATION AND DEVELOPMENT

Table 1.1 summarizes the chronology of reclamation and development of the subject site and adjacent sites in Emeryville, California. Reclamation here refers to the creation of land that is protected from tidal flooding.

The subject site was in the tidal plane of the San Francisco Bay until construction of the East Shore Highway in 1954 (Deasy, CALTRANS, 1986) created a levee protecting inland parcels. Actual "filling" of the Marketplace site, or portions thereof, probably started in the late 1800s. Fill material consisted primarily of silt, clay and sand along with varying amounts of roofing felt, roofing paper, roofing shingles, refined asphalt, concrete and wood. The manmade materials could be termed "scrap" products and byproducts of the manufacturing processes. By 1930 most of the current Marketplace site had been filled with further byproducts and a combination of clear fill and industrial waste.

Relation of Site History to Soils Data. Logs of the soil borings reveal materials that are a part of the historic municipal use of the subject site for land disposal. These materials, for the most part, consist of silts, clays, sands and gravels. Other materials encountered in the soil borings include concrete chunks, brick pieces, tar products and wood. Tar products such as roofing paper, roofing shingles, roofing felt and refined asphalt would have been "scraps" from the manufacturing processes of Paraffine/PABCO/ Fibreboard. Concrete chunks and wood probably were derived from both on site and off site locations.

TABLE 1.1. CHRONOLOGY OF RECLAMATION AND DEVELOPMENT OF THE SUBJECT SITE

Late 1800s:	Emeryville shoreline has been extended baywards by artificial fill over bay mud. The composition of the fill is highly variable imported clayey and/or sandy soils combined with construction spoils and industrial waste.
1884:	The first of the Paraffine Companies, Inc. plants was started.
1902 to 1904:	The Paraffine Companies, Inc. intitiated the manufacture of roofing felt, roofing paper and linoleum. Asphalt was refined on the manufacturing plant property at the foot of Powell Street. The manufacturing site consisted of less than 30 acres.
1915:	Map of Berkeley/Emeryville indicates bay shoreline immediately west of SPRR tracks. The subject site is in the San Francisco Bay tidal plain.
1920s:	The Paraffine Companies, Inc. changed its name to PABCO.
1927:	Aerial view of PABCO indicates facilities on a site of approximately 30 acres.
1929:	PABCO leased from the City of Emeryville a 400 foot wide strip of municipally owned tidelands in the San Francisco Bay to be used as a shipping lane/harbor. Paint manufuacturing begins.
1932:	The PABCO property has expanded to encompass a land area of 30 acres. PABCO owned property also includes 140 acres in the San Francisco Bay, adjoining the 30 acres.
1957:	PABCO was purchased by The Fibreboard Corporation.
1964:	Fibreboard began to divest its industries.
1973 to 1974:	All buildings except for existing ones were demolished.
1975:	Site grading and construction of existing Marketplace parking lot completed.

GEOLOGY

The hills above Emeryville consist of Tertiary sediments and volcanics overlying Jurassic-Cretaceous bedrock of the Franciscan Assemblage. The hills are part of the California Coast Range, and result from repeated episodes of deformation by folding and faulting over the last three million years. This uplift contributed to rapid erosion and deposition of a thick sequence of poorly consolidated alluvial fan deposits. Fluctuation in sea level, as a result of continental glaciation, accelerated this process. As much as 540 feet of this late Tertiary/early Quaternary sediment is believed to overlie bedrock in the Emeryville area.

The oldest alluvial fan deposits consist of poorly consolidated interbedded silts, sands and gravels known as the Alameda Formation (Qa). These in turn are overlain by 10 to 15 feet of alluvium and stream deposited sands and silts of the Temescal formation (Qtc). North of Powell Street in the area of the project site, the Temescal sands and silts are overlain by 30 feet of Merritt sand, a generally fine grained and well sorted beach and windblown sand deposit. Overlying these sands in this area are 10 to 20 feet of bay mud.

Artificial Fill. Since the late 1800s the Emeryville shoreline has been progressively extended baywards by imported fill. Approximately one third of the land area of the City of Emeryville presently consists of fill placed over bay mud. The composition of the fill is highly variable, and in general it appears to consist of imported clayey and/or sandy soils combined with construction and industrial waste materials (City of Emeryville, Emeryville Redevelopment Project Draft EIR, 1977).

Bore holes north of the project site indicate that thicknesses of the artificial fill material in this area range from approximately 15 to 25 feet (City of Emeryville, 1975). Boring logs from the project site itself suggest that artificial fill material is probably not much greater than five feet overlying bay mud. Analysis of these logs suggests stratification of the fill material. The upper 1.0 to 1.5 feet of fill on the subject site consists of asphalt, aggregate base, and imported select fill. The underlying three to three and one half feet of fill consists of a heterogeneous mixture of clay and sand with assorted miscellaneous debris including roofing felt, roofing paper, roofing shingles, concrete chunks, and wood. Maximum concentrations of these materials vary from one location to another.

HYDROLOGY

Major fresh water aquifers in the vicinity of Emeryville include most of the porous sands and gravels of the Alameda, Temescal and Merritt sand formations. Porous members of the older Franciscan assemblage are also known as fresh water sources throughout many subbasins in the San Francisco Bay Area, but this source is limited due to extreme deformation and faulting since its deposition.

Fresh water enters the aquifers through natural rainwater recharge areas wherever these formations surface in the East Bay Hills. The water then flows down gradient into porous sediments underlying the bay mud deposits below San Francisco Bay. It can be assumed that at least some of these porous sediments come into direct contact with deeper bay waters which will enter the aquifers during dry seasons when pressure from the outflowing meteoric water decreases.

Bay mud is extremely clay rich and is virtually saturated with mineral bound water. Flow of water through this layer is minimal; therefore, communication between waters in layers above and below the bay mud deposits can be assumed to be virtually nil.

Artificial fill layers tend to be such heterogeneous mixtures of material that some degree of porosity would be expected. Since the fill material was deposited directly onto tidal flats, it can be assumed that saline groundwaters may ebb and flow to some degree through the artificial fill layers at the Emeryville site.

Surface Water Runoff. Storm runoff flows generally from east to west across the site and into storm drainage beneath Lacoste Street. These waters are ultimately discharged untreated into San Francisco Bay. Prior to the asphalt surfacing of the site in 1975, the area was exposed to years of rainwater percolating through the fill material.

Due to the presence of the "tarry" substance, contamination of the surface water is a concern. Further delineation of this substance is necessary so a possible solution can be arrived at.

METEOROLOGY

Prevailing wind direction at the site is from west to east as winds are funneled through the Golden Gate and directed at the East Bay Hills. This movement is therefore from the bay, across low population industrial areas and freeway along the bay, toward residential areas in the hills to the east. Winter storms occasionally bring surges of moist tropical air from the south. Offshore airflows in this area occur when high pressure forms to the north and east, a condition generally observed in the spring and fall.

BIOLOGY

There is virtually no natural vegetation in the vicinity of the project site. Tidal flats west of Interstate 80 are home to a variety of shellfish and lower forms of marine life, and serve as feeding grounds for the wide variety of waterfowl common to the bay region.

2. EVALUATION OF EXISTING DATA

EXISTING DATA

The following Tables 2.1, 2.2 and 2.3 summarize previous analysis results obtained by Woodward-Clyde Consultants for the Marketplace Site in Emeryville, California.

TABLE 2.1. PREVIOUS SOIL ANALYSIS RESULTS FROM BORINGS PERFORMED BY WOODWARD-CLYDE CONSULTANTS, MARKETPLACE SITE, EMERYVILLE, CALIFORNIA

			LEVELS (in mg/kg; wet weight basis)								
BORING LOG NO.	DEPTH OF PETROLEUM ODOR	DEPTH OF SAMPLE FOR METALS ANALYSIS (FEET)	ARSENIC	CADMIUM	TOTAL CHROMIUM	COBALT	Cu COPPER	Pb LEAD	NICKEL	Zn ZINC	HEXAVALENT CHROMIUM
1	none	4 - 4.5	-	-	76	-	30	15	32	70	<0.2
1A	none	-	-	-	-	-	-	-	-	-	-
2	none	2 - 2.5	3.5	<0.5	46	11	370	340	38	350	<0.2
		4.5 - 5	-	-	62	-	1,600	370	52	800	<0.2
2A	obstruction	-	-	-	-	-	-	-	-	-	-
2B	obstruction	-	-	-	-	-	-	-	-	-	-
2C	obstruction	-	-	-	-	-	-	-	-	-	-
3	none	2.5 - 3	4.6	<0.4	57	8.8	45	38	40	83	<0.2
		6.5 - 7	-	-	70	-	57	20	34	60	<0.2
3A	6' - 6.5'	-	-	-	-	-	-	-	-	-	-
3B	obstruction	-	-	-	-	-	-	-	-	-	-
3C	2' - 2.5'	-	-	-	-	-	-	-	-	-	-
3D	5.5' - 6'	6.5 - 7	2.6	<0.4	63	3.2	16	7	28	36	<0.2
4	2'	-	-	-	-	-	-	-	-	-	-
4A	obstruction	-	-	-	-	-	-	-	-	-	-
4B	obstruction	-	-	-	-	-	-	-	-	-	-
4C	4.5'	4.5 - 5	12	<0.5	110	9	340	280	84	430	<0.2
		9 - 9.5	57	-	-	-	27	10	49	46	<0.2
4D	5'	-	-	-	-	-	-	-	-	-	-
5	2.75'	2 - 2.5	51	-	-	-	71	35	34	80	<0.2
		7 - 7.5	60	-	-	-	27	15	23	34	<0.2
5A	2.5' & 4'	5 - 5.5	3.7	<0.4	50	8	20	44	36	91	0.4
6	none	2.5 - 3	-	<0.5	880	-	230	110	56	550	0.2
6A	none	-	-	-	-	-	-	-	-	-	-
7	none	2 - 2.5	-	-	79	-	52	52	55	95	<0.2
8	none	2.5 - 3	1.6	11	1,000	11	1,100	880	130	2,300	0.2
		4.5 - 5	-	-	96	-	38	55	38	150	<0.2
9	kerosene	4.5 - 5	2.5	<0.5	95	16	49	15	28	42	<0.2
	odor @ 4'	7 - 7.5	2.9	<0.5	200	3.3	42	14	37	81	<0.2
	4.75' & 7'	9.5 - 10	-	-	54	-	61	9	44	66	<0.2
10	3.5'	3.5 - 4	18	1	150	16	1,000	740	240	1,900	0.2
		5.5 - 6	4.4	<0.5	42	8.5	40	9	31	38	<0.2
10A	none	-	-	-	-	-	-	-	-	-	-
10B	ammonia odor @ 3'	-	-	-	-	-	-	-	-	-	-

(CONTINUED)

TABLE 2.1 (CONTINUED). PREVIOUS SOIL ANALYSIS RESULTS FROM BORINGS PERFORMED BY WOODWARD-CLYDE CONSULTANTS, MARKETPLACE SITE, EMERYVILLE, CALIFORNIA

BORING LOG NO.	DEPTH OF PETROLEUM ODOR	DEPTH OF SAMPLE FOR METALS ANALYSIS (FEET)	LEVELS (in mg/kg; wet weight basis) ARSENIC	CADMIUM	TOTAL CHROMIUM	COBALT	Cu COPPER	Pb LEAD	NICKEL	Zn ZINC	HEXAVALENT CHROMIUM
10C	ammonia odor @ 3.5'	-	-	-	-	-	-	-	-	-	-
10D	none	15 - 15.5	-	-	60	-	9.5	10	28	32	<0.2
11	none	1 - 1.5	0.5	<0.5	2.9	<0.7	10	7	46	11	8.4
		4 - 4.5	3.4	<0.5	87	10	31	9	51	97	<0.2
		8.3 - 9	-	-	40	-	7.5	10	30	30	-
12	3',6',8'	-	-	-	-	-	-	-	-	-	-
13	none	-	-	-	-	-	-	-	-	-	-
14	3.5'	-	-	-	-	-	-	-	-	-	-
15	1.5', 3'	-	-	-	-	-	-	-	-	-	-

- signifies not tested

Note: Hexavalent Chromium was run only if Total Chromium was >50.

TABLE 2.2. PREVIOUS SURFACE TAR ANALYSIS RESULTS AS PROVIDED BY WOODWARD-CLYDE CONSULTANTS

LOCATION	LEVELS (in mg/kg; wet weight basis) TOTAL CHROMIUM	HEXAVALENT CHROMIUM	COPPER	LEAD	NICKEL	ZINC
Near Boring #8	20	-	7	50	91	70
Near Boring #11	64	9.4	130	300	112	290

Note: Hexavalent Chromium was run only if Total Chromium was >50.

TABLE 2.3. PREVIOUS WATER ANALYSIS RESULTS AS OBTAINED FROM MONITORING WELLS (WCC - 1982)

WELL NO.	DISSOLVED CONCENTRATIONS IN MG/L							
	ARSENIC	CHROMIUM	CADMIUM	COBALT	COPPER	LEAD	NICKEL	ZINC
4	<0.0005	<0.01	<0.01	<0.01	<0.01	0.003	<0.01	0.02
5	<0.0005	<0.01	<0.01	<0.01	<0.01	<0.001	<0.01	<0.01
10	<0.0005	<0.01	<0.01	<0.01	<0.02	0.004	<0.01	<0.01
12	<0.0005	<0.01	<0.01	<0.01	<0.01	<0.001	<0.01	0.01

STATISTICAL ANALYSIS OF EXISTING DATA

This section addresses statistical methods that will be used to characterize on site conditions, and presents as an example a statistical analysis of the available lead data. Lead data were analyzed using guidelines suggested in EPA's Test Methods for Evaluating Solid Waste (SW846, July 1982). The lead data comprise the only significant indicator of potential contamination available for spatial representation of the site.

Soils Core Data. According to SW846, preliminary data should be used to estimate the expected mean lead level and variance prior to initiation of the work plan. Knowledge a priori of contaminant mean concentration and variance provides, in conjunction with appropriate statistical methods, guidance for determining the number of samples needed to characterize potential contamination throughout the site (SW846, pages 2 and 11). The above strategy applies specifically to the available lead data.

SW846 also addresses several types of sampling, in the statistical sense. Two types of sampling germaine to characterization of on site soils are simple random sampling and stratified random sampling. For the subject case, it is suggested that stratified random sampling is most appropriate in view of the identifiable strata above the original bay mud and available lead data. Authoritative sampling is not considered here, because historical research revealed no special information to suggest that there are any systematic differences across the site with regard to the fill content or historical disposal practices.

LEAD ANALYSIS. The available lead data consist of 24 results from near surface to 12 feet depth (relative to existing grade). Lead data were stratified into three depth categories as follows: 0 to 2.5 feet, 2.5 to 5.0 feet, 5.0 to 7.5 feet and over 8 feet. Means and maximum contaminant levels for each stratum were calculated and are presented in Table 2.4.

Lead levels, as determined by previous borings, have not exceeded the TTLC. Subsequent borings will further delineate lead levels across the site.

Based on SW846, the number of samples needed to characterize the site as a whole, would total 50 to 60. These samples would come from approximately 10 borings (3 per boring). Since there have already been 24 samples analyzed for lead content, approximately 30 more are needed to be able to characterize this site.

TABLE 2.4 STRATUM STATISTICAL ANALYSIS OF METALS

BORING LOG NO.	As	Cd	Cr	Co	Cu	Pb	Ni	Zn
			1 TO 2.5 FEET					
2	3.5	<.5	46	11	370	340	38	350
5	51	-	-	-	71	35	34	80
7	-	-	79	-	52	52	55	95
11	.5	<.5	2.9	<.7	10	7	46	11
MEAN	18.3	<.5	42.6	5.9	125.8	108.5	43.3	134
MAX	51	<.5	79	11	370	340	55	350
			2.5 TO 5 FEET					
1	-	-	76	-	30	15	32	70
2	-	-	62	-	1600	370	52	800
3	4.6	<0.4	57	8.8	45	38	40	83
4C	12	<.5	110	9	340	280	84	430
6	-	<.5	880	-	230	110	56	550
8	1.6	11	1000	11	1100	880	130	2300
8	-	-	96	-	38	55	38	150
9	2.5	<.5	95	16	49	15	28	42
10	18	1	150	16	1000	740	240	1900
11	3.4	<0.5	87	10	31	9	51	97
MEAN	7.0	2.2	261	11.8	446	251	75.1	642
MAX	18	11	1000	16	1600	880	240	2300

(CONTINUED)

TABLE 2.4 (CONTINUED). STRATUM STATISTICAL ANALYSIS OF METALS

BORING LOG NO.	As	Cd	Cr	Co	Cu	Pb	Ni	Zn
				5.0 TO 7.5 FEET				
3	-	-	70	-	57	20	34	60
3D	2.6	<.4	63	3.2	16	7	28	36
5	60	-	-	-	27	15	23	34
5A	3.7	<0.4	50	8	20	44	36	91
9	2.9	<.5	200	3.3	42	14	37	81
10	4.4	<.5	42	8.5	40	9	31	38
MEAN	14.7	<.5	85	5.8	33.7	18.2	31.5	56.7
MAX	60	<.5	200	8.5	57	44	37	91
				8 FEET +				
4C	57	-	-	-	27	10	49	46
9	-	-	54	-	61	9	44	66
10D	-	-	60	-	9.5	10	28	32
11	-	-	40	-	7.5	10	30	30
MEAN	57		51.3		26.3	9.8	37.8	43.5
MAX	57		60		61	10	49	66

3. DETERMINATION OF ANALYTES OF INTEREST

3.1 ANTICIPATED WASTE CHARACTERISTICS

IGNITABILITY

There is no evidence to date of concentrations of flammable materials present that would constitute a combustion hazard on site. The data acquired from the site to date do not indicate the presence of garbage or other organic wastes that could be expected to generate methane, such as has been documented in other municipal landfills. Furthermore, the age of the landfill, years of exposure to the elements, possible exposure to tidal influx of bay waters and core sample analysis indicate that the threat of methane gas production at the site is negligible.

CORROSIVITY

Given the nature of the fill material and its history (age, exposure to rain, tidal waters, etc.) corrosive materials are not expected to be encountered in the artificial fill material of the site. This can be stated with some confidence since EPA definition of corrosivity requires the substance to be an aqueous solution or liquid. The possibility that buried drums or gasoline tanks may have survived intact is remote.

REACTIVITY

Given the nature of the fill material and its history (age, exposure to rain, tidal waters, etc.) highly reactive materials are not expected to be encountered in the artificial fill material on site. Certain solid wastes containing cyanide or sulfide are capable of generating toxic gases or fumes at extremely high or low pH levels, but these conditions are extremely unlikely at the site.

TOXICITY

Levels of lead, zinc or other heavy metals exceeding California's Total Threshold Limit Concentrations (TTLCs) have not been detected in the numerous bore hole cores throughout the project site. Soluble Threshold Limit Concentrations have not been measured.

The term "toxicity" is actually defined by the EPA on the basis of an "Extraction Procedure" (EP) test designed to identify wastes likely to leach hazardous concentrations of particular toxic constituents into groundwater (EPA, RCRA Orientation Manual, 1986). The test method involves the extraction of toxic constituents in ways that simulate leaching action found in landfills. The extract or soluble fraction is then analyzed to determine if it contains any of the EPA listed toxic constituents at or above hazardous levels (see Table 3.1).

3.2 POTENTIAL ROUTES OF HUMAN EXPOSURE

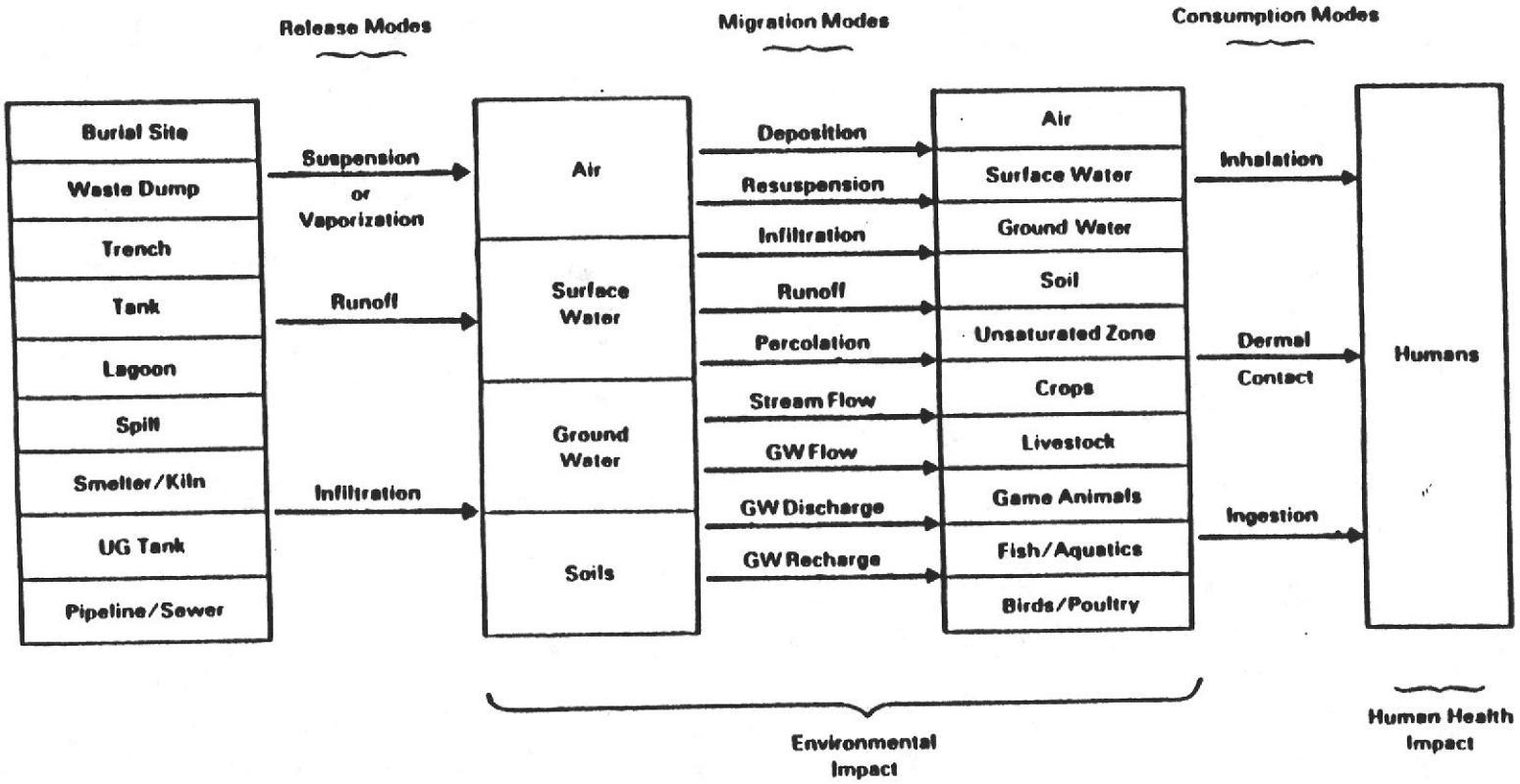
CONSTRUCTION PHASE

A generalized overview of possible pathways of migration of contaminants from a representative hazardous waste site into human receptors is shown in Figure

TABLE 3.1. FEDERAL MAXIMUM RECOMMENDED HAZARDOUS CONSTITUENTS

CONSTITUENT	LEACHATE CONCENTRATION (mg/liter)
Arsenic	5.0
Barium	100.0
Cadmium	1.0
Chromium	5.0
Lead	5.0
Mercury	0.2
Selenium	1.0
Silver	5.0
Endrin	0.02
Lindane	0.4
Methoxychlor	10.0
Toxaphene	0.5
2,4-D	10.0
2,4,5-TP	1.0

Source: EPA, RCRA Orientation Manual, 1986.



SOURCE: EPA, GUIDANCE ON REMEDIAL INVESTIGATIONS UNDER CERCLA, 1985

earth metrics

FIGURE 3.1 OVERVIEW OF EFFECTS AND INTERACTION AT A REPRESENTATIVE HAZARDOUS WASTE SITE

3.1. At the Marketplace site in Emeryville, several possible routes of exposure of construction workers to toxic substances can be anticipated. Experience at Bay Center in Emeryville has shown that worker exposure is acceptable relative to industrial standards.

Inhalation. Movement of fill, removal of asphalt and excavation of subsurface fill material will generate dust that could potentially contain some quantity of heavy metals. Therefore, certain mitigation measures for the protection of construction workers from potential contaminated dust may be implemented.

Workers and residents of nearby properties could be exposed to dust in downwind areas; however, even maximum concentrations of lead found to date would not generate airborne concentrations in hazardous levels. Standard measures of dust control during construction activity are already mandated; therefore, this route of exposure to humans near the project site is not considered cause for concern.

Dermal Contact. Many substances such as organochlorine and organophosphate compounds are toxic through contact with the skin. Measures to protect workers from dermal contact during construction may be implemented, at least until test results are available that demonstrate the absence of potentially harmful levels of contaminants in the artificial fill in which movement, grading or excavation is scheduled to occur.

Ingestion. This is not considered a critical pathway of migration specifically hazardous to construction workers at the site.

OCCUPANCY PHASE

Possible routes of exposure to workers and residents occupying completed buildings at the site are limited.

Inhalation. Construction plans call for encapsulation of all artificial fill material; therefore, inhalation of contaminated dust is not a cause for concern.

Dermal Contact. Construction plans call for encapsulation of all artificial fill material on site; therefore, the possibility of dermal contact by workers and residents occupying the completed development is not a cause for concern.

Ingestion. Pathways of migration leading to ingestion of potential hazardous substances at the Emeryville Marketplace site are speculative. Groundwater from aquifers below the site is not consumed by humans at this time. Groundwater interaction with the bay is a more immediate concern since seafood from the bay is consumed by humans throughout the bay area and beyond. Furthermore, toxic contaminants often enter the food chain through low order marine life common to tidal flats around the perimeter of the bay.

3.3 RECOMMENDED AND ANTICIPATED HAZARDOUS CONSTITUENTS

Toxic threshold limits have been determined for approximately 600 of the over 60,000 chemical substances in recent use. Federal regulations list over 300 (EPA, Guidance on Remedial Investigations under CERCLA) considered as priority constituents (see Appendix C). Of these the EPA lists 14 inorganic and

organic substances as recommended under remedial investigations (see Table 3.1). The State of California, however, lists 20 inorganic elements and 18 organic compounds as priority hazardous constituents under Title 22, "California Environmental Health and Safety Code" (see Tables 3.2 and 3.3).

The primary concern over the presence of hazardous materials at this site is the possibility of groundwater pollution. The sample plan will, therefore, recommend further groundwater monitoring and soil borings so that tests can be made for possible contaminants present in both the soil and the groundwater beneath the site. These water samples should be thoroughly tested for the presence of any substance listed by the state (see Tables 3.2 and 3.3) in amounts exceeding the TTLC. Initial tests for organic compounds should be limited to determining the presence of halogenated compounds (total chlorines indicate presence of organochlorine compounds). If confirmed, GC/MS method should be employed to determine which compounds are likely to be found in hazardous quantities in the fill material at the site. These results will be used to determine those compounds of concern in subsequent soil samples.

In areas where tests on soil samples could facilitate preparation for grading and construction, initial screening for halogenated organics, as well as tests for the entire list of state recommended inorganic compounds, should be made concurrent with those for groundwater analysis. These results will facilitate the delineation of necessary tests on subsequent samples.

TABLE 3.2. TITLE 22 - CALIFORNIA ENVIRONMENTAL HEALTH AND SAFETY CODE - HAZARDOUS SUBSTANCES AND QUANTITIES - INORGANICS

CONSTITUENT	TTLC (mg/kg)	STLC (mg/liter)
Antimony	500	15.0
Arsenic	500	5.0
Asbestos	1	-
Barium	10,000	100.0
Beryllium	75	0.75
Cadmium	100	1.0
Hexavalent Chromium	500	5.0
Chromium/Trivalent Chromium	2,500	560.0
Cobalt	8,000	80.0
Copper	2,500	25.0
Fluoride	18,000	180.0
Lead	1,000	5.0
Mecury	20	0.2
Molybdenum	3,500	350.0
Nickle	2,000	20.0
Selenium	100	1.0
Silver	500	5.0
Thallium	700	7.0
Vanadium	2,400	24.0
Zinc	5,000	250.0

TTLC: Toxic threshold limit concentration.
STLC: Soluable threshold limit concentration.

TABLE 3.3. TITLE 22 - CALIFORNIA ENVIRONMENTAL HEALTH AND SAFETY CODE - HAZARDOUS SUBSTANCES AND QUANTITIES - ORGANICS

CONSTITUENT	TTLC (mg/kg)	STLC (mg/liter)
Aldrin	1.4	0.14
Chlorodane	2.5	0.25
DDT, DDE, DDD	1.0	0.10
2,4-D (Herbacide)	100.0	10.0
Dieldrin	8.0	0.8
Dioxin (2,3,7,8-TCDD)	0.01	0.001
Endrin	0.20	0.02
Heptachlor	4.7	0.47
Kepone	21.0	2.1
Lead Compounds (organic)	13.0	-
Undane	4.0	0.4
Methoxychlor	100.0	10.0
Mirex (Insecticide)	21.0	2.1
Pentachlorophenol (PCP)	17.0	1.7
PCB	50.0	5.0
Toxaphene	5.0	0.5
Trichloroethelene (TCE)	2,040.0	204.0
2,4,5-TP (Herbacide)	10.0	1.0

TTLC: Toxic threshold limit concentration.
STLC: Soluable threshold limit concentration.

4. SAMPLING STRATEGIES AND EQUIPMENT

4.1 SAMPLING STRATEGIES

COMPOSITE SOIL SAMPLING

Where appropriate, soils will be sampled using "composite" methods whereby a number of random samples are initially collected from a waste and combined into a single sample, which is then analyzed for the chemical contaminants of concern. Composite samples ensure accurate representation of the waste providing an adequate number of composite samples are taken.

Composite samples tend to minimize sample variation, just as results from maximizing the physical size of the sample. This will in turn minimize the number of samples that must be collected from the waste (EPA, Test Methods for Evaluating Solid Waste, 1982). Composite sampling is appropriate for exposed soils in stockpiles or foundation fill.

STRATIFIED RANDOM SAMPLING

For sampling of subsurface soils, composite sampling would be inappropriate and impractical. Instead, representative samples from identified strata will be collected. The appropriate number of samples to be collected from each stratum is described in the discussion of stratified random sampling (see Section 2). The number required is a function of the variability of contaminant levels within the material. Sample number in stratified random sampling is the analog to sample mass in composite sampling.

SPLIT SAMPLING

Randomly chosen samples (both soil and water) will be selected for split testing whereby the sample will be divided into two equal parts and parallel tests run separately. If requested, one of the sample splits will be submitted to the Alameda County Health Department for testing at a different facility to assure a nonbiased (precise) determination of accuracy.

CONTAINERS

Sample containers will be one liter wide mouth amber glass jars and brass tubes.

The sampling devices most commonly used for small piles are thiefs, triers, and shovels. Excavation equipment such as backhoes can be useful for sampling medium sized piles.

Subsurface and Foundation Fill in Place. Hollow stem augers combined with split spoon samplers are appropriate for sampling landfills. Water driven or water rinsed coring equipment should not be used for sampling since the water can rinse chemical components from the sample. Excavation equipment such as backhoes may be useful in obtaining samples at various depths; the resulting holes may be useful for viewing and recording the contents of the landfill.

Foundation fill material is approximately four to five feet thick and can be easily sampled by trenching with a backhoe and using a trier or scoop. In

this way composite samples can be taken over the entire interval exposed in order to more accurately represent the material as a whole. If a backhoe is not available, both foundation fill and subsurface fill material will be sampled using hollow stem augers with split spoon samplers.

MONITORING WELLS

For sampling potential contaminants in groundwater beneath the site, monitoring wells will be used. The existing monitoring wells will provide data on potential leached Title 22 heavy metals, hydrocarbons, and other contaminants in groundwater. Presence or absence of toxic substances in groundwater will be used to determine analytes for soils characterization.

BIOTA SAMPLING

Assessments of exposure or endangerment may require collection of flora and fauna as receptor organisms. The major drawback of receptor studies is the large uncertainty associated with uptake and dose mechanisms; cause and effect is very difficult to prove with any certainty. For this reason, in addition to the fact that biological receptors at the site consist of a thin strip of freeway landscaping, biological sampling is not planned for evaluation of this site. If groundwater monitoring reveals the presence of hazardous materials, particularly heavy metals, in considerable concentrations, then sampling of shellfish and low order marine life in the near shore bay environment closest to the site would be recommended.

HUMAN (WORKERS) MONITORING

As discussed in Section 2, Suspended Particulates, air quality monitoring devices will be carried by one or more construction workers at the site and results evaluated daily for lead and other particulates as may be indicated.

Trier

Scope and Application

A trier consists of a tube cut in half lengthwise with a sharpened tip that allows the sampler to cut into sticky solids and loosen soil. A trier samples moist or sticky solids with a particle diameter less than one-half the diameter of the trier.

Apparatus

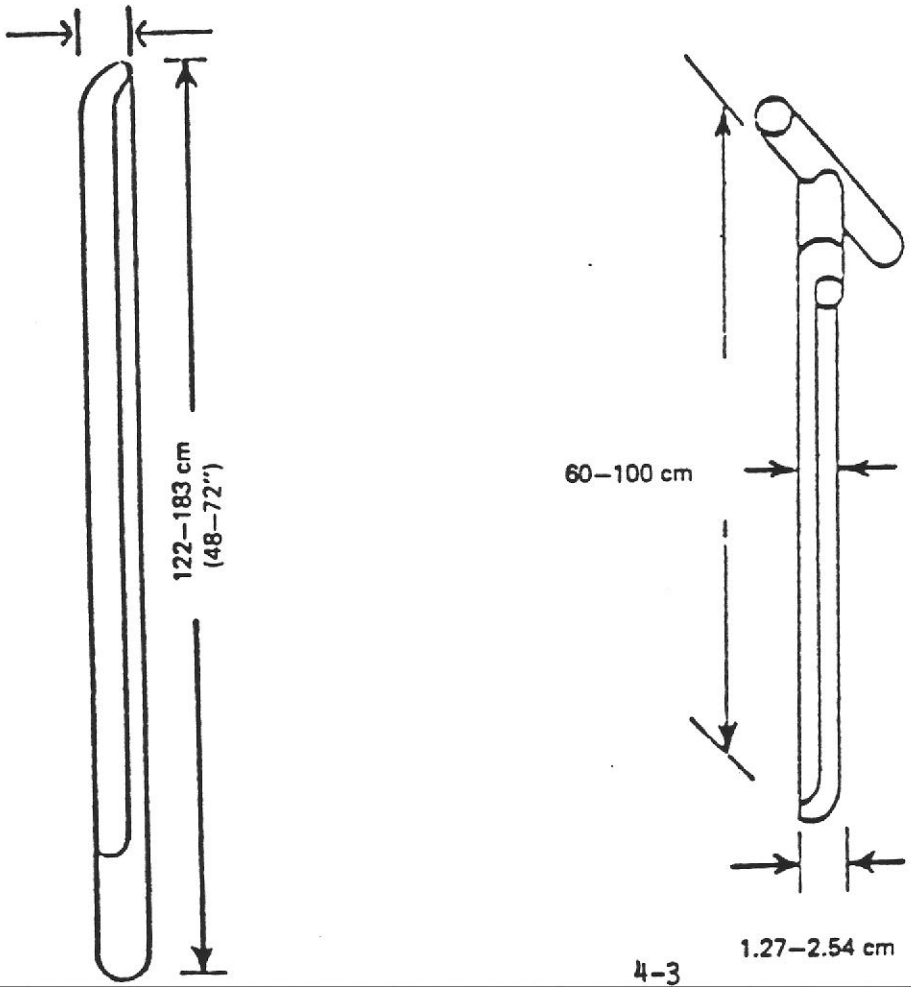
1. Triers 61 to 100 cm long and 1.27 to 2.54 cm in diameter are available at laboratory supply stores.

2. A large trier can be fabricated to conform to the specifications in Figure 5. A metal or polyvinyl chloride pipe, 1.52 m (5 ft) long x 3.2 cm (1.4 in.) I.D., with a 0.32-cm (1-1/8 in.) wall thickness, is needed. The pipe should be sawed lengthwise, about 60-40 split, to form a trough stretching from one end to 10 cm away from the other end. The edges of the slot and the tip of the pipe are sharpened to permit the sampler to cut into the waste material being sampled. The unsplit length of the pipe serves as the handle.

Procedure

1. Clean trier.

2. Insert trier into waste material 0 to 45° from horizontal. Rotate trier to cut a core of the waste. Remove trier with concave side up and transfer sample to container.



Auger

Scope and Application

An auger consists of sharpened spiral blades attached to a hard metal central shaft. An auger samples hard or packed solid wastes or soil.

Apparatus

Augers are available at hardware and laboratory supply stores.

Procedure

1. Clean sampler.

2. Bore a hole through the middle of an aluminum pie pan large enough to allow the blade of the auger to pass through. The pan will be used to catch the sample brought to the surface by the auger.

3. Place pan against the sampling point. Auger through the hole in the pan until the desired sampling depth is reached. Back off the auger and transfer the sample in the pan and adhering to the auger to a container. Spoon out the rest of the loosened sample with a sample trier.

Scoop and Shovel

Scope and Application

Scoops and shovels are used to sample granular or powdered material in bins, shallow containers and conveyor belts.

Apparatus

Scoops are available at laboratory supply houses. Flat-nosed shovels are available at hardware stores.

Procedure

1. Clean sampler.
2. Obtain a full cross section of the waste material using a scoop or shovel that is large enough to contain the waste collected in one cross section sweep.

Weighted Bottle

Scope and Application

This sampler consists of a glass or plastic bottle, sinker, stopper, and a line which is used to lower, raise, and open the bottle. The weighted bottle samples liquids and free-flowing slurries.

General Comments and Precautions

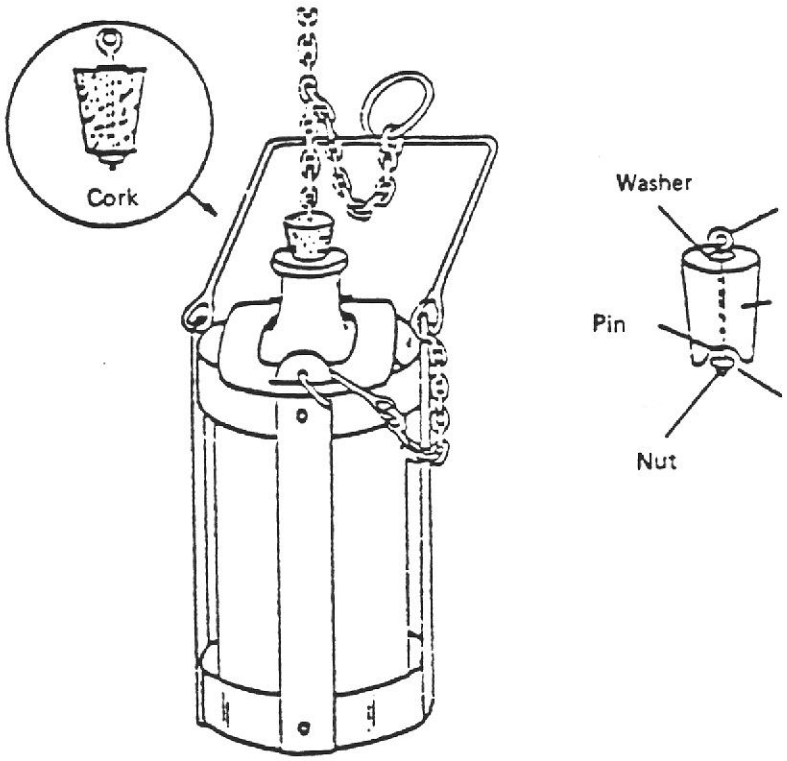
1. Do not use a nonfluorocarbon plastic bottle to sample wastes containing organic materials.
2. Do not use a glass bottle to sample wastes that contain hydrofluoric acid.
3. Before sampling, ensure that the waste will not corrode the sinker, bottle holder, or line.

Apparatus

A weighted bottle with line is built to the specifications in ASTM Methods D 270 and E 300. Figure shows the configuration of a weighted bottle sampler.

Procedure

1. Clean bottle.
2. Assemble weighted bottle sampler.
3. Lower the sampler to directed depth and pull out the bottle stopper by jerking the line.
4. Allow bottle to fill completely as evidenced by cessation of air bubbles.
5. Raise sampler, cap, and wipe off with a disposable cloth. The bottle can serve as a sample container.



Weighted bottle sampler.

Sample Labels

Sample labels (Figure 1) are necessary to prevent misidentification of samples. Gummed paper labels or tags are adequate and should include at least the following information:

Sample number

Name of collector

Date and time of collection

Place of collection

Labels should be affixed to sample containers prior to or at the time of sampling. The labels should be filled out at the time of collection.

erg

ENVIRONMENTAL RESEARCH GROUP, INC.

Client _____

Collection Date _____ Time _____

Sample Location _____

Sample I.D. _____

Collected By _____

For Laboratory Use
Project No. _____
Sample No. _____
_____ of _____
Date _____
S.L. _____

UNPRESERVED

Store Sample at 4°C

- ☐ BOD
- ☐ Br^-
- ☐ Cl^-
- ☐ F^-
- ☐ MBAS
- ☐ Spec. Cond.
- ☐ NO_3-N
- ☐ NO_2-N
- ☐ pH
- ☐ PO_4
- ☐ Cr^{+6}
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

Ann Arbor, MI (313) 662-3104 | Chicago, IL (312) 430-1112 | Cleveland, OH (216) 447-0790 | St. Paul, MN (612) 293-9268 | San Francisco, CA (415) 652-2300

Field Log Book

All information pertinent to a field survey or sampling must be recorded in a log book. This should be bound, preferably with consecutively numbered pages that are 21.6 by 27.9 cm (8-1/2 by 11 in.). As a minimum, entries in the log book must include the following:

Purpose of sampling (e.g., surveillance, contract number)

Location of sampling point

Name and address of field contact

Producer of waste and address, if different than location

Type of process (if known) producing waste

Type of waste (e.g., sludge, wastewater)

Suspected waste composition, including concentrations

Number and volume of sample taken

Description of sampling point and sampling methodology

Date and time of collection

Collector's sample identification number(s)

Sample distribution and how transported (e.g., name of laboratory, UPS, Federal Express)

References such as maps or photographs of the sampling site

Field observations

Any field measurements made (e.g., pH, flammability, explosivity)

Signatures of personnel responsible for observations

Documentation of Chain of Custody

An essential part of any sampling/analytical scheme is ensuring the integrity of the sample from collection to data reporting. This includes the ability to trace the possession and handling of samples from the time of collection through analysis and final disposition. This documentation of the history of the sample is referred to as Chain of Custody.

Chain of custody is necessary if there is any possibility that the analytical data or conclusions based upon analytical data will be used in litigation. In cases where litigation is not involved, many of the chain-of-custody procedures are still useful for routine control of sample flow. The components of chain of custody - sample seals, a field log book, chain-of-custody record, and sample analysis request sheet - and the procedures for their use are described in the following sections.

A sample is considered to be under a person's custody if (1) it is in a person's physical possession, (2) in view of the person after he has taken possession, (3) secured by that person so that no one can tamper with the sample, or (4) secured by that person in an area which is restricted to authorized personnel. A person who has samples under his custody must comply with the procedures described in the following sections.

The material presented here briefly summarizes the major aspects of chain of custody. The reader is referred to NEIC Policies and Procedures, EPA-330/9/78/001-R (as revised 1/82), or other manual as appropriate, for more information.

Chain-of-Custody Record

To establish the documentation necessary to trace sample possession from the time of collection, a chain-of-custody record should be filled out and accompany every sample. This record becomes especially important if the sample is to be introduced as evidence in a court litigation. A chain-of-custody record is illustrated in Figure 3.

The record should contain the following minimum information.

Sample number

Signature of collector

Date and time of collection

Place and address of collection

Waste type

Signature of persons involved in the chain of possession

Inclusive dates of possession

Sample Delivery to the Laboratory

The sample should be delivered to the laboratory for analysis as soon as practicable - usually within 1 or 2 days after sampling. The sample must be accompanied by the chain-of-custody record (Figure 3) and by a sample analysis request sheet (Figure 4). The sample must be delivered to the person in the laboratory authorized to receive samples (often referred to as the sample custodian).

5. PROPOSED WORK PLAN

This plan will evolve as new information is obtained from each phase of testing. Note that Halogenated Hydrocarbons EPA Test 9022 is a low cost method to evaluate possible contamination from Chlorinated Hydrocarbons. If the test indicates an existing contamination problem, more specific testing will be mandated.

The SW846 procedures for statistical analysis of test results and locations will serve as a guide in determining further test depths and locations. Previous test results and locations were provided by Woodward-Clyde Associates. Concurrence with the various agencies in regard to boring locations and sampling will be satisfied.

5.1 RECOMMENDED MONITORING WELLS

No new monitoring wells are proposed. Existing wells will be used to obtain up to four (4) water samples. Water samples will be tested for CAM metals and halogenated hydrocarbons. The recommended water sampling scope is subject to approval of Alameda County.

Proposed Testing. Sampling methods are described in Section 4.

WATER SAMPLES (Wells 4, 5, 10 and 12)

Heavy Metals: California Title 22, ICAP Method (Sb, As, Ba, Be, Cd, Cr (total), Co, Cu, F, Pb, Hg, Mo, Ni, Se, Ag, Tl, V, Zn). These results will determine the analytes of interest in all subsequent samples tested.

Halogenated Hydrocarbons: EPA Method 9022. These results will determine the necessity of testing for Chlorinated Hydrocarbons (EPA Method 8080 or GC/MS as needed for identification).

Total Hydrocarbon Response: (California Regional Water Quality Board, 1985). For supplemental information regarding Hydrocarbon Contamination Abatement program.

Cyanides: EPA Method 9010

Sulfides: EPA Method 9030

5.2 SOIL SAMPLING AND LABORATORY TESTS

Procedure. Stratified random sampling will be performed on this site as there are presently no stockpiles and foundation fills exposed. The plat (see Figure 5.1) has depicted our initial recommendations for soil borings (soil cores). Multiple depth soil samples will be collected for analysis. This recommended soil sampling scope is subject to approval of Alameda County.

PROPOSED TESTS FOR THE BORINGS AT THE MARKETPLACE SITE (see plat that details the proposed borings, Earth Metrics Draft Work Plan, Figure 5.1)

PROPOSED SOILS ANALYSIS			
BORING NO.	TPH (EPA 8015/3050)	CAM TTLC (19 TOXIC METALS SCAN)	HALOGENATED HYDROCARBONS
EM1	X	X	X
EM2	X	X	X
EM3		X	X
EM4		X	
EM5		X	
EM6		X	
EM7		X	X
EM8		X	X

PROPOSED WATER ANALYSIS (Sampling of Previously Installed Monitoring Wells)		
WELL NO.	CAM TTLC (19 TOXIC METALS SCAN)	HALOGENATED HYDROCARBONS
4	X	X
5	X	X
10	X	X
12	X	X

REFERENCES

Woodward-Clyde Associates, Assessment of Subsurface Contaminants, Marketplace Property, Emeryville, California (1982).

APPENDIX B.

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ENVIRONMENTAL LABORATORY

Peter D. Nance
Earth Metrics
859 Cowan Road
Burlingame, CA 94010

L A B O R A T O R Y R E S U L T S

Supply/Order No.:
Client's Survey No.:
Contract/PO No.: 02817
Release No.:

Laboratory Job No.: 874168
Date Received: 11/16/87
Date Reported: 12/03/87
Client Code: EART7

TOTAL OIL & GREASE(EPA 413.2)

MATRIX:SOIL FREON EX

LABNO	SMPLNO	COMPOUND	FOUND MG/KG	CA TTLC MG/KG	DET.LIM. MG/KG
25209	EM-1	OIL & GREASE	3960.0		150.00
25210	EM-1	OIL & GREASE	8100.0		150.00
25213	EM-2	OIL & GREASE	5831.3		149.78
25217	EM-4	OIL & GREASE	1233.8		29.85
25224	EM-8	OIL & GREASE	95.2		6.0
25225	EM-8	OIL & GREASE	<6.0		6.0

ANALYST:DAVE BUSCH

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L A B O R A T O R Y R E S U L T S

Laboratory Job No.: 874168

ASSAY:METAL SCAN BY ICP(EPA 6010)

LABNO	SMPLNO-ID	RESULTS			DET. LIM.
25208	EM1-1.5 SOIL			CA TTLC	
	AG	<0.4	MG/KG	500.000	0.4
	AS	DETECTED	MG/KG	500.000	4.0
	BA	127.3	MG/KG	10000.000	2.0
	BE	<0.2	MG/KG	75.000	0.2
	CD	2.53	MG/KG	100.000	0.10
	CO	7.8	MG/KG	8000.000	0.4
	CR	33.6	MG/KG	2500.000	0.4
	CU	37.3	MG/KG	2500.000	0.2
	HG	<1.0	MG/KG	20.000	1.0
	MN	370.2	MG/KG		0.2
	MO	<1.0	MG/KG	3500.000	1.0
	NI	31.4	MG/KG	2000.000	1.0
	PB	49.2	MG/KG	1000.000	1.0
	SB	<10.0	MG/KG	500.000	10.0
	SE	<4.0	MG/KG	100.000	4.0
	SN	DETECTED	MG/KG		2.0
	TL	<10.0	MG/KG	700.000	10.0
	V	25.9	MG/KG	2400.000	1.0
	ZN	93.3	MG/KG	5000.000	1.0
25209	EM1-3.5 SOIL			CA TTLC	
	AG	<0.4	MG/KG	500.000	0.4
	AS	DETECTED	MG/KG	500.000	4.0
	BA	145.6	MG/KG	10000.000	2.0
	BE	DETECTED	MG/KG	75.000	0.2
	CD	3.13	MG/KG	100.000	0.10
	CO	10.3	MG/KG	8000.000	0.4
	CR	56.7	MG/KG	2500.000	0.4
	CU	41.3	MG/KG	2500.000	0.2
	HG	<1.0	MG/KG	20.000	1.0
	MN	361.0	MG/KG		0.2

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LABNO	SMPLNO-ID		RESULTS			DET. LIM.
		MO	DETECTED	MG/KG	3500.000	1.0
		NI	41.1	MG/KG	2000.000	1.0
		PB	67.9	MG/KG	1000.000	1.0
		SB	<10.0	MG/KG	500.000	10.0
		SE	<4.0	MG/KG	100.000	4.0
		SN	26.7	MG/KG		2.0
		TL	<10.0	MG/KG	700.000	10.0
		V	25.8	MG/KG	2400.000	1.0
		ZN	142.3	MG/KG	5000.000	1.0
25210	EM1-5 SOIL				CA TTLC	
		AG	<0.4	MG/KG	500.000	0.4
		AS	<3.9	MG/KG	500.000	3.9
		BA	99.9	MG/KG	10000.000	2.0
		BE	<0.2	MG/KG	75.000	0.2
		CD	2.22	MG/KG	100.000	0.10
		CO	7.5	MG/KG	8000.000	0.4
		CR	39.8	MG/KG	2500.000	0.4
		CU	102.9	MG/KG	2500.000	0.2
		HG	<1.0	MG/KG	20.000	1.0
		MN	287.1	MG/KG		0.2
		MO	<1.0	MG/KG	3500.000	1.0
		NI	33.9	MG/KG	2000.000	1.0
		PB	47.1	MG/KG	1000.000	1.0
		SB	<9.9	MG/KG	500.000	9.9
		SE	<3.9	MG/KG	100.000	3.9
		SN	12.8	MG/KG		2.0
		TL	<9.9	MG/KG	700.000	9.9
		V	20.0	MG/KG	2400.000	1.0
		ZN	85.0	MG/KG	5000.000	1.0
25211	EM1-10 SOIL				CA TTLC	
		AG	<0.4	MG/KG	500.000	0.4
		AS	<4.0	MG/KG	500.000	4.0
		BA	118.5	MG/KG	10000.000	2.0
		BE	DETECTED	MG/KG	75.000	0.2
		CD	2.19	MG/KG	100.000	0.10
		CO	7.9	MG/KG	8000.000	0.4
		CR	50.1	MG/KG	2500.000	0.4
		CU	44.3	MG/KG	2500.000	0.2

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LABNO	SMPLNO-ID		RESULTS			DET. LIM.
		HG	<1.0	MG/KG	20.000	1.0
		MN	286.6	MG/KG		0.2
		MO	<1.0	MG/KG	3500.000	1.0
		NI	31.3	MG/KG	2000.000	1.0
		PB	63.2	MG/KG	1000.000	1.0
		SB	<9.9	MG/KG	500.000	9.9
		SE	<4.0	MG/KG	100.000	4.0
		SN	19.5	MG/KG		2.0
		TL	<9.9	MG/KG	700.000	9.9
		V	22.3	MG/KG	2400.000	1.0
		ZN	104.6	MG/KG	5000.000	1.0
25212	EM2-1.5 SOIL				CA TTLC	
		AG	<0.4	MG/KG	500.000	0.4
		AS	<4.0	MG/KG	500.000	4.0
		BA	93.3	MG/KG	10000.000	2.0
		BE	<0.2	MG/KG	75.000	0.2
		CD	2.22	MG/KG	100.000	0.10
		CO	6.4	MG/KG	8000.000	0.4
		CR	21.1	MG/KG	2500.000	0.4
		CU	24.2	MG/KG	2500.000	0.2
		HG	<1.0	MG/KG	20.000	1.0
		MN	213.9	MG/KG		0.2
		MO	<1.0	MG/KG	3500.000	1.0
		NI	25.2	MG/KG	2000.000	1.0
		PB	30.4	MG/KG	1000.000	1.0
		SB	<10.0	MG/KG	500.000	10.0
		SE	<4.0	MG/KG	100.000	4.0
		SN	<2.0	MG/KG		2.0
		TL	<10.0	MG/KG	700.000	10.0
		V	19.5	MG/KG	2400.000	1.0
		ZN	66.0	MG/KG	5000.000	1.0
25213	EM2-3.5 SOIL				CA TTLC	
		AG	<0.4	MG/KG	500.000	0.4
		AS	<4.0	MG/KG	500.000	4.0
		BA	133.6	MG/KG	10000.000	2.0
		BE	DETECTED	MG/KG	75.000	0.2
		CD	3.35	MG/KG	100.000	0.10
		CO	12.0	MG/KG	8000.000	0.4

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Laboratory Job No.: 874168

LABNO	SMPLNO-ID		RESULTS			DET. LIM.
		CR	32.2	MG/KG	2500.000	0.4
		CU	14.2	MG/KG	2500.000	0.2
		HG	<1.0	MG/KG	20.000	1.0
		MN	373.0	MG/KG		0.2
		MO	<1.0	MG/KG	3500.000	1.0
		NI	31.3	MG/KG	2000.000	1.0
		PB	<1.0	MG/KG	1000.000	1.0
		SB	<9.9	MG/KG	500.000	9.9
		SE	<4.0	MG/KG	100.000	4.0
		SN	<2.0	MG/KG		2.0
		TL	<9.9	MG/KG	700.000	9.9
		V	29.9	MG/KG	2400.000	1.0
		ZN	39.9	MG/KG	5000.000	1.0
25214	EM2-6.5 SOIL				CA TTLC	
		AG	<0.4	MG/KG	500.000	0.4
		AS	<4.0	MG/KG	500.000	4.0
		BA	131.4	MG/KG	10000.000	2.0
		BE	DETECTED	MG/KG	75.000	0.2
		CD	3.55	MG/KG	100.000	0.10
		CO	11.6	MG/KG	8000.000	0.4
		CR	30.9	MG/KG	2500.000	0.4
		CU	14.9	MG/KG	2500.000	0.2
		HG	<1.0	MG/KG	20.000	1.0
		MN	443.8	MG/KG		0.2
		MO	<1.0	MG/KG	3500.000	1.0
		NI	31.4	MG/KG	2000.000	1.0
		PB	<1.0	MG/KG	1000.000	1.0
		SB	<10.0	MG/KG	500.000	10.0
		SE	<4.0	MG/KG	100.000	4.0
		SN	<2.0	MG/KG		2.0
		TL	<10.0	MG/KG	700.000	10.0
		V	31.3	MG/KG	2400.000	1.0
		ZN	42.6	MG/KG	5000.000	1.0
25215	EM3-1.5 SOIL				CA TTLC	
		AG	<0.4	MG/KG	500.000	0.4
		AS	DETECTED	MG/KG	500.000	4.0
		BA	92.9	MG/KG	10000.000	2.0
		BE	DETECTED	MG/KG	75.000	0.2

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INSURANCE COMPANIES
Environmental Laboratory
3700 Lakeville Highway
Petaluma, CA 94952
800-227-0765
(California 800-227-5889)

ENVIRONMENTAL LABORATORY

L A B O R A T O R Y R E S U L T S

Laboratory Job No.: 874168

LABNO	SMPLNO-ID		RESULTS			DET. LIM.
		CD	6.27	MG/KG	100.000	0.10
		CO	10.4	MG/KG	8000.000	0.4
		CR	59.1	MG/KG	2500.000	0.4
		CU	176.2	MG/KG	2500.000	0.2
		HG	<1.0	MG/KG	20.000	1.0
		MN	506.6	MG/KG		0.2
		MO	6.2	MG/KG	3500.000	1.0
		NI	80.2	MG/KG	2000.000	1.0
		PB	30.5	MG/KG	1000.000	1.0
		SB	<10.0	MG/KG	500.000	10.0
		SE	<4.0	MG/KG	100.000	4.0
		SN	12.8	MG/KG		2.0
		TL	<10.0	MG/KG	700.000	10.0
		V	23.4	MG/KG	2400.000	1.0
		ZN	73.3	MG/KG	5000.000	1.0
25216	EM3-3 SOIL				CA TTLC	
		AG	<0.4	MG/KG	500.000	0.4
		AS	DETECTED	MG/KG	500.000	4.0
		BA	517.8	MG/KG	10000.000	2.0
		BE	DETECTED	MG/KG	75.000	0.2
		CD	3.26	MG/KG	100.000	0.10
		CO	8.4	MG/KG	8000.000	0.4
		CR	39.1	MG/KG	2500.000	0.4
		CU	52.4	MG/KG	2500.000	0.2
		HG	<1.0	MG/KG	20.000	1.0
		MN	375.0	MG/KG		0.2
		MO	DETECTED	MG/KG	3500.000	1.0
		NI	47.1	MG/KG	2000.000	1.0
		PB	85.2	MG/KG	1000.000	1.0
		SB	<10.0	MG/KG	500.000	10.0
		SE	<4.0	MG/KG	100.000	4.0
		SN	DETECTED	MG/KG		2.0
		TL	<10.0	MG/KG	700.000	10.0
		V	31.6	MG/KG	2400.000	1.0
		ZN	137.8	MG/KG	5000.000	1.0
25217	EM4-2.5 SOIL				CA TTLC	
		AG	DETECTED	MG/KG	500.000	0.4
		AS	14.3	MG/KG	500.000	3.9

DUPLICATE

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LABNO	SMPLNO-ID	RESULTS			DET. LIM.
	BA	98.6	MG/KG	10000.000	2.0
	BE	DETECTED	MG/KG	75.000	0.2
	CD	13.30	MG/KG	100.000	0.10
	CO	17.3	MG/KG	8000.000	0.4
	CR	146.2	MG/KG	2500.000	0.4
	CU	615.6	MG/KG	2500.000	0.2
	HG	<1.0	MG/KG	20.000	1.0
	MN	1594.5	MG/KG		0.2
	MO	18.2	MG/KG	3500.000	1.0
	NI	167.3	MG/KG	2000.000	1.0
	PB	60.0	MG/KG	1000.000	1.0
	SB	<9.9	MG/KG	500.000	9.9
	SE	<40.0	MG/KG	100.000	40.0
	SN	41.3	MG/KG		2.0
	TL	<9.9	MG/KG	700.000	9.9
	V	32.1	MG/KG	2400.000	1.0
	ZN	79.1	MG/KG	5000.000	1.0
25218	EM5-3.5 SOIL			CA TTLC	
	AG	<0.4	MG/KG	500.000	0.4
	AS	<4.0	MG/KG	500.000	4.0
	BA	75.0	MG/KG	10000.000	2.0
	BE	DETECTED	MG/KG	75.000	0.2
	CD	1.33	MG/KG	100.000	0.10
	CO	5.1	MG/KG	8000.000	0.4
	CR	15.9	MG/KG	2500.000	0.4
	CU	15.5	MG/KG	2500.000	0.2
	HG	<1.0	MG/KG	20.000	1.0
	MN	271.5	MG/KG		0.2
	MO	<1.0	MG/KG	3500.000	1.0
	NI	22.5	MG/KG	2000.000	1.0
	PB	5.8	MG/KG	1000.000	1.0
	SB	<10.0	MG/KG	500.000	10.0
	SE	<4.0	MG/KG	100.000	4.0
	SN	<2.0	MG/KG		2.0
	TL	<10.0	MG/KG	700.000	10.0
	V	16.1	MG/KG	2400.000	1.0
	ZN	38.0	MG/KG	5000.000	1.0
25219	EM5-5 SOIL			CA TTLC	

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LABNO	SMPLNO-ID	RESULTS			DET. LIM.
	AG	<0.4	MG/KG	500.000	0.4
	AS	<4.0	MG/KG	500.000	4.0
	BA	264.3	MG/KG	10000.000	2.0
	BE	1.4	MG/KG	75.000	0.2
	CD	5.31	MG/KG	100.000	0.10
	CO	16.5	MG/KG	8000.000	0.4
	CR	56.7	MG/KG	2500.000	0.4
	CU	29.4	MG/KG	2500.000	0.2
	HG	<1.0	MG/KG	20.000	1.0
	MN	1436.2	MG/KG		0.2
	MO	DETECTED	MG/KG	3500.000	1.0
	NI	110.8	MG/KG	2000.000	1.0
	PB	<1.0	MG/KG	1000.000	1.0
	SB	<10.0	MG/KG	500.000	10.0
	SE	<12.4	MG/KG	100.000	12.4
	SN	<2.0	MG/KG		2.0
	TL	<10.0	MG/KG	700.000	10.0
	V	41.8	MG/KG	2400.000	1.0
	ZN	64.8	MG/KG	5000.000	1.0
25220	EM6-1.5 SOIL			CA TTLC	
	AG	DETECTED	MG/KG	500.000	0.4
	AS	<3.9	MG/KG	500.000	3.9
	BA	119.0	MG/KG	10000.000	2.0
	BE	DETECTED	MG/KG	75.000	0.2
	CD	5.96	MG/KG	100.000	0.10
	CO	8.0	MG/KG	8000.000	0.4
	CR	125.0	MG/KG	2500.000	0.4
	CU	140.3	MG/KG	2500.000	0.2
	HG	<1.0	MG/KG	20.000	1.0
	MN	2533.9	MG/KG		0.2
	MO	5.8	MG/KG	3500.000	1.0
	NI	54.1	MG/KG	2000.000	1.0
	PB	20.0	MG/KG	1000.000	1.0
	SB	<9.8	MG/KG	500.000	9.8
	SE	<3.9	MG/KG	100.000	3.9
	SN	8.4	MG/KG		2.0
	TL	<9.8	MG/KG	700.000	9.8
	V	45.9	MG/KG	2400.000	1.0

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LABNO	SMPLNO-ID		RESULTS			DET. LIM.
		ZN	75.6	MG/KG	5000.000	1.0
25221	EM6-3	SOIL			CA TTLC	
		AG	DETECTED	MG/KG	500.000	0.4
		AS	DETECTED	MG/KG	500.000	4.0
		BA	141.7	MG/KG	10000.000	2.0
		BE	DETECTED	MG/KG	75.000	0.2
		CD	9.86	MG/KG	100.000	0.10
		CO	20.6	MG/KG	8000.000	0.4
		CR	141.8	MG/KG	2500.000	0.4
		CU	310.5	MG/KG	2500.000	0.2
		HG	<1.0	MG/KG	20.000	1.0
		MN	3102.4	MG/KG		0.2
		MO	9.5	MG/KG	3500.000	1.0
		NI	99.8	MG/KG	2000.000	1.0
		PB	45.0	MG/KG	1000.000	1.0
		SB	<9.9	MG/KG	500.000	9.9
		SE	<40.0	MG/KG	100.000	40.0
		SN	20.3	MG/KG		2.0
		TL	<9.9	MG/KG	700.000	9.9
		V	49.9	MG/KG	2400.000	1.0
		ZN	124.5	MG/KG	5000.000	1.0
25222	EM6-5	SOIL			CA TTLC	
		AG	<0.4	MG/KG	500.000	0.4
		AS	<4.0	MG/KG	500.000	4.0
		BA	86.3	MG/KG	10000.000	2.0
		BE	DETECTED	MG/KG	75.000	0.2
		CD	5.79	MG/KG	100.000	0.10
		CO	6.9	MG/KG	8000.000	0.4
		CR	60.7	MG/KG	2500.000	0.4
		CU	75.5	MG/KG	2500.000	0.2
		HG	<1.0	MG/KG	20.000	1.0
		MN	519.0	MG/KG		0.2
		MO	DETECTED	MG/KG	3500.000	1.0
		NI	42.8	MG/KG	2000.000	1.0
		PB	14.4	MG/KG	1000.000	1.0
		SB	<10.0	MG/KG	500.000	10.0
		SE	<4.0	MG/KG	100.000	4.0
		SN	DETECTED	MG/KG		2.0

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		TL	<10.0	MG/KG	700.000	10.0
		V	46.5	MG/KG	2400.000	1.0
		ZN	63.9	MG/KG	5000.000	1.0
25223	EM7-3	SOIL			CA TTLC	
		AG	<0.4	MG/KG	500.000	0.4
		AS	<4.0	MG/KG	500.000	4.0
		BA	45.3	MG/KG	10000.000	2.0
		BE	<0.2	MG/KG	75.000	0.2
		CD	1.29	MG/KG	100.000	0.10
		CO	4.3	MG/KG	8000.000	0.4
		CR	29.6	MG/KG	2500.000	0.4
		CU	7.7	MG/KG	2500.000	0.2
		HG	<1.0	MG/KG	20.000	1.0
		MN	191.2	MG/KG		0.2
		MO	<1.0	MG/KG	3500.000	1.0
		NI	24.1	MG/KG	2000.000	1.0
		PB	<1.0	MG/KG	1000.000	1.0
		SB	<9.9	MG/KG	500.000	9.9
		SE	<4.0	MG/KG	100.000	4.0
		SN	<2.0	MG/KG		2.0
		TL	<9.9	MG/KG	700.000	9.9
		V	18.0	MG/KG	2400.000	1.0
		ZN	22.4	MG/KG	5000.000	1.0
25224	EM8-3	SOIL			CA TTLC	
		AG	20.4	MG/KG	500.000	0.4
		AS	19.2	MG/KG	500.000	4.0
		BA	377.2	MG/KG	10000.000	2.0
		BE	<0.2	MG/KG	75.000	0.2
		CD	24.80	MG/KG	100.000	0.10
		CO	6.5	MG/KG	8000.000	0.4
		CR	133.3	MG/KG	2500.000	0.4
		CU	46819.0	MG/KG	2500.000*	0.2
		HG	40.1	MG/KG	20.000*	1.0
		MN	264.3	MG/KG		0.2
		MO	<1.0	MG/KG	3500.000	1.0
		NI	61.7	MG/KG	2000.000	1.0
		PB	2129.9	MG/KG	1000.000*	1.0
		SB	<10.0	MG/KG	500.000	10.0

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		SE	<39.8	MG/KG	100.000	39.8
		SN	140.7	MG/KG		2.0
		TL	<10.0	MG/KG	700.000	10.0
		V	23.9	MG/KG	2400.000	1.0
		ZN	24317.3	MG/KG	5000.000*	1.0
25225	EM8-5 SOIL				CA TTLC	
		AG	<0.4	MG/KG	500.000	0.4
		AS	<4.0	MG/KG	500.000	4.0
		BA	29.4	MG/KG	10000.000	2.0
		BE	<0.2	MG/KG	75.000	0.2
		CD	2.70	MG/KG	100.000	0.10
		CO	8.9	MG/KG	8000.000	0.4
		CR	34.0	MG/KG	2500.000	0.4
		CU	72.8	MG/KG	2500.000	0.2
		HG	<1.0	MG/KG	20.000	1.0
		MN	214.6	MG/KG		0.2
		MO	<1.0	MG/KG	3500.000	1.0
		NI	35.3	MG/KG	2000.000	1.0
		PB	7.6	MG/KG	1000.000	1.0
		SB	<10.0	MG/KG	500.000	10.0
		SE	<4.0	MG/KG	100.000	4.0
		SN	<2.0	MG/KG		2.0
		TL	<10.0	MG/KG	700.000	10.0
		V	22.8	MG/KG	2400.000	1.0
		ZN	77.5	MG/KG	5000.000	1.0

DETECTED=DETECTED BUT NOT QUANTITATED
QUANTITATION LIMIT=3.3- DETECTION LIMIT.

ANALYST:NANCY S.TESCHE

DUPLICATE