Pacific Gas and Electric Company

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May 20, 1999

Ms. Susan Hugo
Senior Hazardous Materials Specialist
Alameda County Health Agency
1131 Harbor Bay Parkway, 2nd Floor
Alameda, CA 94502

Subject: Groundwater Monitoring and Sampling Report, Fourth Quarter 1998
Former Aboveground Storage Tank Area, Emeryville, California

Dear Ms. Hugo:

Enclosed is a copy of the report, *Groundwater Monitoring and Sampling Report, Pacific Gas & Electric's Emeryville Materials Facility, 4525 Hollis Street, Emeryville, California, Fourth Quarter 1998.* The report summarizes the groundwater flow direction, hydraulic gradient, and the results of chemical analyses of groundwater samples collected in December 1998.

Findings of the groundwater monitoring performed during the fourth quarter 1998 include:

- *The depth to groundwater ranges from 9.86 to 13.18 feet below the surface. Groundwater flow was to the north with a gradient of 0.02 ft/ft between Wells ESE-2 and MW4, and to the north-northeast with a gradient of 0.07 ft/ft between Wells ESE-2 and ESE-1.*

- *All compounds were below the method-detection limit with the exception of the presence of mineral oil at a concentration of 180 µ/1 in an unfiltered sample from Well ESE-1. A duplicate sample of this well also collected and passed through a glass filter and silica gel cleaned prior to analysis. This sample contained no mineral oil above the method reporting limit.*

Please note that this quarterly sampling event included duplicates to compare analytical results for analysis using silica gel cleanup and glass filtration. A recent memorandum from the San Francisco Bay Regional Water Quality

Control Board regarding this procedure is included with this report. This methodology will be used in all subsequent reports. Should you have any questions or comments, please call me at 415/972-5719.

Sincerely,

Sue Fandel

Susan M. Fandel
Environmental Specialist

SMF:nem

cc: Mr. Derek Lee
San Francisco Regional Water Quality Control Board

Enclosure

TES

Groundwater Monitoring and Sampling Report

Former Aboveground Storage Tank
4525 Hollis Street
Emeryville, California

Fourth Quarter 1998

Prepared by

Technical and Ecological Services

March 1999

Report No.: 402.331-99.53

Pacific Gas and Electric Company
Technical and Ecological Services
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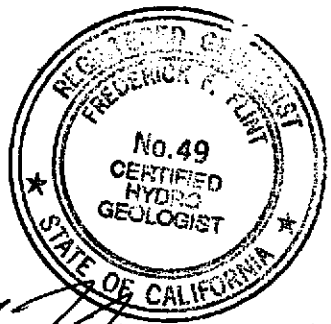
Legal Notice

Prepared by:

Karen S. Piini
Engineer

Approved by:



Frederick F. Flint
Certified Hydrogeologist

Korbin D. Creek
Acting Supervisor, Land and Water Quality Unit

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FIGURES

TABLES

1 INTRODUCTION

This report presents the results of groundwater monitoring performed during the fourth quarter 1998 in conjunction with the former above ground storage tank at the Pacific Gas and Electric Company (PG&E) Emeryville Maintenance Facility at 4525 Hollis Street in Emeryville, California (see Figure 1).

2 GROUNDWATER GRADIENT AND DIRECTION

Fourth quarter groundwater levels were measured at the PG&E Maintenance Facility in Emeryville, California, on December 1, 1998, in wells ESE-1, ESE-2, ESE-3, and MW-4, using an electronic sounding device, and recorded on the water level / floating product survey form included in Appendix A. The groundwater elevations are summarized in Table 1. Well ESE-4 has been abandoned and is no longer part of the monitoring well network. The December data were used to construct a groundwater contour map (see Figure 2). December water levels ranged from 11.50 feet above mean sea level (MSL) in well ESE-1 to 18.28 feet above MSL in well MW-4. The groundwater gradient is 0.02 foot per foot (ft/ft) to the north between monitoring wells ESE-2 and MW-4, and 0.07 ft/ft to the north-northeast between monitoring wells ESE-2 and ESE-1.

3 SAMPLING, ANALYSIS, AND MONITORING PROGRAM RESULTS

Groundwater samples were collected from wells ESE-1 through ESE-3 on December 1, 1998, consistent with the protocol presented in Figure 3, and analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) by U.S. Environmental Protection Agency (USEPA) Method 602; polychlorinated biphenyls (PCBs) by USEPA Method 8080; and total extractable petroleum hydrocarbons (TEPH) as mineral oil by USEPA Method 8015M. Temperature, pH, and electrical conductivity were measured in the field and recorded on the purging and sampling log sheets (see Appendix A). Field readings from the fourth quarter 1998 monitoring event are summarized in Table 1.

Beginning with the December 1998 sampling event, unfiltered and glass filtered groundwater samples will be collected from the Emeryville Maintenance Facility site and analyzed for PCBs and TEPH as mineral oil. Sample preparation for TEPH analysis will also include silica gel clean-up to remove non-petroleum hydrocarbons. The California Regional Water Quality Control Board (RWQCB) has approved this sample preparation procedure (see RWQCB letter dated February 16, 1999, Appendix C).

Fourth quarter 1998 and historical analytical data are summarized in Table 2. Certified analytical reports and chain-of-custody records are included in Appendix B. The analytical results are discussed below:

- BTEX was not detected at or above the method reporting limit (MRL) in samples collected from wells ESE-1 through ESE-3.
- PCBs were not detected at or above the method reporting limit (MRL) in the unfiltered or filtered samples collected from wells ESE-1 through ESE-3.
- Mineral oil was detected at a concentration of 180 micrograms per liter (µg/L) in the unfiltered sample collected from well ESE-1. It was not detected (< 100 µg/L) in the filtered sample collected from this well. Mineral oil was not detected in the unfiltered or filtered samples collected from wells ESE-2 and ESE-3.

4 FIELD LABORATORY QUALITY CONTROL RESULTS

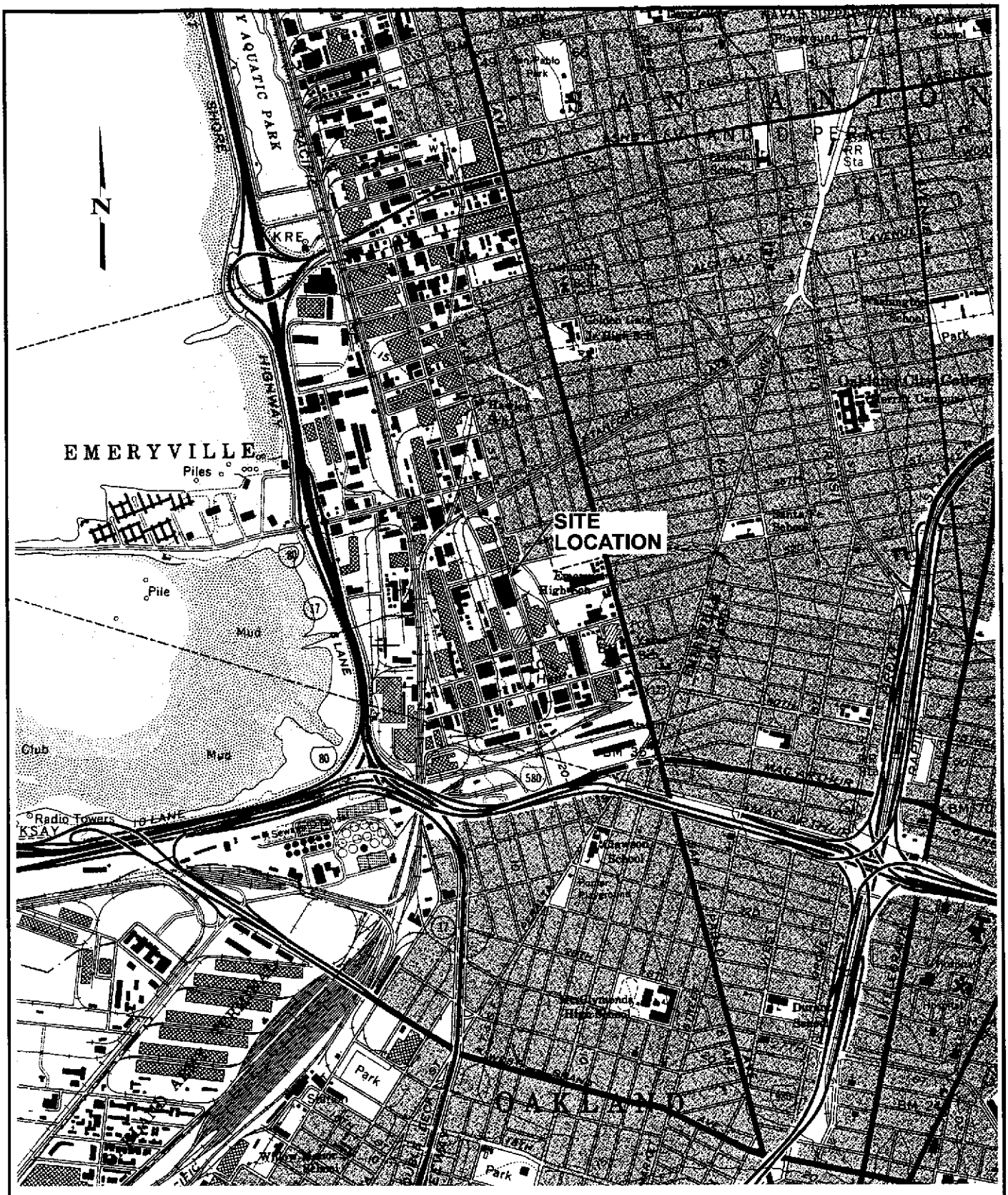
Analytical data were evaluated for accuracy and precision based on field and laboratory quality control (QC) sample performance. The field QC consisted of collecting one field blank (FB-1) and analyzing it for BTEX.

Field blanks are collected to assess the effect of field environments on the analytical results and to identify false positives. No parameters were detected above their respective MRLs in the field blank, indicating no adverse effects from sampling procedures.

The laboratory QC consisted of checking adherence to holding times and evaluating method blanks and matrix spike (MS) results. Holding times are established by the USEPA and refer to the maximum time allowed to pass between sample collection and analysis by the laboratory. These limits assist in determining data validity. The method blank results are used to assess the effect of the laboratory environment on the analytical results. The MS recoveries are used to assess accuracy.

All analyses were done within the holding times specified by the USEPA. No compounds were detected in the daily method blanks. The MS results were within the laboratory acceptance limits.

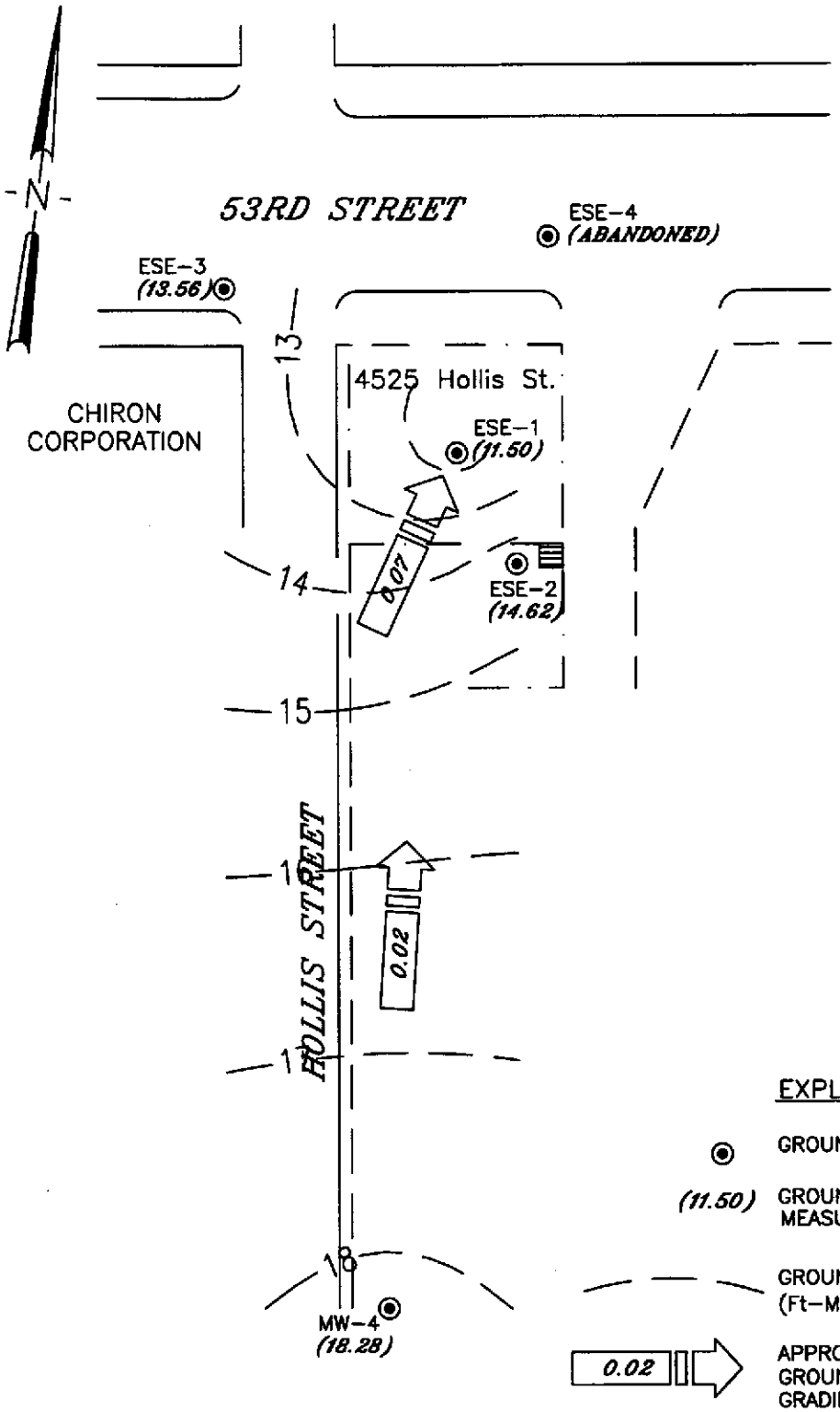
The field and laboratory QC results indicate that the analytical data are of acceptable quality.



Base map from U.S. Geological Survey 7.5 minute series.
Quadrangle: Oakland West, Calif.

Figure 1. Site Location Map of Emeryville Service Center

grndwtr/serv-ctr/emeryville



PG&E	Emeryville Maintenance Facility Groundwater Contour Map – December 1, 1998	DRN:LKE	DATE : 1-13-99
		CHK:F. Flint	SCALE: As Shown
		APR:KDC	SHEET Emeryville
	TECHNICAL AND ECOLOGICAL SERVICES – LWQU	FIGURE 2	REV. 0

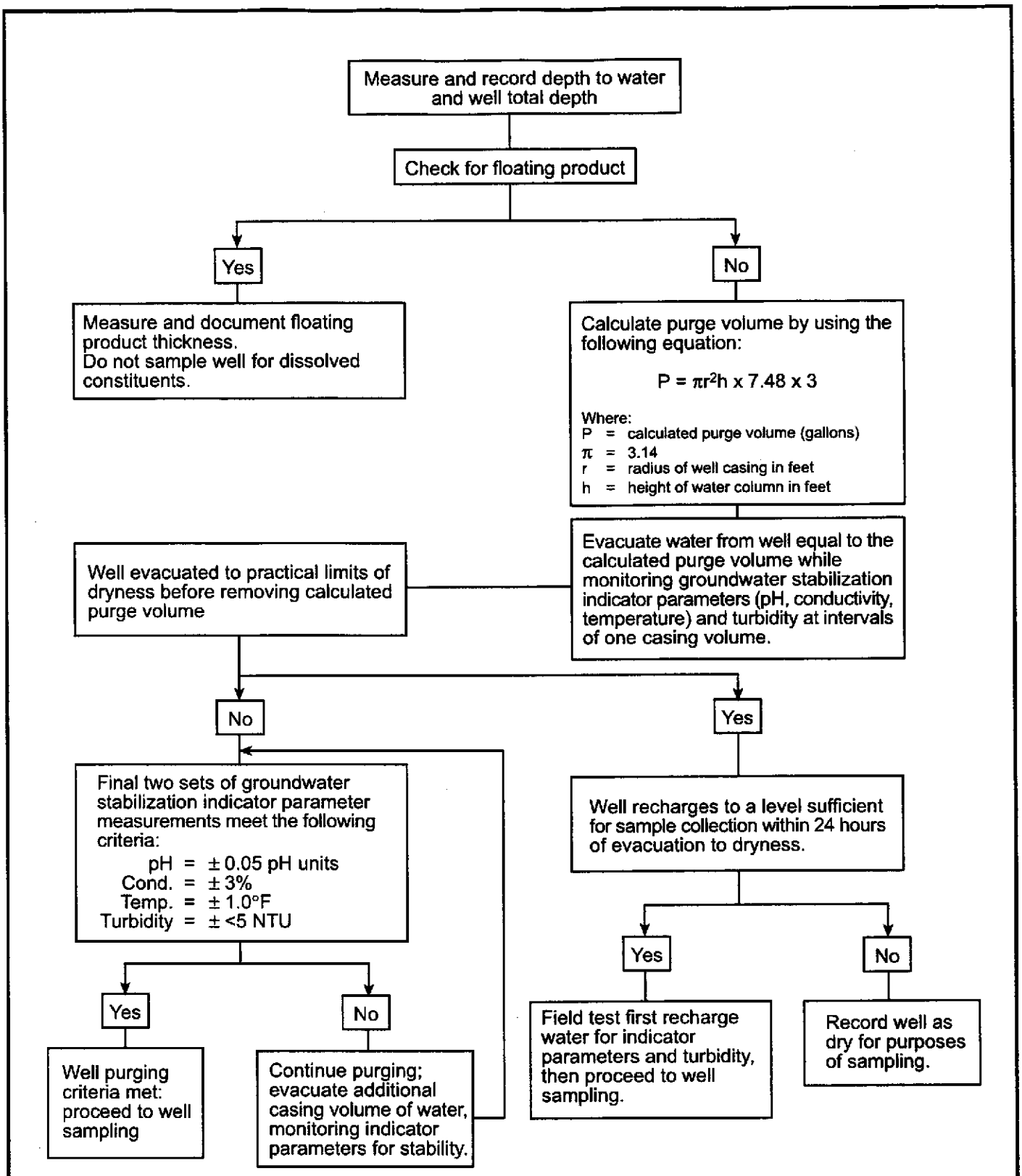


Figure 3. Monitoring Well Purging Protocol

grndwtr/protocol

Table 1
Field Measurements
Fourth Quarter 1998 and Historical Data
Pacific Gas and Electric Company
Emeryville, California

Sample Designation	Date	Top-of-Casing Elevation (ft/MSL)[1]	Depth to Water (feet)	Groundwater Elevation (ft/MSL)	Measured Well Depth (feet)	pH (units)	Temperature (°F)	Electrical Conductivity (umhos/cm)
ESE-1	03/28/94	23.66	10.06	13.60	20.8	8.48	73.1	600
ESE-1	04/07/94	23.66	10.22	13.44	NM[3]	NS[4]	NS	NS
ESE-1	12/12/94	23.66	9.18	14.48	30.6	7.26	63.4	588
ESE-1	03/13/95	23.66	8.20	15.46	30.6	7.33	63.3	548
ESE-1	06/15/95	23.66	9.50	14.16	30.6	6.90	64	505
ESE-1	09/15/95	23.66	10.13	13.53	30.6	6.80	65.1	505
ESE-1	12/15/95	23.66	10.55	13.11	33.8	7.04	65.1	511
ESE-1	03/15/96	23.66	11.79	11.87	33.6	6.94	64.9	540
ESE-1	06/14/96	23.66	12.68	10.98	33.6	6.93	67.4	517
ESE-1	10/07/96	23.66	12.56	11.10	34.0	6.94	73.3	494
ESE-1	12/04/96	23.66	12.67	10.99	34.2	6.80	64.4	507
ESE-1	02/14/97	23.66	12.62	11.04	34.2	6.96	67.5	509
ESE-1	05/16/97	23.66	13.05	10.61	34.2	7.07	69.0	534
ESE-1	08/22/97	23.66	12.60	11.06	34.0	6.32	67.4	597
ESE-1	11/14/97	23.66	12.32	11.34	33.7	7.35	65.9	600
ESE-1	02/13/98	23.66	10.61	13.05	33.7	7.21	61.8	621
ESE-1	05/15/98	23.66	12.64	11.02	33.7	7.19	68.0	598
ESE-1	08/21/98	23.66	12.61	11.05	33.6	7.15	68.2	603
ESE-1	12/01/98	23.66	12.16	11.50	33.2	6.86	66.7	483
ESE-2	03/28/94	27.80	10.13	17.67	34.2	7.67	67.5	580
ESE-2	04/07/94	27.80	14.37	13.43	NM	NS	NS	NS
ESE-2	12/12/94	27.80	13.05	14.75	34.3	7.05	64.6	610
ESE-2	03/13/95	27.80	12.48	15.32	34.3	7.19	62.5	596
ESE-2	06/15/95	27.80	13.85	13.95	34.3	7.02	65.1	601
ESE-2	09/15/95	27.80	14.22	13.58	34.3	6.91	65.6	627
ESE-2	12/15/95	27.80	11.65	16.15	34.1	7.12	64.7	591
ESE-2	03/15/96	27.80	12.87	14.93	34.1	7.01	65.8	669

Table 1
Field Measurements
Fourth Quarter 1998 and Historical Data
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Emeryville, California

Sample Designation	Date	Top-of-Casing Elevation (ft/MSL)[1]	Depth to Water (feet)	Groundwater Elevation (ft/MSL)	Measured Well Depth (feet)	pH (units)	Temperature (°F)	Electrical Conductivity (umhos/cm)
ESE-2	06/14/96	27.80	13.94	13.86	34.1	7.08	67.1	607
ESE-2	10/07/96	27.80	13.58	14.22	34.0	7.10	74.6	558
ESE-2	12/04/96	27.80	14.20	13.60	34.4	6.89	65.0	618
ESE-2	02/14/97	27.80	13.80	14.00	34.4	7.02	66.3	578
ESE-2	05/16/97	27.80	14.07	13.73	34.4	7.00	69.9	580
ESE-2	08/22/97	27.80	14.35	13.45	34.4	6.49	66.1	623
ESE-2	11/14/97	27.80	13.80	14.00	34.4	7.23	66.8	649
ESE-2	02/13/98	27.80	11.52	16.28	34.4	7.15	62.4	646
ESE-2	05/15/98	27.80	13.56	14.24	34.4	7.29	68.7	611
ESE-2	08/21/98	27.80	13.63	14.17	34.4	7.21	67.1	603
ESE-2	12/01/98	27.80	13.18	14.62	34.1	6.88	71.8	516
ESE-3	03/28/94	23.91	11.23	12.68	30.9	7.47	68.7	610
ESE-3	04/07/94	23.91	11.29	12.62	NM	NS	NS	NS
ESE-3	12/12/94	23.91	10.62	13.29	31.0	7.19	63.9	600
ESE-3	03/13/95	23.91	9.45	14.46	31.0	6.99	62.5	600
ESE-3	06/15/95	23.91	10.27	13.64	31.0	7.10	64.9	556
ESE-3	09/15/95	23.91	10.87	13.04	31.0	6.96	65.5	559
ESE-3	12/19/95	23.91	9.40	14.51	31.0	7.28	64.2	556
ESE-3	03/15/96	23.91	10.02	13.89	30.9	7.01	65.0	583
ESE-3	06/14/96	23.91	10.63	13.28	30.9	7.09	67.0	546
ESE-3	10/07/96	23.91	10.85	13.06	31.0	6.87	68.8	514
ESE-3	12/04/96[5]	23.91	10.67	13.24	30.9	NM	NM	NM
ESE-3	02/14/97	23.91	10.75	13.16	30.9	7.01	65.9	506
ESE-3	05/16/97	23.91	10.99	12.92	31.0	7.40	69.9	539
ESE-3	08/22/97	23.91	10.65	13.26	31.0	6.86	66.6	563
ESE-3	11/14/97	23.91	10.50	13.41	31.0	7.47	65.8	583
ESE-3	02/13/98	23.91	9.32	14.59	31.0	7.04	63.7	602

Table 1
Field Measurements
Fourth Quarter 1998 and Historical Data
Pacific Gas and Electric Company
Emeryville, California

Sample Designation	Date	Top-of-Casing Elevation (ft/MSL)[1]	Depth to Water (feet)	Groundwater Elevation (ft/MSL)	Measured Well Depth (feet)	pH (units)	Temperature (°F)	Electrical Conductivity (umhos/cm)
ESE-3	05/15/98	23.91	10.72	13.19	31.0	7.42	67.8	593
ESE-3	08/21/98	23.91	10.65	13.26	31.0	6.95	65.8	600
ESE-3	12/01/98	23.91	10.35	13.56	30.8	6.92	65.5	489
ESE-4	03/28/94	24.33	10.63	13.70	31.4	7.77	66.3	610
ESE-4	04/07/94	24.33	10.85	13.48	NM	NS	NS	NS
ESE-4	12/12/94	24.33	9.63	14.70	31.6	7.11	63.1	591
ESE-4	03/13/95	24.33	8.90	15.43	31.6	7.16	61.2	595
ESE-4	06/15/95	24.33	9.81	14.52	31.6	7.05	64.1	565
ESE-4	09/15/95	24.33	10.85	13.48	31.6	7.01	66.3	584
ESE-4	12/15/95	24.33	8.72	15.61	31.6	7.05	64.6	555
ESE-4	03/15/96	24.33	9.29	15.04	31.5	7.01	63.7	600
ESE-4	06/14/96	24.33	10.23	14.10	31.5	7.04	66.0	591
ESE-4	10/07/96	24.33	10.44	13.89	31.5	6.89	70.1	541
ESE-4	12/04/96[5]	24.33	10.31	14.02	31.5	NM	NM	NM
ESE-4	02/14/97	24.33	10.12	14.21	31.5	7.11	65.3	511
ESE-4	05/16/97	24.33	10.56	13.77	31.6	7.40	69.1	559
ESE-4	08/22/97[5]	24.33	NM	NM	NM	NM	NM	NM
ESE-4	11/14/97	24.33	10.20	14.13	31.5	7.52	65.5	576
ESE-4	02/13/98[6]	24.33	NM	NM	NM	NM	NM	NM
ESE-4	Well Abandoned							
MW-4	03/13/95	28.14	9.84	18.30	14.7	NS	NS	NS
MW-4	06/15/95	28.14	10.74	17.40	14.7	NS	NS	NS
MW-4	09/15/95	28.14	10.90	17.24	14.7	NS	NS	NS
MW-4	12/15/95	28.14	6.53	21.61	14.7	NS	NS	NS
MW-4	03/15/96	28.14	8.12	20.02	14.7	NS	NS	NS

Table 1
Field Measurements
Fourth Quarter 1998 and Historical Data
Pacific Gas and Electric Company
Emeryville, California

Sample Designation	Date	Top-of-Casing Elevation (ft/MSL)[1]	Depth to Water (feet)	Groundwater Elevation (ft/MSL)	Measured Well Depth (feet)	pH (units)	Temperature (°F)	Electrical Conductivity (umhos/cm)
MW-4	06/14/96	28.14	10.78	17.36	14.7	NS	NS	NS
MW-4	10/07/96	28.14	10.81	17.33	14.7	NS	NS	NS
MW-4	12/04/96	28.14	10.44	17.70	14.7	NS	NS	NS
MW-4	02/14/97	28.14	10.41	17.73	14.7	NS	NS	NS
MW-4	05/16/97	28.14	10.78	17.36	14.7	NS	NS	NS
MW-4	08/22/97	28.14	10.55	17.59	14.7	NS	NS	NS
MW-4	11/14/97	28.14	10.15	17.99	14.7	NS	NS	NS
MW-4	02/13/98	28.14	9.75	18.39	14.7	NS	NS	NS
MW-4	05/15/98	28.14	10.29	17.85	14.7	NS	NS	NS
MW-4	08/21/98	28.14	10.65	17.49	14.7	NS	NS	NS
MW-4	12/01/98	28.14	9.86	18.28	14.5	NS	NS	NS

[1] ft/MSL = feet relative to mean sea level.
[2] umhos/cm = micromhos per centimeter at 77°F.
[3] NM = not measured.
[4] NS = not sampled.
[5] Wells not sampled due to construction in the area resulting in heavy traffic.
[6] Unable to locate well. Well area covered with mud and crushed rock from road construction.

Table 2
Analytical Data
Fourth Quarter 1998 and Historical Data
Pacific Gas and Electric Company
Emeryville, California
(µg/L) [1]

Sample Designation	Sampling Date	Polychlorinated Biphenols	TEPH[2]	Benzene	Toluene	Ethylbenzene	Xylenes
ESE-1	03/28/94	<1	340	<0.3	<0.3	<0.3	<0.3
ESE-1	12/12/94	<0.5	80	<0.5	<0.5	<0.5	<0.5
ESE-1	03/13/95	1.3	500 [3]	<0.5	<0.5	<0.5	<0.5
ESE-1	06/15/95	<0.5	350 [3]	<0.5	<0.5	<0.5	<0.5
ESE-1	09/15/95	<0.5	470 [3]	<0.5	<0.5	<0.5	<0.5
ESE-1	12/15/95	<0.5	440 [3]	<0.5	<0.5	<0.5	<0.5
ESE-1	03/15/96	<0.5	277	<0.5	<0.5	<0.5	<0.5
ESE-1	06/14/96	<0.5	<500	<0.5	<0.5	<0.5	<0.5
ESE-1	10/07/96	<0.5	110 [4]	<0.5	<0.5	<0.5	<0.5
ESE-1	12/04/96	<0.5	430 [4]	<0.5	<0.5	<0.5	<0.5
ESE-1	02/14/97	<0.5	1,600	<0.5	<0.5	<0.5	<0.5
ESE-1	05/16/97	<0.5	510 [8]	<0.5	<0.5	<0.5	<0.5
ESE-1	08/22/97	<0.5	740 [8]	<0.5	<0.5	<0.5	<0.5
ESE-1	11/14/97	<0.5	410 [8]	<0.5	<0.5	<0.5	<0.5
ESE-1	02/13/98	<0.5	<100 [8]	<0.5	<0.5	<0.5	<0.5
ESE-1	05/15/98	<0.5	<500	<0.5	<0.5	<0.5	<0.5
ESE-1	08/21/98	<0.5	<500	<0.5	<0.5	<0.5	<0.5
ESE-1	12/01/98	<0.50 / <0.54 [A]	180 / <100 [A]	<0.50	<0.50	<0.50	<0.50
ESE-2	03/28/94	<1	250	0.8	1.5	<0.3	2.7
ESE-2	12/12/94	<0.5	<50	<0.5	<0.5	<0.5	<0.5
ESE-2	03/13/95	<0.5	120 [5]	<0.5	<0.5	<0.5	<0.5
ESE-2	06/15/95	<0.5	<50	<0.5	<0.5	<0.5	<0.5
ESE-2	09/15/95	<0.5	<50	<0.5	<0.5	<0.5	<0.5
ESE-2	12/15/95	<0.5	<50	<0.5	<0.5	<0.5	<0.5
ESE-2	03/15/96	<0.5	<59	<0.5	<0.5	<0.5	<0.5
ESE-2	06/14/96	<0.5	<500	<0.5	<0.5	<0.5	<0.5
ESE-2	10/07/96	<0.5	150 [4]	<0.5	<0.5	<0.5	<0.5

Table 2
Analytical Data
Fourth Quarter 1998 and Historical Data
Pacific Gas and Electric Company
Emeryville, California
(µg/L) [1]

Sample Designation	Sampling Date	Polychlorinated Biphenols	TEPH[2]	Benzene	Toluene	Ethylbenzene	Xylenes
ESE-2	12/04/96	<0.5	380 [4]	<0.5	<0.5	<0.5	<0.5
ESE-2	02/14/97	<0.5	510	<0.5	<0.5	<0.5	<0.5
ESE-2	05/16/97	<0.5	190 [8]	<0.5	<0.5	<0.5	<0.5
ESE-2	08/22/97	<0.5	<100 [8]	<0.5	<0.5	0.51	<0.5
ESE-2	11/14/97	<0.52	<100 [8]	<0.5	<0.5	<0.5	<0.5
ESE-2	02/13/98	<0.5	<100 [8]	<0.5	<0.5	<0.5	<0.5
ESE-2	05/15/98	<0.5	<500	<0.5	<0.5	<0.5	<0.5
ESE-2	08/21/98	<0.5	<500	<0.5	<0.5	<0.5	<0.5
ESE-2	12/01/98	<0.50 / <0.54 [A]	<100 / <100 [A]	<0.50	<0.50	<0.50	<0.50
ESE-3	03/28/94	<1	<50	<0.3	<0.3	<0.3	<0.3
ESE-3	12/12/94	<0.5	<50	<0.5	<0.5	<0.5	<0.5
ESE-3	03/13/95	<0.5	<50	<0.5	<0.5	<0.5	<0.5
ESE-3	06/15/95	<0.5	<50	<0.5	<0.5	<0.5	<0.5
ESE-3	09/15/95	<0.5	<50	<0.5	<0.5	<0.5	<0.5
ESE-3	12/15/95	<0.5	<50	<0.5	<0.5	<0.5	<0.5
ESE-3	03/15/96	<0.5	<59	<0.5	<0.5	<0.5	<0.5
ESE-3	06/14/96	<0.5	<500	<0.5	<0.5	<0.5	<0.5
ESE-3	10/07/96	<0.5	<100	<0.5	<0.5	<0.5	<0.5
ESE-3	12/04/96 [6]	NA [7]	NA	NA	NA	NA	NA
ESE-3	02/14/97	<0.5	<100	<0.5	<0.5	<0.5	<0.5
ESE-3	05/16/97	<0.5	<110 [8]	<0.5	<0.5	<0.5	<0.5
ESE-3	08/22/97	<0.5	<100 [8]	<0.5	<0.5	<0.5	<0.5
ESE-3	11/14/97	<0.5	<100 [8]	<0.5	<0.5	<0.5	<0.5
ESE-3	02/13/98	<0.5	<100 [8]	<0.5	<0.5	<0.5	<0.5
ESE-3	05/15/98	<0.5	<500	<0.5	<0.5	<0.5	<0.5
ESE-3	08/21/98	<0.5	<500	<0.5	<0.5	<0.5	<0.5
ESE-3	12/01/98	<0.50 / <0.53 [A]	<100 / <100 [A]	<0.50	<0.50	<0.50	<0.50

Table 2
Analytical Data
Fourth Quarter 1998 and Historical Data
Pacific Gas and Electric Company
Emeryville, California
(µg/L) [1]

Sample Designation	Sampling Date	Polychlorinated Biphenols	TEPH[2]	Benzene	Toluene	Ethylbenzene	Xylenes
ESE-4	03/28/94	<1	<50	<0.3	<0.3	<0.3	<0.3
ESE-4	12/12/94	<0.5	<50	<0.5	<0.5	<0.5	<0.5
ESE-4	03/13/95	<0.5	56 [5]	<0.5	<0.5	<0.5	<0.5
ESE-4	06/15/95	<0.5	<50	<0.5	<0.5	<0.5	<0.5
ESE-4	09/15/95	<0.5	<50	<0.5	<0.5	<0.5	<0.5
ESE-4	12/15/95	<0.5	57 [5]	<0.5	<0.5	<0.5	<0.5
ESE-4	03/15/96	<0.5	<59	<0.5	<0.5	<0.5	<0.5
ESE-4	06/14/96	<0.5	<500	<0.5	<0.5	<0.5	<0.5
ESE-4	10/07/96	<0.5	<100	<0.5	<0.5	<0.5	<0.5
ESE-4	12/04/96 [6]	NA	NA	NA	NA	NA	NA
ESE-4	02/14/97	<0.5	270 [4]	<0.5	<0.5	<0.5	<0.5
ESE-4	05/16/97	<0.5	<110 [8]	<0.5	<0.5	<0.5	<0.5
ESE-4	08/22/97 [6]	NA	NA	NA	NA	NA	NA
ESE-4	11/14/97	<0.5	<100 [8]	<0.5	<0.5	<0.5	<0.5
ESE-4	02/13/98 [9]	NA	NA	NA	NA	NA	NA
ESE-4	05/15/98 [9]	NA	NA	NA	NA	NA	NA
ESE-4	08/21/98 [9]	NA	NA	NA	NA	NA	NA
ESE-4	12/1/98 [9]	NA	NA	NA	NA	NA	NA
Trip Blank	03/28/94	<1	<50	<0.3	<0.3	<0.3	<0.3
Trip Blank	12/12/94	NA	NA	<0.5	<0.5	<0.5	<0.5
Trip Blank	03/13/95	NA	NA	<0.5	<0.5	<0.5	<0.5
Trip Blank	06/15/95	NA	NA	<0.5	<0.5	<0.5	<0.5
Trip Blank	09/15/95	NA	NA	<0.5	<0.5	<0.5	<0.5
Trip Blank	12/15/95	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	03/28/94	NA	NA	NA	NA	NA	NA
Field Blank	12/12/94	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	03/13/95	NA	NA	<0.5	<0.5	<0.5	<0.5

Table 2
Analytical Data
Fourth Quarter 1998 and Historical Data
Pacific Gas and Electric Company
Emeryville, California
(µg/L) [1]

Sample Designation	Sampling Date	Polychlorinated Biphenols	TEPH[2]	Benzene	Toluene	Ethylbenzene	Xylenes
Field Blank	06/15/95	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	09/15/95	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	12/15/95	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	03/15/96	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	06/14/96	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	10/07/96	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	12/04/96	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	02/14/97	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	05/16/97	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	08/22/97	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	11/14/97	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	02/13/98	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	05/15/98	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	08/21/98	NA	NA	<0.5	<0.5	<0.5	<0.5
Field Blank	12/01/98	NA	NA	<0.50	<0.50	<0.50	<0.50

[1] µg/L = micrograms per liter.
[2] TEPH = total extractable petroleum hydrocarbons.
[3] Compounds similar to client-supplied transformer oil were found.
[4] Hydrocarbon reported does not match the pattern of laboratory standard for mineral oil.
[5] Compounds in diesel range not similar to laboratory standard for transformer oil.
[6] Wells not sampled due to construction in the area resulting in heavy traffic.
[7] NA = not analyzed.
[8] Quantitation for mineral oil is based on the response factor of diesel.
[9] Unable to locate well. Well area covered with mud and crushed rock from road construction.
[A] Analyses run on both unfiltered and filtered (silica gel) samples. Results reported as unfiltered / filtered.

Appendix A

WATER LEVEL / FLOATING PRODUCT SURVEY FORM AND PURGING AND SAMPLING LOG SHEETS

FIELD REPORT
WATER LEVEL / FLOATING PRODUCT SURVEY
PG&E TECHNICAL AND ECOLOGICAL SERVICES

Site Location: Emeryville Svc. Center

Survey Date: 12/1/98

Sampler: Don Bryant

Well ID	Casing Elevation (ft, MSL)	Time of Level	Total Depth (ft)	Depth to Water (ft)	Depth to Floating Product (ft)	Floating Product Thickness (ft)	Dissolved Oxygen (mg/L	Temp. (°C)	Comments
ESE-1	—	1121	33.15	12.16	—	—	—	—	~~½" bolts~~
ESE-2	—	1117	34.10	13.18	—	—	—	—	½" bolts
ESE-3	—	1058	30.84	10.35	—	—	—	—	
ESE-4	—	~~+~~	~~+~~	~~9.86~~					Abandoned
MW-4		1112	14.51	9.86	—	—	—	—	13/16 bolts
~~ESE-3~~									
~~ESE-3~~									

Comments:

Don Bryant
Signature

PG & E PURGING AND SAMPLING LOG

SITE Emeryville JOB ID 005200 0E1 WELL # ESE-1

PURGE DATE 12/11/98 BY NB WEATHER Clear

SAMPLE DATE 12/11/98 BY NB

WATER ELEVATION / VOLUME CALCULATIONS

MEASURING POINT (MP) TOC @ mark (notch) HYDROCARBON ODOR YES (NO)

DEPTH OF WELL (DTB) 33.15 FT THICKNESS

DEPTH TO WATER (DTW) 12.16 FT

TOTAL WATER DEPTH 20.99 FT

MEASUREMENT METHOD SOLINST SLOPE INDICATOR

TOC ELEV = _____ FT - DTW _____ FT = GW ELEV. _____ FT

PURGE VOLUME CALCULATIONS

20.99 FT WATER * CASING FACTOR = 3.5 (0.17) GAL/CASING VOL. * 3 VOLUMES = 10.5 TOTAL PURGED (GALS)

CASING FACTOR (CIRCLE ONE) FOR 2" DIA = 0.17 GAL / FT

FOR 3" DIA = 0.38 GAL / FT

FOR 4" DIA = 0.66 GAL / FT

PURGING

TIME START	TIME END	CUMULATIVE DISCHARGE (GAL)	pH	CONDUCTIVITY umho/cm	TURBIDITY	°C TEMP	COMMENTS
1221	1231	3.5	6.42	532	med	19.5	water muddy
1239	1242	7.0	6.49	499	med	19.5	
1243	1251	10.5	6.52	493	516	19.3	V

METHOD OF DISCHARGE DISPOSAL GROUND (BARREL) POND (CIRCLE ONE)

METHOD OF PURGING HOMELITE (BAILER) HAND PUMP SUBMERSIBLE WATERRA (CIRCLE ONE)

METHOD OF SAMPLING WELL WIZARD TEFLON BAILER HAND PUMP (DISPOSABLE BAILER) (CIRCLE ONE)

METHOD OF CLEANING ALCONOX / DI WATER STEAM CLEANER / DI WATER (CIRCLE ONE)

PUMP LINES / BAILER ROPES NEW, CLEANED, OR DEDICATED (CIRCLE ONE)

pH METER YSI 3500 CALIBRATED (YES) NO COND. METER YSI 3500 CALIBRATED (YES) NO

TEMP. CORRECTED YES NO CALIBRATION DATA pH 4 = _____ COND. 1,000= 9.65

7.07 pH 7 = 7.00 COND. 10,000= _____

10.84 pH 10 = 10.00 14.2° C

SAMPLES

LAB ANALYSIS TPH mineral oil, PNA, HVOC

LABORATORY [illegible]

SAMPLE TIME [illegible]

REMARKS

PG & E PURGING AND SAMPLING LOG

SITE Emeryville JOB ID 00524 DE1 WELL # ESE-2
PURGE DATE 12/1/93 BY [illegible] WEATHER clear
SAMPLE DATE 12/1/93 BY [illegible]

WATER ELEVATION / VOLUME CALCULATIONS

MEASURING POINT (MP) TOC @ mark HYDROCARBON ODOR YES (NO)
DEPTH OF WELL (DTB) 34.10 FT THICKNESS ———
DEPTH TO WATER (DTW) 13.18 FT
TOTAL WATER DEPTH 20.92 FT
MEASUREMENT METHOD SOLINST SLOPE INDICATOR

TOC ELEV = _____ FT - DTW _____ FT = GW ELEV. _____ FT

PURGE VOLUME CALCULATIONS

13.18 FT WATER * CASING FACTOR = 3.5 (0.17) GAL/CASING VOL. * 3 VOLUMES = 10.5 TOTAL PURGED (GALS)

CASING FACTOR (CIRCLE ONE)
FOR 2" DIA = 0.17 GAL / FT
FOR 3" DIA = 0.38 GAL / FT
FOR 4" DIA = 0.66 GAL / FT

PURGING

TIME START	TIME END	CUMULATIVE DISCHARGE (GAL)	pH	CONDUCTIVITY umho/cm	TURBIDITY	°C TEMP	COMMENTS
1506	1511	3.5	[illegible]	511	med	22.2	muddy water
1511	1514	7.0	[illegible]	521	low	[illegible]	clear
"	[illegible]	10.5	6.88	516	low	22.1	clear

METHOD OF DISCHARGE DISPOSAL GROUND (BARREL) POND *(CIRCLE ONE)*
METHOD OF PURGING HOMELITE BAILER HAND PUMP SUBMERSIBLE WATERRA *(CIRCLE ONE)* surface sample
METHOD OF SAMPLING WELL WIZARD TEFLON BAILER HAND PUMP (DISPOSABLE BAILER) *(CIRCLE ONE)*
METHOD OF CLEANING ALCONOX / DI WATER STEAM CLEANER / DI WATER *(CIRCLE ONE)*
PUMP LINES / BAILER ROPES NEW, CLEANED, OR DEDICATED *(CIRCLE ONE)*
pH METER _____ CALIBRATED YES NO COND. METER _____ CALIBRATED YES NO
TEMP. CORRECTED YES NO CALIBRATION DATA pH 4 = _____ COND. 1,000= _____
See ESE-1 pH 7 = _____ COND. 10,000= _____
SAMPLES pH 10 = _____
LAB ANALYSIS TPH [illegible]
LABORATORY [illegible]
SAMPLE TIME 1535
REMARKS

PG & E PURGING AND SAMPLING LOG

SITE Emeryville JOB ID 0052V DE1 WELL # ESE-3

PURGE DATE 12/[illegible]/91 BY [illegible] WEATHER Clear

SAMPLE DATE [illegible] BY [illegible]

WATER ELEVATION / VOLUME CALCULATIONS

MEASURING POINT (MP) TOC @ mark HYDROCARBON ODOR YES NO

DEPTH OF WELL (DTB) 30.90 FT THICKNESS

DEPTH TO WATER (DTW) 10.35 FT

TOTAL WATER DEPTH 20.49 FT

MEASUREMENT METHOD SOLINST SLOPE INDICATOR

TOC ELEV = _____ FT - DTW _____ FT = GW ELEV. _____ FT

PURGE VOLUME CALCULATIONS

20.55 FT WATER * CASING FACTOR = 3.5 GAL/CASING VOL * 3 VOLUMES = 10.5 TOTAL PURGED (GALS)

0.17

CASING FACTOR (CIRCLE ONE)

FOR 2" DIA = 0.17 GAL / FT

FOR 3" DIA = 0.38 GAL / FT

FOR 4" DIA = 0.66 GAL / FT

PURGING

TIME START	TIME END	CUMULATIVE DISCHARGE (GAL)	pH	CONDUCTIVITY umho/cm	TURBIDITY	°C TEMP	COMMENTS
1350	1355	3.5	6.21	480	low	18.8	clear, no odor
[illegible]	[illegible]	7.0	6.09	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	10.5	6.02	479	200	18.6	"

METHOD OF DISCHARGE DISPOSAL GROUND (BARREL) POND *(CIRCLE ONE)*

METHOD OF PURGING HOMELITE (BAILER) HAND PUMP SUBMERSIBLE WATERRA *(CIRCLE ONE)*

METHOD OF SAMPLING WELL WIZARD TEFLON BAILER HAND PUMP (DISPOSABLE BAILER) *(CIRCLE ONE)*

METHOD OF CLEANING ALCONOX / DI WATER STEAM CLEANER / DI WATER *(CIRCLE ONE)*

PUMP LINES / BAILER ROPES NEW, CLEANED, OR DEDICATED *(CIRCLE ONE)*

pH METER _____ CALIBRATED YES NO COND. METER _____ CALIBRATED YES NO

TEMP. CORRECTED YES NO CALIBRATION DATA pH 4 = _____ COND. 1,000= _____

pH 7 = _____ COND. 10,000= _____

SAMPLES pH 10 = _____

LAB ANALYSIS [illegible]

LABORATORY [illegible]

SAMPLE TIME 1425

REMARKS

Appendix B

CERTIFIED ANALYTICAL REPORTS AND CHAIN-OF-CUSTODY DOCUMENTATION

CHROMALAB, INC.

Environmental Services (SDB)

December 8, 1998 *Submission #:* 9812042

P.G.& E. LAB

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for Polychlorinated Biphenyls (PCBs) analysis.
Method: *SW846 Method 8080A Sept 1994*

Client Sample ID: **ESE-1U**
Spl#: 218876 *Matrix:* WATER *Extracted:* December 3, 1998
Sampled: December 1, 1998 *Run#:* 16289 *Analyzed:* December 8, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
AROCLOR 1016	N.D.	0.50	N.D.	99.0	1
AROCLOR 1221	N.D.	0.50	N.D.	--	1
AROCLOR 1232	N.D.	0.50	N.D.	--	1
AROCLOR 1242	N.D.	0.50	N.D.	--	1
AROCLOR 1248	N.D.	0.50	N.D.	--	1
AROCLOR 1254	N.D.	0.50	N.D.	--	1
AROCLOR 1260	N.D.	0.50	N.D.	116	1

Rene Boongaling
Analyst

Michael Verona
Laboratory Operations Manager

925-866-5681 GC 12/14

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Federal ID #68-0140157

CHROMALAB, INC.

Environmental Services (SDB)

March 9, 1999

Submission #: 9812042
Revised

P.G.& E. LAB

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for Polychlorinated Biphenyls (PCBs) analysis.
Method: *SW846 Method 8080A Sept 1994*

Client Sample ID: **ESE-1F**
Spl#: 218879 *Matrix:* WATER *Extracted:* December 3, 1998
Sampled: December 1, 1998 *Run#:* 16289 *Analyzed:* December 5, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
AROCLOR 1016	N.D.	0.54	N.D.	99.0	1
AROCLOR 1221	N.D.	0.54	N.D.	--	1
AROCLOR 1232	N.D.	0.54	N.D.	--	1
AROCLOR 1242	N.D.	0.54	N.D.	--	1
AROCLOR 1248	N.D.	0.54	N.D.	--	1
AROCLOR 1254	N.D.	0.54	N.D.	--	1
AROCLOR 1260	N.D.	0.54	N.D.	116	1

Note: Filtered through 0.7 micron filter before extraction.

Rene Boongaling
Analyst

Michael Verona
Laboratory Operations Manager

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CHROMALAB, INC.

Environmental Services (SDB)

December 8, 1998 *Submission #:* 9812042

P.G.& E. LAB

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for Polychlorinated Biphenyls (PCBs) analysis.
Method: *SW846 Method 8080A Sept 1994*

Client Sample ID: **ESE-2U**
Spl#: 218877 *Matrix:* WATER *Extracted:* December 3, 1998
Sampled: December 1, 1998 *Run#:* 16289 *Analyzed:* December 8, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
AROCLOR 1016	N.D.	0.50	N.D.	99.0	1
AROCLOR 1221	N.D.	0.50	N.D.	--	1
AROCLOR 1232	N.D.	0.50	N.D.	--	1
AROCLOR 1242	N.D.	0.50	N.D.	--	1
AROCLOR 1248	N.D.	0.50	N.D.	--	1
AROCLOR 1254	N.D.	0.50	N.D.	--	1
AROCLOR 1260	N.D.	0.50	N.D.	116	1

Rene Boongaling
Analyst

Michael Verona
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Federal ID #68-0140157

CHROMALAB, INC.

Environmental Services (SDB)

March 9, 1999 *Submission #:* 9812042

P.G.& E. LAB **Revised**

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for Polychlorinated Biphenyls (PCBs) analysis.
Method: *SW846 Method 8080A Sept 1994*

Client Sample ID: **ESE-2F**
Spl#: 218880 *Matrix:* WATER *Extracted:* December 3, 1998
Sampled: December 1, 1998 *Run#:* 16289 *Analyzed:* December 8, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
AROCLOR 1016	N.D.	0.54	N.D.	99.0	1
AROCLOR 1221	N.D.	0.54	N.D.	--	1
AROCLOR 1232	N.D.	0.54	N.D.	--	1
AROCLOR 1242	N.D.	0.54	N.D.	--	1
AROCLOR 1248	N.D.	0.54	N.D.	--	1
AROCLOR 1254	N.D.	0.54	N.D.	--	1
AROCLOR 1260	N.D.	0.54	N.D.	116	1

Note: Filtered through 0.7 micron filter before extraction.

Rene Boongaling
Analyst

Michael Verona
Laboratory Operations Manager

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CHROMALAB, INC.

Environmental Services (SDB)

December 8, 1998 *Submission #:* 9812042

P.G.& E. LAB

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for Polychlorinated Biphenyls (PCBs) analysis.
Method: *SW846 Method 8080A Sept 1994*

Client Sample ID: **ESE-3U**
Spl#: 218878 *Matrix:* WATER *Extracted:* December 3, 1998
Sampled: December 1, 1998 *Run#:* 16289 *Analyzed:* December 5, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
AROCLOR 1016	N.D.	0.50	N.D.	99.0	1
AROCLOR 1221	N.D.	0.50	N.D.	--	1
AROCLOR 1232	N.D.	0.50	N.D.	--	1
AROCLOR 1242	N.D.	0.50	N.D.	--	1
AROCLOR 1248	N.D.	0.50	N.D.	--	1
AROCLOR 1254	N.D.	0.50	N.D.	--	1
AROCLOR 1260	N.D.	0.50	N.D.	116	1

Rene Boongaling
Analyst

Michael Verona
Laboratory Operations Manager

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Federal ID #68-0140157

CHROMALAB, INC.

Environmental Services (SDB)

March 9, 1999 *Submission #:* 9812042

P.G.& E. LAB **Revised**

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for Polychlorinated Biphenyls (PCBs) analysis.
Method: *SW846 Method 8080A Sept 1994*

Client Sample ID: **ESE-3F**
Spl#: 218881 *Matrix:* WATER *Extracted:* December 3, 1998
Sampled: December 1, 1998 *Run#:* 16289 *Analyzed:* December 8, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
AROCLOR 1016	N.D.	0.53	N.D.	99.0	1
AROCLOR 1221	N.D.	0.53	N.D.	--	1
AROCLOR 1232	N.D.	0.53	N.D.	--	1
AROCLOR 1242	N.D.	0.53	N.D.	--	1
AROCLOR 1248	N.D.	0.53	N.D.	--	1
AROCLOR 1254	N.D.	0.53	N.D.	--	1
AROCLOR 1260	N.D.	0.53	N.D.	116	1

Note: Filtered through 0.7 micron filter before extraction.

Rene Boongaling
Analyst

Michael Verona
Laboratory Operations Manager

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Federal ID #68-0140157

CHROMALAB, INC.

Environmental Services (SDB)

December 14, 1998 *Submission #:* 9812042

P.G.& E. LAB

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for TEPH analysis.
Method: *EPA 8015M*

Client Sample ID: **ESE-1U**
Spl#: 218876 *Matrix:* WATER *Extracted:* December 3, 1998
Sampled: December 1, 1998 *Run#:*16297 *Analyzed:* December 14, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
MINERAL OIL	180	100	N.D.	86.8	1

Carolyn House
Analyst

Bruce Havlik
Analyst

925-868-5881 GC 12/14

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Federal ID #68-0140157

CHROMALAB, INC.

Environmental Services (SDB)

March 9, 1999 *Submission #:* 9812042

Revised

P.G.& E. LAB

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for TEPH with Silica Gel Cleanup analysis.
Method: *EPA 8015M*

Client Sample ID: **ESE-1F**
Spl#: 218879 *Matrix:* WATER *Extracted:* December 3, 1998
Sampled: December 1, 1998 *Run#:*16264 *Analyzed:* December 14, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
MINERAL OIL	N.D.	100	N.D.	--	1

Note: Filtered through .7 micron filter before extraction.Silica gel cleanup.

Carolyn House
Analyst

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CHROMALAB, INC.

Environmental Services (SDB)

December 14, 1998 *Submission #:* 9812042

P.G.& E. LAB

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for TEPH analysis.
Method: *EPA 8015M*

Client Sample ID: **ESE-2U**
Spl#: 218877 *Matrix:* WATER *Extracted:* December 3, 1998
Sampled: December 1, 1998 *Run#:*16297 *Analyzed:* December 11, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
MINERAL OIL	N.D.	100	N.D.	86.8	1

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CHROMALAB, INC.

Environmental Services (SDB)

March 9, 1999 *Submission #:* 9812042

Revised

P.G.& E. LAB

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for TEPH with Silica Gel Cleanup analysis.
Method: *EPA 8015M*

Client Sample ID: **ESE-2F**
Spl#: 218880 *Matrix:* WATER *Extracted:* December 2, 1998
Sampled: December 1, 1998 *Run#:*16264 *Analyzed:* December 11, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
MINERAL OIL	N.D.	100	N.D.	--	1

Note: Filtered through .7 micron filter before extraction.Silica gel cleanup.

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925-866-5681 GC 12/14

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S015 0:0C0405 BUBBA 14:03

CHROMALAB, INC.

Environmental Services (SDB)

December 14, 1998 *Submission #:* 9812042

P.G.& E. LAB

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for TEPH analysis.
Method: *EPA 8015M*

Client Sample ID: **ESE-3U**
Spl#: 218878 *Matrix:* WATER *Extracted:* December 3, 1998
Sampled: December 1, 1998 *Run#:*16297 *Analyzed:* December 14, 1998

✓ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
MINERAL OIL	N.D.	100	N.D.	86.8	1

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CHROMALAB, INC.

Environmental Services (SDB)

March 9, 1999 *Submission #:* 9812042

Revised

P.G.& E. LAB

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for TEPH with Silica Gel Cleanup analysis.
Method: *EPA 8015M*

Client Sample ID: **ESE-3F**
Spl#: 218881 *Matrix:* WATER *Extracted:* December 2, 1998
Sampled: December 1, 1998 *Run#:*16264 *Analyzed:* December 11, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
MINERAL OIL	N.D.	100	N.D.	--	1

Note: Filtered through .7 micron filter before extraction.Silica gel cleanup.

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CHROMALAB, INC.

Environmental Services (SDB)

December 8, 1998 *Submission #:* 9812042

P.G.& E. LAB

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for BTEX analysis.
Method: SW846 8020A Nov 1990

Client Sample ID: **ESE-1**
Spl#: 218872 *Matrix:* WATER
Sampled: December 1, 1998 *Run#:*16338 *Analyzed:* December 4, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
BENZENE	N.D.	0.50	N.D.	99	1
TOLUENE	N.D.	0.50	N.D.	95	1
ETHYL BENZENE	N.D.	0.50	N.D.	92	1
XYLENES	N.D.	0.50	N.D.	94	1

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GC V132 O:BTEXQC0220
VINCE 15:18

CHROMALAB, INC.

Environmental Services (SDB)

December 8, 1998 *Submission #:* 9812042

P.G.& E. LAB

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for BTEX analysis.
Method: SW846 8020A Nov 1990

Client Sample ID: **ESE-2**
Spl#: 218873 *Matrix:* WATER
Sampled: December 1, 1998 *Run#:*16338 *Analyzed:* December 4, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
BENZENE	N.D.	0.50	N.D.	99	1
TOLUENE	N.D.	0.50	N.D.	95	1
ETHYL BENZENE	N.D.	0.50	N.D.	92	1
XYLENES	N.D.	0.50	N.D.	94	1

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December 8, 1998 *Submission #:* 9812042

P.G.& E. LAB

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for BTEX analysis.
Method: SW846 8020A Nov 1990

Client Sample ID: **ESE-3**
Spl#: 218874 *Matrix:* WATER
Sampled: December 1, 1998 *Run#:*16338 *Analyzed:* December 4, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
BENZENE	N.D.	0.50	N.D.	99	1
TOLUENE	N.D.	0.50	N.D.	95	1
ETHYL BENZENE	N.D.	0.50	N.D.	92	1
XYLENES	N.D.	0.50	N.D.	94	1

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CHROMALAB, INC.

Environmental Services (SDB)

December 8, 1998 *Submission #:* 9812042

P.G.& E. LAB

Atten: Karen Piini

Project: EMERYVILLE CENTER *Project#:* 00524 0E1
Received: December 2, 1998

re: One sample for BTEX analysis.
Method: SW846 8020A Nov 1990

Client Sample ID: **FIELD BLANK**
Spl#: 218875 *Matrix:* WATER
Sampled: December 1, 1998 *Run#:*16338 *Analyzed:* December 4, 1998

ANALYTE	RESULT (ug/L)	REPORTING LIMIT (ug/L)	BLANK RESULT (ug/L)	BLANK SPIKE (%)	DILUTION FACTOR
BENZENE	N.D.	0.50	N.D.	99	1
TOLUENE	N.D.	0.50	N.D.	95	1
ETHYL BENZENE	N.D.	0.50	N.D.	92	1
XYLENES	N.D.	0.50	N.D.	94	1

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CHAIN OF CUSTODY RECORD

Pacific Gas & Electric Company

3400 Crow Canyon Road, San Ramon, California 94583
(510) 820-2000

Ship To: Chromalab, Inc.
1220 Quarry Ln.
Pleasanton, Ca. 94566

Attention: Gary Cook | Phone: (925) 484-1919 | Page 1 of 1

Job Number:	Project Name:	Project Manager:
00524 0E1	Emeryville Svc Center	Karen Piini
Samplers: (Signatures) Don Bryant		Field Team Leader: Fred Flint

SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	SAMPLE INFORMATION	NO. OF CNTRS.	BTEX (EPA 602)	PCB's (EPA 8080)	TPH (mod.) (EPA 8015)	3-VOA's (BTEX) 2-Amber (TPH) 1 Amber (PCB)	REMARKS
ESE-1	12/1/98	1310	water	Groundwater monitor well	3	X				Std TAT (10 day - Tier I QC)
ESE-1U					3		X	X		
ESE-1F					3		X	X		Analyze samples ESE-1U,
ESE-2					3	X				2U, & 3U unfiltered
ESE-2U					3		X	X		
ESE-2F					3		X	X		Analyze samples ESE-1F,
ESE-3		1425			3	X				2F, & 3F filtered - Pre-
ESE-3U					3		X	X		treatment w/silica gel clean-up
ESE-3F					3		X	X		(laboratory filtration w/glass
Field Blank	12/1/98				2	X				0.7 micron or less) call Fred
										Flint @ 866-5808 if you have any
										questions.
										Fax results to Karen Piini @ 866-5681

SUBM #: 9812042 REP: GC
CLIENT: PGE-LAB
DUE: 12/09/98
REF #:43423

Relinquished By: (Signature)	Date/Time:	Received By: (Signature)	Date/Time:	Ship Via:
Don Bryant	12/2/98 1618		12-2-98 16:19	5.3°C ON ICE
Relinquished By: (Signature)	Date/Time:	Received By: (Signature)	Date/Time:	Airbill Number: 9UBA5 2FB / Date:
	12/2/98 17:10		12/2/98 17:10	
Relinquished By: (Signature)	Date/Time:	Received By: (Signature)	Date/Time:	

DISTRIBUTION: Original Accompanies Shipment; Canary Copy to PG&E; Pink-Sampler

NOTE: Samples are discarded 30 days after results are reported unless other arrangements are made.

60006997/GI/T197

Appendix C

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD LETTER, DATED FEBRUARY 16, 1999

Winston H. Hickox
Secretary for Environmental Protection

California Regional Water Quality Control Board

San Francisco Bay Regional Water Quality Control Board

Gray Davis
Governor

Internet Address: http://www.swrcb.ca.gov
1515 Clay Street, Suite 1400, Oakland, California 94612
Phone (510) 622-2300 FAX (510) 622-2460

MEMORANDUM

TO: Stephen Morse, Chief
Toxics Cleanup Division

Concur: Stephen J. Morse
February 16, 1999

FROM: Ravi Arulanantham, Ph.D.
Toxics Cleanup Division

DATE: February 16, 1999

SUBJECT: **Use of Silica Gel Cleanup for Extractable TPH Analysis**

Recommendation:

Total petroleum hydrocarbon (TPH) measurement (EPA Method 8015M, "CA LUFT," or equivalent) in ground water is routinely requested at petroleum impacted sites for regulatory decision making purposes. At many sites TPH detections in ground water, in the absence of benzene, toluene, ethylbenzene, or xylenes (BTEX) or polynuclear aromatic compounds (PNAs) pose a dilemma in determining case closure. Recent research has demonstrated that extractable TPH detections in the absence of BTEX and PNAs can be the result of positive interferences to the Method 8015M measurement and not dissolved petroleum. These interferences are primarily due to the presence of polar biogenic material that may naturally occur in ground water or result from the biodegradation of petroleum hydrocarbons.

This memorandum provides the technical background for this topic and recommends the use of silica gel cleanup (whenever the extractable fraction of TPH is requested) to mitigate the effects of interferences to the extractable TPH analysis. The mitigation of these interferences is important so that site-specific decisions can be made based on analytical data that represents dissolved petroleum.

cont.....

Background:

The Water-Soluble Fraction of Petroleum Products

Crude oils and petroleum products are complex mixtures of hundreds to thousands of individual petroleum constituents. The water-soluble fraction (WSF) of a petroleum product is a function of both the molecular class and the molecular weight (number of carbon atoms) of its constituents; within a given molecular class, lower molecular weight constituents usually tend to be more soluble (Mackay and Shiu, 1992; Yaws et al., 1990). In addition, the measurable portion of the WSF of a given product is a function not only of the solubility of each constituent, but also the mole-fraction of the constituent within the product and the partitioning coefficient of the constituent between water and the other organics in the product. Based on these factors, the WSF should be limited to a few petroleum constituents out of the thousands that make up the petroleum product or crude oil.

As summarized in Zemo (1997a, 1997b), the WSF of fresh petroleum products and crude oil has been investigated at laboratory conditions by several researchers using various combinations of gas chromatography (GC) and mass spectrometry (MS) (Coleman et al., 1984; Shiu et al., 1990; Bruya and Friedman, 1992; Thomas and Delfino, 1991; Chen et al., 1994; and Potter, 1996). All of these studies indicate that the WSFs of the products tested (42 crude oils, fresh gasoline, kerosene, jet fuel, diesel and motor oil) are limited primarily to the very small alkanes ($\leq C_6$) and the C_6 to C_{14} aromatics, including BTEX, alkylated benzenes, naphthalene, methylnaphthalenes, acenaphthene, fluorene, phenanthrene, and anthracenes. Thomas and Delfino (1991) and Potter (1996) also reported very low concentrations of phenol and methylated phenols in the WSF of the products tested; phenols were not identified by the other researchers. Chromatograms provided in Thomas and Delfino (1991), Coleman et al. (1984), and Bruya and Friedman (1992) show that the WSF of each product is composed of discrete peaks and does not resemble the parent product. The discrete constituents comprising the WSF are reliably identified and quantified by routine GC/MS methods. This identification of the WSF of various products has great significance for interpretation of TPH analytical results from ground water samples.

Method 8015M (TPH) and Sources of Interference

Method 8015M (TPH) is a GC-FID analysis that is normally required at petroleum impacted sites. The analysis is intended to provide a measure of petroleum hydrocarbons in the sample. The analysis quantifies an amount of volatile or semi-volatile hydrocarbons that elute within a selected boiling range or range of molecular weights using a flame ionization detector. It is generally separated into purgeable and extractable fractions. It is an aggregate rather than a constituent-specific analysis. A TPH analysis transmits no direct information about which petroleum constituents are present in the sample, or even if petroleum is present in the sample at all (Bruya, 1993; Zemo, et al., 1995).

Because of its non-specificity, Method 8015M can be unreliable for measurement of dissolved petroleum constituents in ground water samples. Zemo (1997b) presented data from 21 sites (Table 1) that showed that the extractable TPH concentration of ground water samples resulting

from constituents other than the $\leq C_6$ alkanes or $\leq C_{14}$ aromatics were a direct result of one or both of the following interferences: (1) the sample contained non-dissolved petroleum constituents, or (2) the sample contained soluble non-petroleum hydrocarbons (such as polar biogenic materials or biodegradation products). Samples affected by either or both of these sources of interference do not provide an accurate assessment of dissolved-phase concentrations of petroleum in ground water.

Non-dissolved petroleum constituents can be incorporated into water samples by passing a bailer or other sampling device through a sheen on top of the water column or by entraining petroleum that is sorbed onto sediment (turbidity). Non-dissolved petroleum included in the sample will be extracted along with the water at the laboratory and the "TPH" result for the ground water sample will include these non-dissolved constituents. Although this source of interference is not the main subject of this memorandum it has been documented by Zemo and Synowiec (1995), Foote et al. (1997), and Army and Wright (1997). Mitigation of this situation (interference) has been achieved by filtering the sample through a glass-fiber filter prior to extraction (Foote, et al, 1997).

Soluble non-petroleum hydrocarbons such as polar biogenic materials and biodegradation products can be incorporated into water samples when wells are screened within or downgradient from petroleum-affected soil that is undergoing intrinsic biodegradation. Barcelona et al. (1995 and 1996), identified by GC/MS numerous aliphatic and aromatic organic acids that are degradation metabolic intermediates of petroleum products in ground water samples. According to Dragun (1998), Cookson (1995), and Barcelona et al. (1995), other potential oxygenated metabolites that may be present in ground water include phenols, aldehydes, and hydroxy-aliphatic acids. Collection of such polar materials within a water sample in the vicinity of active intrinsic biodegradation is unavoidable because of their relatively high solubility. Unlike Method 418.1, Method 8015M normally does not include a silica gel or other cleanup step to remove polar materials; consequently the "TPH" result for the ground water sample will include these non-petroleum constituents. Zemo and Synowiec (1995) and Zemo (1997b) found that these polar materials were the predominant source of TPH detections at several sites where older petroleum releases had undergone significant intrinsic biodegradation. In addition to soluble constituents resulting from intrinsic biodegradation of petroleum, Girard and Edelman (1994) found TPH detections in ground water samples resulting solely from soluble organic compounds derived from natural decomposition of wood waste (e.g., degradation byproducts of tanin/lignins).

Silica Gel Cleanup

Silica gel is a material that is highly polar in chemical structure and attracts polar molecules to itself. It is commonly used as a desiccant (water is highly polar) and is also used in several EPA methods to "clean up" sample extracts so that only the target constituents for the method are analyzed. Silica gel is used in Method 418.1 to remove fatty acids and other highly polar, non-petroleum materials from the sample extract. Unfortunately, when Method 8015 was brought into use to replace Method 418.1, the silica gel cleanup step was omitted. This inadvertently caused the analysis and quantitation of the "improved" (GC-FID) method to include interferences from

non-petroleum hydrocarbons. The magnitude and implications of this problem were not understood until recent research results were published. Therefore, for regulatory decision making purposes, it is important that the TPH analytical results represent only dissolved petroleum hydrocarbons. Accordingly, the sample extracts should be cleaned up with silica gel prior to Method 8015M analysis. Similar interferences to the purgeable TPH analysis are expected; however, silica gel cleanup cannot be performed for this analysis. Modification of the purgeable TPH analysis to address these sources of interference is an area requiring future work.

The analytical laboratory can perform a silica gel cleanup based on EPA Method 3630B (with no solvent exchanges). According to Zemo (1997b), passing the extract through a glass column packed with silica gel typically results in an adequate cleanup; a cleanup based on EPA Method 418.1 (adding 3 grams of silica gel to the extract and shaking the mixture) frequently did not result in adequate removal of polar biogenic material. Cleanup can also be achieved using prepackaged silica gel cartridges. Completeness of a silica gel cleanup can be assessed only by reviewing the chromatograms. Cleanup may be incomplete due to either the polarity or the mass of biogenic material in the extract; weakly polar materials may not be removed, too much material can use up all the active sites on the silica gel. Laboratory QA/QC must be assessed by standard methods (e.g., blind duplicates, acceptable spike and surrogate recoveries) to ensure that the cleanup step does not cause negative bias by removing dissolved petroleum from the sample.

Biodegradation Products and Metabolites of Petroleum Hydrocarbons

As mentioned previously a wide variety compounds are formed during petroleum degradation. Even though numerous specific compounds could result from the degradation of petroleum hydrocarbons, certain classes of compounds are common to most degradation pathways. In general, petroleum hydrocarbons undergo sequential abiotic and biotic oxidation to initially form alcohols, which are transformed to organic acids, and ultimately to carbon dioxide and water. Intermediate metabolites that could occur include aldehydes, ketones, aromatic alcohols (e.g., phenol and catecol), and esters. It is important to note that organic acids also occur naturally in the environment. These classes of compounds are polar in their molecular structure, can be very soluble in water, and therefore, would be removed by silica gel.

Therefore, during site-specific decision making, and especially during case closure, the presence of these residual degradation products (e.g., their longevity, toxicity, nuisance, etc.) must be considered in the context of future likely use of ground water at the site.

Summary

As shown in Table 1, several field studies have demonstrated that the interference of non-petroleum hydrocarbons to Method 8015M measurements of ground water samples can be moderate to significant. This overestimation of concentrations of dissolved petroleum hydrocarbons can pose difficulty during decision-making on low-risk case closures and may inadvertently lead to the perceived need for additional monitoring and/or remediation. The non-petroleum hydrocarbons that cause this interference are polar biogenic materials that may

naturally occur in ground water or result from the biotic and/or abiotic degradation of petroleum hydrocarbons. We recommend that silica gel cleanup be performed on sample extracts prior to the use of Method 8015 analysis to mitigate the effects of these interferences and ensure that site specific decisions can be made based on analytical data that represents dissolved petroleum.

The potential impact to the future beneficial use of ground water caused by the presence of these polar biogenic materials (e.g., taste and odor and/or toxicity) should be evaluated on a site-by-site basis; we recommend that TPH (Method 8015M) measurements not be used for this evaluation.

Acknowledgments

The author gratefully acknowledges the assistance provided by Dawn Zemo in completing this review.

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Ravi:tphmemo04.W97. Dis.08/1999

TABLE 1

METHOD 8015M (TPH) ANALYTICAL RESULTS FOR GROUND WATER SAMPLES BEFORE AND AFTER CLEANUP [1]

Site	Conventional "TPHd" (ug/l)[2] (Before Cleanup)	Blind Duplicate(s) Filter and/or Silica Gel "TPHd" (ug/l)[3]	Interference[4]
1	20,000	F only = 15,000; SG only = <1000	biogenic
2	110,000	F+SG= 1200; SG only = 55,000	grab sample w/particulates that pass filter
3	100	F+SG = <50; SG only = <50	biogenic
4	200	F+SG = <50; SG only = <50	biogenic
5	390	F+SG = <50; SG only = <50	biogenic
6	6600	F+SG = 140; SG only = 140	biogenic, incomplete cleanup
7	630	F+SG = <50	biogenic
8	120,000	F+SG = 690	grab samples w/particulates and incomplete cleanup
9	4500	F+SG = 750	biogenic, incomplete cleanup
10	1100	F only = 390; SG only = <50	mostly biogenic
11	790	F+SG = <50; SG only = <50	biogenic
12	1500	F+SG = <50; SG only = <50	biogenic
13	2230	SG only = <50	biogenic
14	2000	SG only = <50	biogenic
15	3900	SG only = 1900	no filtering, entrained non-dissolved petroleum
16	2600	SG only = 270	biogenic, incomplete cleanup
17	2300	SG only = <50	biogenic
18	1800	SG only = 100	biogenic, incomplete cleanup
19	1400	F only = 1300; SG only = <50	biogenic
20	1700	SG only = <50	biogenic
21	810	F only = 840; SG only = <50	biogenic

Notes:

1 Table reproduced from Zemo (1997b); data for sites 1 through 12 previously published in Zemo (1997a).

2 Analysis by EPA Method 8015M against a diesel standard; quantitation range varied among laboratories, typically C_8 to C_{30}.

3 Filtered by laboratory using glass fiber TCLP filter (0.7-micron); silica gel cleanup by either 418.1 or Method 3630B equivalents (see text).

4 Major component of interference based on review of chromatograms.