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Certified Mail No. P-101-726-934
Return Receipt Requested

December 28, 1994

BHP Hawaii

Mr. Mitch Kaplan
Arizona, Nevada, Pacific Island Section (H-3-1)
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, California 94105

Subject: **Revisions Request to Groundwater Level Measurement of Groundwater Monitoring Plan (GMP), October 19, 1993; HID 056786395**

Dear Mr. Kaplan:

This letter is regarding a technical modification on the proposed groundwater level measurement in the original GMP workplan (page 29). It was proposed in the GMP that a groundwater equipotentionmetric surface map will be made through continuous water level measurements (hourly reading) for one month in each of the summer and winter seasons for a total of two months on all the ten new cluster wells and selected existing monitoring wells.

However, this type of measurements are usually conducted for a time period of 24 to 48 hours, and the data collected can provide enough information to generate an equipotentionmetric surface map as well as to reflect any tidal influence such as in our case. Because our refinery is located in an area with very little rainfall and the unconfined aquifer under the refinery is in direct connection with the ocean water, there is negligible seasonal fluctuation of water level. Therefore, we would like to modify the proposed groundwater level measurement to once in the summer of 1995, and also to reduce the measurement period to 48 hours on selected new cluster wells and existing wells based on the well distribution within the Refinery.

It was also proposed in the GMP to establish a weather station at the Refinery to monitor barometric pressure, temperature, rainfall, and evaporation. The objective of this monitoring is to adjust any water level change due to the variation of the above parameters. However, temperature has never been a factor for groundwater level fluctuations in a relatively short time period as in our case; and particularly, temperature variation itself is very small in Hawaii as you know. Studies also found that barometric fluctuations are rarely observed in unconfined aquifers. The reason for this is that changes in atmospheric pressure are transmitted equally to the column of water in a well and to the water table through the unsaturated zone and there are no pressure gradients (Domenico and Schwartz, Physical and chemical hydrogeology. p. 130). Rainfall information for the area the Refinery located can be obtained from nearby Barbers

BHP Hawaii Inc
733 Bishop Street Honolulu Hawaii 96813 USA
PO Box 3379 Honolulu Hawaii 96842 USA
Telephone 808 547 3111 Facsimile 808 547 3145

Point Naval observation; and the evaporation data can be obtained either through reference survey or from National Weather Service. Therefore, we would like to modify our original proposal to not set up a weather station in the Refinery but to collect the necessary information from the professional organizations such as the National Weather Service.

After your approval of the above modification, a summary of all the previous modification requests and an updated GMP schedule which reflects the approved modifications will be submitted to you for your record. There are several errors on the original GMP schedule table (Table 1) which was overlooked by the reviewers, and we would like to correct them here and will be shown in the updated schedule to be submitted: (1) the submit of first quarterly sampling data was put in a wrong position (it was marked before the laboratory finishing its analysis), and it should be approximately two weeks after we received the analytical report from the laboratory; (2) the second quarterly sampling was put in less than two months after the first quarterly sampling, and it should be put at three months after the first quarterly sampling; and (3) the laboratory analytical time period should be marked following the sampling time period instead of showing simultaneously.

We have conducted the first quarterly sampling during the week of December 19, 1994 to December 23, 1994, and samples were shipped to the laboratory through overnight delivery. Free product was found only in the four old monitoring wells of MW-3 to MW-6. Because the sampling and analysis of free product was required as once a year according to the GMP and it has been done in our last quarterly sampling conducted in August, 1994, therefore, no free product samples were taken during this quarterly sampling and it will be sampled in the third quarterly sampling in June 1995. As regarding other tasks in the GMP: we have submitted our database selection to EPA in a letter dated Oct. 17, 1994; and we are also working with our consultants - Dames & Moore to evaluate groundwater transport models and the selection of model(s) will be submitted for your approval soon in January 1995.

Your earliest reply to our above requests will be greatly appreciated; so we can make preparation for the water level measurement and submit the new updated GMP schedule as soon as possible. Please contact our staff hydrogeologist - Dr. Tony Shan at (808) 547-3804 should you have any questions.

Sincerely,

FDC / M. Mark Lee

Frank D. Clouse
Refinery Manager

cc: Mr. Larry Bowerman, EPA
Mr. Steve Chang, HDOH

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Certified Mail No. P-101-726-919
Return Receipt Requested

BHP Hawaii

November 2, 1994

Mr. Mitch Kaplan
Arizona, Nevada, Pacific Island Section (H-3-1)
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, California 94105

Dear Mr. Kaplan:

Revisions Request to Groundwater Sample General Chemistry Analysis of Groundwater Monitoring Plan (GMP), October 19, 1993
HID 056786395

The drilling and installation of the ten new groundwater monitoring wells (CW-5 to CW-9) at BHP Hawaii Refinery were finished on Oct. 24, 1994. The survey of the well elevation will be conducted from Nov. 3, 1994 to Nov. 8, 1994. The installation of dedicated pumps for all the new wells plus the nine existing wells (CW-1 to CW-3) will be conducted between Nov. 7, 1994 to Dec. 4, 1994, and will be performed by Dames & Moore - Hawaii. The first quarterly groundwater sampling (for the new GMP) will be conducted shortly after the pumps are installed and tested.

We would like to make a modification to the proposed general chemistry analysis on the GMP which was approved by EPA on August 19, 1994. The parameters for the general chemistry analysis proposed in the GMP are listed as:

Total Dissolved Solids (TDS)
Alkalinity
Fluoride
Nitrate/Nitrite as N
Surfactants
Sulfate
pH
EC - Specific Conductivity
Chloride.

However, according to EPA's 40CFR265.92 b(2) and b(3), parameters establishing

BHP Hawaii Inc
733 Bishop Street Honolulu Hawaii 96813 USA
PO Box 3379 Honolulu Hawaii 96842 USA
Telephone 808 547 3111 Facsimile 808 547 3145

groundwater quality are:

Chloride
Iron
Manganese
Phenols
Sodium;

and the parameters used as indicators of groundwater contamination are:

pH
Specific Conductance
Total Organic Carbon (TOC)
Total Organic Halogen (TOH).

In order to meet the above requirements, we would like to change our general chemistry analysis list to the following:

Total Dissolved Solids (EPA 160.1)
Chloride (EPA 9253)
Iron (EPA 6010)
Manganese (EPA 6010)
Phenols (EPA 9066 or 8270)
Sodium (EPA 6010)
pH (EPA 9040)
EC - Specific Conductivity (EPA 9050).

TOC and TOH do not need to be analyzed because individual volatile and semi-volatile organic compounds will be analyzed vs EPA methods 8240 and 8270; and those analysis will provide more detail information about organic compounds presented in groundwater. We look forward to receiving your favorable response. Please contact our staff hydrogeologist - Dr. Tony Shan at (808) 547-3804 should you have any questions.

Sincerely,

Frank D. Clouse

Frank D. Clouse
Refinery Manager

cc: Ms. Paula Bisson, EPA
Ms. Nicole Moutous, EPA

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October 24, 1994

Mr. Mitch Kaplan
Arizona, Nevada, Pacific Island Section (H-3-1)
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, California 94105

BHP Hawaii

Dear Mr. Kaplan:

Revisions Request to Groundwater Sample Metal Analysis of Groundwater Monitoring Plan, October 19, 1993
HID 056786395

This letter is regarding a revision to the sample analysis on the Groundwater Monitoring Plan (GMP) which was approved by EPA on August 19, 1994. It was proposed in the GMP that both the total metals and dissolved metals will be analyzed for groundwater samples collected. However, we feel that it is not necessary to analyze the dissolved metals after carefully reviewing our groundwater data for the past three quarters of this year. There are no significant differences between the reported values of the two analyses (please see the enclosed table). This is because that the groundwater aquifer underneath the Refinery is composed of mostly carbonate coral rocks; and there is very little fine sediments presented in the groundwater.

We feel that the excessive testing and the extra expense are not justifiable from the technical as well as the economical point of view. Therefore, we ask your approval to analyze only total metals for our GMP sample analysis and this should provide us the worst scenario data because the total metal values should include the dissolved metals. We believe this approach can provide sufficient data information for our groundwater monitoring purpose. We look forward to receiving your favorable response. Please contact our staff hydrogeologist - Dr. Tony Shan at (808) 547-3804 should you or your staff have any questions.

Sincerely,

Frank D. Clouse

Frank D. Clouse
Refinery Manager

cc: Ms. Paula Bisson, EPA
Ms. Nicole Moutous, EPA
Mr. Steven Y. K. Chang, HDOH

BHP Hawaii Inc
733 Bishop Street Honolulu Hawaii 96813 USA
PO Box 3379 Honolulu Hawaii 96842 USA
Telephone 808 547 3111 Facsimile 808 547 3145

Table 1. Comparison of groundwater analytical results of total metals vs. dissolved metals
BHP Hawaii Refinery

Well MW-3 low tidal (Aug. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.02	<0.02	0
Barium	mg/l	1.0	0.02	0.02	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.002	<0.002	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.02	<0.02	0
Vanadium	mg/l	NE	0.01	0.01	0

* Parameters below detection limits are expressed as less than the detection limit value.

Well MW-3 high tidal (Aug. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.02	<0.02	0
Barium	mg/l	1.0	0.03	0.03	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.002	<0.002	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.02	<0.02	0
Vanadium	mg/l	NE	0.02	<0.01	0.01

* Parameters below detection limits are expressed as less than the detection limit value.

Table 1. Comparison of groundwater analytical results of total metals vs. dissolved metals
BHP Hawaii Refinery (continue)

Well MW-4 low tidal (Aug. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.02	<0.02	0
Barium	mg/l	1.0	0.02	0.02	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.002	<0.002	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.02	<0.02	0
Vanadium	mg/l	NE	0.01	0.01	0

* Parameters below detection limits are expressed as less than the detection limit value.

Well MW-4 high tidal (Aug. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.02	<0.02	0
Barium	mg/l	1.0	0.03	0.03	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.002	<0.002	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.02	<0.02	0
Vanadium	mg/l	NE	0.02	0.01	0.01

* Parameters below detection limits are expressed as less than the detection limit value.

Table 1. Comparison of groundwater analytical results of total metals vs. dissolved metals
BHP Hawaii Refinery (continue)

Well MW-5 low tidal (Aug. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.02	<0.02	0
Barium	mg/l	1.0	0.01	0.01	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.003	<0.003	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.02	<0.02	0
Vanadium	mg/l	NE	0.02	0.02	0

* Parameters below detection limits are expressed as less than the detection limit value.

Well MW-5 high tidal (Aug. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.02	<0.02	0
Barium	mg/l	1.0	0.01	0.01	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.002	<0.002	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.02	<0.02	0
Vanadium	mg/l	NE	0.01	0.01	0

* Parameters below detection limits are expressed as less than the detection limit value.

Table 1. Comparison of groundwater analytical results of total metals vs. dissolved metals
BHP Hawaii Refinery (continue)

Well MW-6 low tidal (Aug. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.01	<0.01	0
Barium	mg/l	1.0	0.01	0.01	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	0.01	0
Lead	mg/l	0.05	<0.002	<0.002	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.02	<0.02	0
Vanadium	mg/l	NE	0.02	0.02	0

* Parameters below detection limits are expressed as less than the detection limit value.

Well MW-6 high tidal (Aug. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.01	<0.01	0
Barium	mg/l	1.0	0.02	0.01	0.01
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	0.01	<0.01	0
Lead	mg/l	0.05	<0.002	<0.002	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.02	<0.02	0
Vanadium	mg/l	NE	0.02	0.02	0

* Parameters below detection limits are expressed as less than the detection limit value.

Table 1. Comparison of groundwater analytical results of total metals vs. dissolved metals
BHP Hawaii Refinery (continue)

Well CW-4A low tidal (Aug. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.02	<0.02	0
Barium	mg/l	1.0	<0.01	<0.01	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.02	<0.02	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.02	<0.04	DL diff.
Vanadium	mg/l	NE	0.01	0.01	0

* Parameters below detection limits are expressed as less than the detection limit value.

Well CW-4A high tidal (Aug. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.02	<0.02	0
Barium	mg/l	1.0	<0.01	<0.01	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.02	<0.02	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	0.052	<0.02	0.032
Vanadium	mg/l	NE	0.01	0.01	0

* Parameters below detection limits are expressed as less than the detection limit value.

Table 1. Comparison of groundwater analytical results of total metals vs. dissolved metals
BHP Hawaii Refinery (continue)

Well CW-4B low tidal (Aug. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.02	<0.02	0
Barium	mg/l	1.0	0.03	0.03	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.02	<0.02	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.04	<0.04	0
Vanadium	mg/l	NE	<0.01	<0.01	0

* Parameters below detection limits are expressed as less than the detection limit value.

Well CW-4B high tidal (Aug. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.02	<0.02	0
Barium	mg/l	1.0	0.03	0.03	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	0.0008	<0.0005	0.0003
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.02	<0.02	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	0.065	<0.04	0.025
Vanadium	mg/l	NE	<0.01	<0.01	0

* Parameters below detection limits are expressed as less than the detection limit value.

Table 1. Comparison of groundwater analytical results of total metals vs. dissolved metals
BHP Hawaii Refinery (continue)

Well CW-4C low tidal (Aug. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.02	<0.02	0
Barium	mg/l	1.0	0.02	0.02	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.02	<0.02	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	0.059	<0.04	0.019
Vanadium	mg/l	NE	<0.01	<0.01	0

* Parameters below detection limits are expressed as less than the detection limit value.

Well CW-4C high tidal (Aug. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.02	<0.02	0
Barium	mg/l	1.0	0.02	0.02	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.02	<0.02	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	0.043	<0.04	0.003
Vanadium	mg/l	NE	<0.01	<0.01	0

* Parameters below detection limits are expressed as less than the detection limit value.

Table 1. Comparison of groundwater analytical results of total metals vs. dissolved metals
BHP Hawaii Refinery (continue)

Well MW-4 (May 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	0.004	0.004	0
Barium	mg/l	1.0	<0.01	<0.01	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.0005	<0.0005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.002	<0.002	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.005	<0.005	0
Vanadium	mg/l	NE	0.02	0.02	0

* Parameters below detection limits are expressed as less than the detection limit value.

Well MW-5 (May 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	0.014	0.012	0.002
Barium	mg/l	1.0	0.01	<0.01	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.0005	<0.0005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	0.01	<0.01	0
Lead	mg/l	0.05	<0.002	<0.002	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	0.006	0.009	?
Vanadium	mg/l	NE	0.02	0.02	0

* Parameters below detection limits are expressed as less than the detection limit value.

Table 1. Comparison of groundwater analytical results of total metals vs. dissolved metals
BHP Hawaii Refinery (continue)

Well MW-6 (May 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	0.003	<0.002	0.001
Barium	mg/l	1.0	0.01	0.01	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.0005	<0.0005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	0.01	0.02	?
Lead	mg/l	0.05	<0.002	<0.002	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.005	<0.005	0
Vanadium	mg/l	NE	0.02	0.02	0

* Parameters below detection limits are expressed as less than the detection limit value.

Well MW-3 (May 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	0.004	0.004	0
Barium	mg/l	1.0	<0.01	<0.01	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.0005	<0.0005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.002	<0.002	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.005	<0.005	0
Vanadium	mg/l	NE	0.02	0.02	0

* Parameters below detection limits are expressed as less than the detection limit value.

Table 1. Comparison of groundwater analytical results of total metals vs. dissolved metals
BHP Hawaii Refinery (continue)

Well MW-4 (Feb. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	0.004	0.006	?
Barium	mg/l	1.0	<0.01	<0.01	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	0.003	<0.002	0.001
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.003	<0.003	0
Vanadium	mg/l	NE	0.01	0.01	0

* Parameters below detection limits are expressed as less than the detection limit value.

Well MW-5 (Feb. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	0.015	0.011	0.004
Barium	mg/l	1.0	0.01	0.01	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	0.02	<0.01	0
Lead	mg/l	0.05	<0.002	<0.002	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	0.013	0.013	0
Vanadium	mg/l	NE	0.02	0.02	0

* Parameters below detection limits are expressed as less than the detection limit value.

Table 1. Comparison of groundwater analytical results of total metals vs. dissolved metals
BHP Hawaii Refinery (continue)

Well MW-6 (Feb. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	<0.003	<0.002	DL diff.
Barium	mg/l	1.0	0.01	0.01	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	0.02	<0.01	0.01
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	0.03	0.02	0.01
Lead	mg/l	0.05	<0.002	<0.002	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.005	<0.002	DL diff.
Vanadium	mg/l	NE	0.01	0.02	?

* Parameters below detection limits are expressed as less than the detection limit value.

Well MW-3 (Feb. 1994)

Parameter*	Units	MCL (1992)	Total amount	Dissolved amount	Difference
Arsenic	mg/l	0.05	0.003	0.004	?
Barium	mg/l	1.0	<0.01	<0.01	0
Beryllium	mg/l	0.004	<0.005	<0.005	0
Cadmium	mg/l	0.005	<0.005	<0.005	0
Cobalt	mg/l	NE	<0.01	<0.01	0
Chromium	mg/l	0.10	<0.01	<0.01	0
Mercury	mg/l	0.002	<0.0005	<0.0005	0
Nickel	mg/l	0.10	<0.01	<0.01	0
Lead	mg/l	0.05	<0.002	<0.002	0
Antimony	mg/l	0.006	<0.03	<0.03	0
Selenium	mg/l	0.05	<0.003	<0.002	DL diff.
Vanadium	mg/l	NE	0.01	0.01	0

* Parameters below detection limits are expressed as less than the detection limit value.

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September 28, 1994

BHP Hawaii

CERTIFIED MAIL NO. P-101-726-890
RETURN RECEIPT REQUESTED

Ms. Paula Bisson, Chief
Arizona, Nevada, Pacific Island Section (H-2-2)
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, California 94105

Dear Ms. Bisson:

Revisions to Groundwater Monitoring Plan
October 19, 1993
HID 056786395

This letter is regarding a revision to the sampling of the Groundwater Monitoring Plan (GMP) which was approved by EPA on August 19, 1994.On page 15 of the GMP, it stated:

"For the first quarterly sampling event, sample sets will be collected at each monitoring well twice in the same 24-hour period to account for the possible dilutionary effects of tidal influences... If the first quarter sampling results indicate a change of 20% or greater for 90% of the analytical parameters, then two sample sets will be collected for the remaining three quarterly sampling events. If the first quarter sampling results indicate a change between the two sampling sets of less than 20% for 90% of the analytical parameters, then the remaining three quarterly sampling events will be limited to only one sample set."

As stated in a letter to EPA on July 19, 1994 and approved by EPA on August 19, 1994, BHP Petroleum Americas Refining Inc. conducted the groundwater sampling twice within a 24-hour period in August 1994 at all four monitoring wells (MW-3, MW-4, MW-5, and MW-6) plus cluster wells CW-4A, CW-4B, and CW-4C to measure the high and low tidal effects on water quality. Based on the previous hydrogeological characterization study conducted at the Refinery (January 1993), there is a time lag of 3 to 4 hours between the sea level at Barbers Point and the water level in the Refinery monitoring wells. Therefore, the sampling time was adjusted to match the possible highest and the lowest water levels in the wells.

BHP Hawaii Inc
733 Bishop Street Honolulu Hawaii 96813 USA
PO Box 3379 Honolulu Hawaii 96842 USA
Telephone 808 547 3111 Facsimile 808 547 3145

The analytical results are summarized in Table 1 (enclosed). It is clear from Table 1 that none of the seven wells sampled indicates a change of 20% or greater for 90% of the analytical parameters (it is between 4% and 14%). The analytical result of the two sets of samples indicates that there is no significant difference between samples collected at high tide verse low tide (a tide figure is also enclosed). It does not meet the requirement for sampling twice as specified in the GMP.

Another factor that needs to be considered is that we will conduct groundwater sampling in all 26 groundwater monitoring wells in the Refinery during our next four quarterly sampling events as required by the GMP. It is very difficult to conduct the sampling twice within a 24-hour time period with so many wells that requires excessive manpower. It is also extremely expensive to analyze the extra set of ground water samples for so many wells.

We feel that the excessive sampling, testing, and the extra expense are not justifiable from the technical as well as the economical point of view as indicated above. Therefore, BHP Petroleum Americas Refining Inc. asks EPA's approval to conduct future quarterly groundwater sampling on one (1) set basis as we did in the past. We believe this approach can provide sufficient data information for our groundwater monitoring purpose.

We look forward to receiving your favorable response. Please contact our hydrogeologist - Mr. Tony Shan at (808) 547-3804 should you or your staff have any questions.

Sincerely,

J. Kapel /FDC

Frank D. Clouse
Refinery Manager

Enclosure

cc: Mr. Mitch Kaplan, EPA
Mr. Steven Y. K. Chang, HDOH

BHP PETROLEUM AMERICAS REFINING INC.
GROUNDWATER ELEVATION DATA

Well I.D. No.	Date [a]	Time [a]	Top of Stainless Steel or PVC Casing Elevation (ft,MSL) [b]	Top of Concrete Apron Elevation (ft,MSL) [c]	Ground Surface Elevation (ft,MSL) [c]	Depth to Oil (ft)	Depth to Water (ft)	Oil Thickness (ft)	Corrected Depth to Water (ft) [d]	Corrected Water Table Elevation (ft,MSL) [e]
MW-3	8/10/94	10:25am	12.81	11.76	11.11	12.00	12.08	0.08	12.01	0.80
		15:39pm				12.17	12.27	0.10	12.18	0.63
MW-4	8/10/94	11:40am	13.29	12.15	11.75	12.45	12.93	0.48	12.51	0.78
		16:40pm				12.45	12.86	0.41	12.50	0.79
MW-5	8/10/94	9:39am	13.58	11.85	11.05	12.66	12.66	0.0	12.66	0.92
		14:39pm				12.89	12.89	0.0	12.89	0.69
MW-6	8/10/94	8:42am	13.12	11.58	11.28	12.30	12.39	0.09	12.31	0.81
		13:56pm				12.53	12.64	0.11	12.54	0.58
CW4A	8/10/94	9:24am	12.24	N/A	10.07	N/A	11.07	0.0	11.07	1.17
		14:30pm					11.25	0.0	11.25	0.99
CW4B	8/10/94	10:50am	12.01	N/A	9.68	N/A	10.92	0.0	10.92	1.09
		15:55pm					11.13	0.0	11.13	0.88
CW4C	8/10/94	11:50am	12.13	N/A	9.74	N/A	11.35	0.0	11.35	0.78
		16:50pm					11.37	0.0	11.37	0.76

(a) Date and time of water level measurements; all oil samples were taken on August 9, 1994

(b) Survey conducted in 8/87 for MW-3, MW-4, MW-5, MW-6; and in 6/92 for CW-4A, CW-4B, and CW-4C

(c) Survey conducted 9/17/91

(d) Corrected depth to water = depth to water-(oil thickness x specific gravity)
Note: Specific gravities of oils were measured by the laboratory to be 0.88 for MW-3, MW-4, and MW-5; and 0.87 for MW-6.

(e) Corrected water table elevation = top of casing elevation - corrected depth to water

Quality Assurance Investigation

Date: 9/19/94
by: Pat Schroder/Leslie Getman
Subject Chlorobenzene in water sample

Client: Environmental Technologies, Inc.
Accession: 408168
Project: Pond 1 Quarterly Monitoring

Problem: A 2200ppb hit for Chlorobenzene was reported for 8240 analysis of sample 408168-01 (HMW-6). The client was not expecting this and questioned the validity of the result.

Action 1: Raw Data Review: Original runs diluted by a factor 50 and 20 were reviewed. A large hit was seen for Chlorobenzene that was run just prior to the 50X dilution (screen) of the sample. The rerun (analysis #2: 20X) followed a 500ppb hit for Chlorobenzene. (There is a also possibility of cross contamination from the 5ml loading syringe and the 500ul sample delivery syringe, since these samples were loaded after one another). Most samples run in the tubes prior to this accession's first and second runs had hits of Chlorobenzene. The 50X run followed a 3200ppb Chlorobenzene; it showed a 39ppb hit (X50 = 1950ppb). The 20X run followed a 500ppb hit for Chlorobenzene; it showed 112ppb hit (X20 = 2240ppb).

Action 2: Reanalysis of Sample Past Holding Time :Additional sample from a liter bottle with no head space was run and Chlorobenzene was not found (<1ug/L). The VOA vials were then located. The second, previously unopened vial (no head space), was then run at 1:20 and no Chlorobenzene was found (<20ug/L). The original bottle, whose septa had been pierced with a needle during the original 50X and 20X runs, was rerun straight. No Chlorobenzene was seen (<1ug/L). These reruns were made after the holding time expired. A second analysis (at 1X) is now being run. VOA vials were checked and found to be preserved properly (9/19/94).

Discussion of Results: These results are contradictory and therefore inconclusive.

Point A: The results of the two initial runs match very closely which one would not expect to happen with random carry over at two different dilutions. It should also be pointed out that if 39 ppb carried over after 3200ppb hit, on the second run 112ppb would not be expected to carry over from a hit of 500ppb. We would expect at least some system contamination after a 3200ppb hit, but we would expect it to start out high and to get incrementally smaller.

Point B: If 2200ppb were found in a sample, reanalysis of a preserved sample three to four weeks later would be expected to show at least 20 to 50 % of that value, even past the 14 day holding time.

Conclusion: Possibility of contamination from carryover cannot be ruled out. If resampling is possible ATI will expedite an 8240 analysis at no charge.

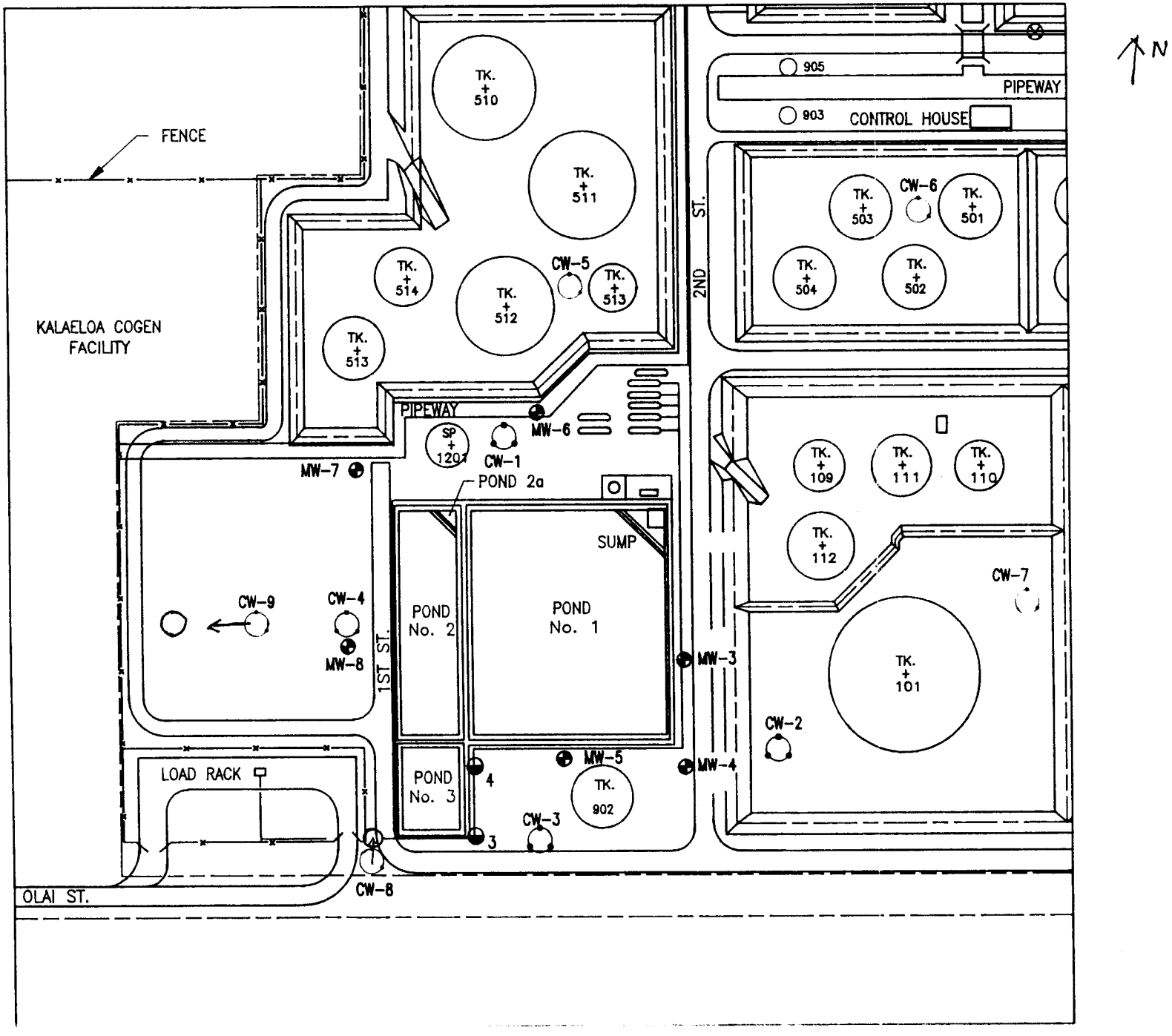
N
FENCE
KALAELOA COGEN FACILITY
TK. + 510
TK. + 511
TK. + 512
TK. + 513
TK. + 514
TK. + 513
CW-5
PIPEWAY
MW-6
SP + 1201
CW-1
MW-7
POND 2a
SUMP
POND No. 2
POND No. 1
POND No. 3
1ST ST.
2ND ST.
CW-9
CW-4
MW-8
LOAD RACK
4
3
MW-5
TK. 902
CW-3
MW-3
MW-4
CW-8
OLAI ST.
905
903
PIPEWAY
CONTROL HOUSE
TK. + 503
CW-6
TK. + 501
TK. + 504
TK. + 502
TK. + 109
TK. + 111
TK. + 110
TK. + 112
CW-7
TK. + 101
CW-2

Table 1. Comparison of groundwater analytical results of high tide vs low tide

Parameter Lab Id #	Units	Low MW-3	High MW-3	Percent Diff.	Low MW-4	High MW-4	Percent Diff.	Low MW-5	High MW-5	Percent Diff.	Low MW-6	High MW-6	Percent Diff.	Low CW-4A	High CW-4A	Percent Diff.	Low CW-4B	High CW-4B	Percent Diff.	Low CW-4C	High CW-4C	Percent Diff.	% of Wells Where Diff. >20%
Carbonate as CaCO3	mg/l	<5.0	<5.0	0%	<5.0	<5.0	0%	<5.0	<5.0	0%	<5.0	<5.0	0%	<5.0	<5.0	0%	<5.0	<5.0	0%	<5.0	<5.0	0%	0%
Bicarbonate as CaCO3	mg/l	544	527	3%	506	447	12%	534	520	3%	1090	1080	1%	706	696	1%	195	177	10%	135	140	4%	0%
Hydroxide as CaCO3	mg/l	<5.0	<5.0	0%	<5.0	<5.0	0%	<5.0	<5.0	0%	<5.0	<5.0	0%	<5.0	<5.0	0%	<5.0	<5.0	0%	<5.0	<5.0	0%	0%
Total Alkalinity as CaCO3	mg/l	544	527	3%	506	447	12%	534	520	3%	1090	1080	1%	706	696	1%	195	177	10%	135	140	4%	0%
Chloride	mg/l	3220	3360	4%	2210	3310	40%	1120	1150	3%	1410	1500	6%	1850	1880	2%	12300	12700	3%	14200	14100	1%	14%
Electrical Conductivity	umhos/cm	11600	12300	6%	9440	12200	26%	6970	6860	2%	6200	6580	6%	8140	8440	4%	32800	33800	3%	36500	36500	0%	14%
Fluoride	mg/l	<0.5	<0.5	0%	<0.5	<0.5	0%	<0.5	<0.5	0%	<0.5	0.61	84%	<0.5	<0.5	0%	<0.5	<0.5	0%	0.9	0.64	34%	29%
Surfactants (MBAS)	mg/l	0.26	0.3	14%	0.25	0.16	44%	0.22	0.15	38%	0.41	0.35	16%	<0.1	0.16	105%	<0.1	<0.1	0%	<0.1	<0.1	0%	43%
Nitrate-Nitrite as Nitrogen	mg/l	<0.05	<0.05	0%	<0.05	<0.05	0%	<0.05	<0.05	0%	<0.05	<0.05	0%	<0.05	<0.05	0%	0.05	<0.05	67%	1.4	1.1	24%	29%
pH	units	7.81	7.79	0%	7.82	7.77	1%	7.84	7.85	0%	7.32	7.37	1%	7.85	7.84	0%	7.14	7.21	1%	7.44	7.44	0%	0%
Sulfate	mg/l	1330	1400	5%	1330	1990	40%	1610	1930	18%	212	277	27%	1170	1190	2%	2830	2290	21%	2890	2960	2%	43%
Total Dissolved Solids	mg/l	7400	7720	4%	5740	8020	33%	4770	4640	3%	3640	3880	6%	5000	5220	4%	27500	23900	14%	24600	27500	11%	14%
Total Arsenic	mg/l	<0.02	<0.02	0%	<0.02	<0.02	0%	<0.02	<0.02	0%	<0.01	<0.01	0%	<0.02	<0.02	0%	<0.02	<0.02	0%	<0.02	<0.02	0%	0%
Total Barium	mg/l	0.02	0.03	40%	0.02	0.03	40%	0.01	0.01	0%	0.01	0.02	67%	<0.01	<0.01	0%	0.03	0.03	0%	0.02	0.02	0%	43%
Total Beryllium	mg/l	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	0%
Total Cadmium	mg/l	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	0%
Total Cobalt	mg/l	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	0%
Total Chromium	mg/l	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	0%
Total Mercury	mg/l	<0.0005	<0.0005	0%	<0.0005	<0.0005	0%	<0.0005	<0.0005	0%	<0.0005	<0.0005	0%	<0.0005	<0.0005	0%	<0.0005	0.0008	105%	<0.0005	<0.0005	0%	14%
Total Nickel	mg/l	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	0.01	67%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	14%
Total Lead	mg/l	<0.002	<0.002	0%	<0.002	<0.002	0%	0.003	<0.002	100%	<0.002	<0.002	0%	<0.02	<0.01	0%	<0.02	<0.02	0%	<0.02	<0.02	0%	14%
Total Antimony	mg/l	<0.03	<0.03	0%	<0.03	<0.03	0%	<0.03	<0.03	0%	<0.03	<0.03	0%	<0.03	<0.03	0%	<0.03	<0.03	0%	<0.03	<0.03	0%	0%
Total Selenium	mg/l	<0.02	<0.02	0%	<0.02	<0.02	0%	<0.02	<0.02	0%	<0.02	<0.02	0%	<0.02	0.052	135%	<0.04	0.065	106%	0.059	0.043	31%	43%
Total Vanadium	mg/l	0.01	0.02	67%	0.01	0.02	67%	0.02	0.01	67%	0.02	0.02	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	43%
Dissolved Arsenic	mg/l	<0.02	<0.02	0%	<0.02	<0.02	0%	<0.02	<0.02	0%	<0.01	<0.01	0%	<0.02	<0.02	0%	<0.02	<0.02	0%	<0.02	<0.02	0%	0%
Dissolved Barium	mg/l	0.02	0.03	40%	0.02	0.03	40%	0.01	0.01	0%	0.01	0.01	0%	<0.01	<0.01	0%	0.03	0.03	0%	0.02	0.02	0%	29%
Dissolved Beryllium	mg/l	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	0%
Dissolved Cadmium	mg/l	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	<0.005	<0.005	0%	0%
Dissolved Cobalt	mg/l	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	0%
Dissolved Chromium	mg/l	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	0%
Dissolved Mercury	mg/l	<0.0005	<0.0005	0%	<0.0005	<0.0005	0%	<0.0005	<0.0005	0%	<0.0005	<0.0005	0%	<0.0005	<0.0005	0%	<0.0005	<0.0005	0%	<0.0005	<0.0005	0%	0%
Dissolved Nickel	mg/l	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	0.01	<0.01	67%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	14%
Dissolved Lead	mg/l	<0.002	<0.002	0%	<0.003	<0.002	0%	<0.003	<0.003	0%	<0.002	<0.002	0%	<0.02	<0.02	0%	<0.02	<0.02	0%	<0.02	<0.02	0%	0%
Dissolved Antimony	mg/l	<0.03	<0.03	0%	<0.03	<0.03	0%	<0.03	<0.03	0%	<0.03	<0.03	0%	<0.03	<0.03	0%	<0.03	<0.03	0%	<0.03	<0.03	0%	0%
Dissolved Selenium	mg/l	<0.02	<0.02	0%	<0.02	<0.02	0%	<0.02	<0.02	0%	<0.02	<0.02	0%	<0.04	<0.02	0%	<0.04	<0.04	0%	<0.04	<0.04	0%	0%
Dissolved Vanadium	mg/l	0.01	<0.01	67%	0.01	0.01	0%	0.02	0.01	67%	0.02	0.02	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	<0.01	<0.01	0%	29%
Carbon Disulfide	ug/l	<2	<2	0%	<2	<2	0%	<2	<2	0%	<2	<40	0%	<2	<2	0%	<2	<2	0%	<2	<2	0%	0%
1,4-Dioxane	ug/l	<200	<200	0%	<200	<200	0%	<200	<200	0%	<200	<4000	0%	<200	<200	0%	<200	<200	0%	<200	<200	0%	0%
Chloroform	ug/l	<1	<1	0%	<1	<1	0%	<1	<1	0%	<1	<20	0%	<1	<1	0%	<1	<1	0%	<1	<1	0%	0%
Ethylene Dibromide	ug/l	<5	<5	0%	<5	<5	0%	<5	<5	0%	<5	<100	0%	<5	<5	0%	<5	<5	0%	<5	<5	0%	0%
2-Butanone (MEK)	ug/l	<10	<10	0%	<10	<10	0%	<10	<10	0%	<10	<200	0%	<10	<10	0%	<10	<10	0%	<10	<10	0%	0%
Cyclohexane	ug/l	<10	<10	0%	<10	<10	0%	<10	<10	0%	<10	<200	0%	<10	<10	0%	<10	<10	0%	<10	<10	0%	0%
1,2-Dichloroethene	ug/l	<1	<1	0%	<1	<1	0%	<1	<1	0%	<1	<20	0%	<1	<1	0%	<1	<1	0%	<1	<1	0%	0%
Benzene	ug/l	8	7	13%	2	2	0%	<1	<1	0%	8	<20	22%	1	1	0%	<1	<1	0%	<1	<1	0%	14%
Toluene	ug/l	<2	<2	0%	<2	<2	0%	<2	<2	0%	<2	<40	0%	<2	<2	0%	<2	<2	0%	<2	<2	0%	0%

	UNITS	LOW MW-3	HIGH MW-3	% DIF	LOW MW-4	HIGH MW-4	% DIF	LOW MW-5	HIGH MW-5	% DIF	LOW MW-6	HIGH MW-6	% DIF	LOW CW-4A	HIGH CW-4A	% DIF	LOW CW-4B	HIGH CW-4B	% DIF	LOW CW-4C	HIGH CW-4C	% DIF	% WELLS DIF>20%
Chlorobenzene	ug/l	<1	<1	0%	<1	<1	0%	13	<1	185%	<1	[redacted]	200%	<1	<1	0%	<1	<1	0%	<1	<1	0%	29%
Ethylbenzene	ug/l	<1	5	164%	4	2	67%	<1	5	164%	<1	<20	0%	<1	2	120%	<1	<1	0%	<1	<1	0%	57%
Xylenes (Total)	ug/l	<1	<1	0%	<1	<1	0%	<1	2	120%	<1	<20	0%	2	2	0%	<1	<1	0%	<1	<1	0%	14%
Styrene	ug/l	<2	<2	0%	<2	<2	0%	<2	<2	0%	<2	<40	0%	<2	<2	0%	<2	<2	0%	<2	<2	0%	0%
Anthracene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Benzo(a)Anthracene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Benzo(b)Fluoranthene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Benzo(k)Fluoranthene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Benzo(a)Pyrene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Bis(2-Ethylhexyl)Phthalate	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Butylbenzylphthalate	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Chrysene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Dibenz(a,h)Acridine	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Dibenz(a,h)Anthracene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
1,2-Dichlorobenzene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
1,3-Dichlorobenzene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
1,4-Dichlorobenzene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Diethylphthalate	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
7,12-Dimethylbenzo(a)anthracene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Dimethylphthalate	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Di-N-Butylphthalate	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Di-N-Octylphthalate	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Fluoranthene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Naphthalene	ug/l	110	110	0%	31	49	45%	<25	<25	0%	<25	42	108%	<10	<20	0%	<10	<10	0%	<10	<10	0%	29%
Phenanthrene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Pyrene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
2-Methylnaphthalene	ug/l	38	26	38%	<25	25	200%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	29%
Benzenethiol	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
4-Nitrophenol	ug/l	<130	<130	0%	<130	<130	0%	<130	<130	0%	<130	<130	0%	<50	<100	0%	<50	<50	0%	<50	<50	0%	0%
2,4-Dimethylphenol	ug/l	<25	<25	0%	<25	<25	0%	28	<25	77%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	14%
2,4-Dinitrophenol	ug/l	<130	<130	0%	<130	<130	0%	<130	<130	0%	<130	<130	0%	<50	<100	0%	<50	<50	0%	<50	<50	0%	0%
Phenol	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
2-Methylphenol	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
3- & 4-Methylphenol	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
Indene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
1-Methylnaphthalene	ug/l	130	150	14%	90	280	103%	64	73	13%	110	93	17%	<10	23	200%	<10	<10	0%	<10	<10	0%	29%
Pyridine	ug/l	<130	<130	0%	<130	<130	0%	<130	<130	0%	<130	<130	0%	<50	<100	0%	<50	<50	0%	<50	<50	0%	0%
Quinoline	ug/l	<130	<130	0%	<130	<130	0%	<130	<130	0%	<130	<130	0%	<50	<100	0%	<50	<50	0%	<50	<50	0%	0%
6-Methyl Chrysene	ug/l	<25	<25	0%	<25	<25	0%	<25	<25	0%	<25	<25	0%	<10	<20	0%	<10	<10	0%	<10	<10	0%	0%
% of parameters where diff. > 20%				7%			14%			10%			10%			5%			5%			4%	

1. Shaded box indicates error suspected. Previous groundwater monitoring events and the sample collected at low tide did not reveal high concentrations of chlorobenzene in the groundwater.
2. For chemical concentration below detection limit one-half of the detection limit value is used for calculation.
3. The percentage difference is calculated as $\{|C_H - C_L| / [(C_H + C_L) / 2]\} * 100$

Outrigger pearl div Photo by Darrell Wong

AUGUST 1994

Time lag 3-4 hours

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
31 July R 6:05am S 7:41pm R 12:30pm S 1:52pm AM L 4:07 0.3 PM H 12:07 1.7 L 7:38 0.7 H 10:43 0.8	1 R 6:05am S 7:40pm R 1:13am S 2:43pm AM L 4:59 0.2 PM H 12:55 1.9 L 6:23 0.6	2 R 6:05am S 7:10pm R 2:00am S 3:33pm AM H 12:03 0.8 L 5:51 0.2 PM H 1:36 2.0 L 6:54 0.5	3 R 6:06am S 7:09pm R 2:50am S 4:23pm AM H 1:04 0.8 L 6:39 0.1 PM H 2:12 2.1 L 9:21 0.5	4 R 6:06am S 7:09pm R 3:43am S 5:11pm AM H 1:49 0.9 L 7:23 0.1 PM H 2:46 2.2 L 9:47 0.4	5 R 6:07am S 7:08pm R 4:38am S 5:57pm AM H 2:33 1.0 L 8:06 0.0 PM H 3:19 2.3 L 10:13 0.3	6 R 6:07am S 7:07pm R 5:34am S 6:42pm AM H 3:15 1.1 L 8:49 0.0 PM H 3:52 2.3 L 10:43 0.2
7 R 6:07am S 7:07pm R 6:31am S 7:25pm AM H 3:58 1.2 L 9:33 0.1 PM H 4:25 2.2 L 11:10 0.2	8 R 6:08am S 7:06pm R 7:29am S 8:07pm AM H 4:43 1.3 L 10:19 0.2 PM H 5:00 2.1 L 11:41 0.1	9 R 6:08am S 7:05pm R 8:27am S 8:50pm AM H 5:32 1.4 L 11:09 0.3 PM H 5:36 1.9	10 R 6:08am S 7:05pm R 9:26am S 9:33pm AM L 12:14 0.1 H 6:26 1.5 PM L 12:07 0.5 H 6:13 1.7	11 R 6:09am S 7:04pm R 10:26am S 10:18pm AM L 12:50 0.1 H 7:26 1.6 PM L 1:16 0.6 H 6:53 1.5	12 R 6:09am S 7:04pm R 11:27am S 11:06pm AM L 1:31 0.1 H 8:35 1.7 PM L 2:47 0.8 H 7:40 1.2	13 R 6:09am S 7:03pm R 12:28pm S 11:58pm AM L 2:17 0.1 H 9:51 1.8 PM L 4:45 0.8 H 8:43 1.0
14 R 6:10am S 7:02pm R 1:30pm AM L 3:13 0.1 H 11:06 2.0 PM L 6:33 0.7 H 10:14 0.9	15 R 6:10am S 7:02pm S 12:52am R 2:30pm AM L 4:18 0.2 PM H 12:11 2.1 L 7:40 0.5 H 11:45 0.8	16 R 6:10am S 7:01pm S 1:48am R 3:27pm AM L 5:25 0.1 PM H 1:06 2.2 L 8:26 0.4	17 R 6:11am S 7:00pm S 2:47am R 4:20pm AM H 1:01 0.9 L 6:26 0.1 PM H 1:53 2.3 L 9:00 0.3	18 R 6:11am S 6:59pm S 3:46am R 5:10pm AM H 1:56 1.0 L 7:23 0.1 PM H 2:34 2.3 L 9:32 0.3	19 R 6:11am S 6:58pm S 4:45am R 5:56pm AM H 2:43 1.1 L 8:18 0.1 PM H 3:12 2.3 L 10:00 0.2	20 R 6:12am S 6:58pm S 5:42am R 6:37pm AM H 3:25 1.2 L 8:59 0.2 PM H 3:45 2.2 L 10:27 0.2
21 R 6:12am S 6:57pm S 6:37am R 7:16pm AM H 4:04 1.3 L 9:43 0.2 PM H 4:18 2.1 L 10:54 0.2	22 R 6:12am S 6:56pm S 7:30am R 7:54pm AM H 4:43 1.4 L 10:26 0.3 PM H 4:50 1.9 L 11:20 0.2	23 R 6:12am S 6:55pm S 8:22am R 8:31pm AM H 5:23 1.5 L 11:10 0.4 PM H 5:20 1.7 L 11:47 0.3	24 R 6:13am S 6:54pm S 9:13am R 9:00pm AM H 6:05 1.6 L 11:58 0.6 PM H 5:51 1.5	25 R 6:13am S 6:54pm S 10:03am R 9:48pm AM L 12:15 0.3 H 6:51 1.6 PM L 12:53 0.7 H 6:22 1.3	26 R 6:13am S 6:53pm S 10:54am R 10:26pm AM L 12:45 0.3 H 7:45 1.6 PM L 2:03 0.6 H 6:55 1.2	27 R 6:14am S 6:52pm S 11:44am R 11:00pm AM L 1:20 0.4 H 8:50 1.6 PM L 3:44 0.9 H 7:37 1.0
28 R 6:14am S 6:51pm S 12:34pm R 11:53pm AM L 2:05 0.4 H 10:03 1.7 PM L 5:47 0.8 H 8:50 0.9	29 R 6:14am S 6:50pm S 1:24pm AM L 3:05 0.5 H 11:13 1.8 PM L 7:01 0.7 H 10:37 0.8	30 R 6:14am S 6:49pm R 12:41am S 2:13pm AM L 4:15 0.5 PM H 12:09 1.9 L 7:38 0.6 H 11:27 0.9	31 R 6:15am S 6:48pm R 1:32am S 3:02pm AM L 5:22 0.4 PM H 12:54 2.0 L 8:35 0.5			

The Gas Company®

BHP Hawaii

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BHP

September 28, 1994

CERTIFIED MAIL NO. P-101-726-890
RETURN RECEIPT REQUESTED

BHP Hawaii

Ms. Paula Bisson, Chief
Arizona, Nevada, Pacific Island Section (H-2-2)
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, California 94105

Dear Ms. Bisson:

Groundwater Analytical Results
HID 056786395

BHP Petroleum Americas Refining Inc., submits, for your review, the enclosed report on the above subject for August 1994. Pursuant to the requirements of the Revised Groundwater Sampling and Analysis Plan (August 28, 1991), samples of free product floating on the water table in the monitoring wells were also analyzed during this quarterly groundwater monitoring event, and the analytical results are also enclosed.

As stated in a letter sent to EPA dated July 19, 1994, we conducted the groundwater sampling twice within a 24-hour time period at all four monitoring wells (MW3, 4, 5, and 6) plus cluster well CW-4A, 4B, and 4C to measure the high and low tidal effects on water quality. Therefore, two sets of analytical data (high tidal vs. low tidal) for the above wells are submitted. Please contact Mr. Tony Shan at (808) 547-3804 should you have any questions.

Sincerely,

Frank D. Clouse
Refinery Manager

Enclosure

cc: Mr. Steven Y. K. Chang, HDOH
CERTIFIED MAIL NO. P-101-726-891
RETURN RECEIPT REQUESTED

BHP Hawaii Inc
733 Bishop Street Honolulu Hawaii 96813 USA
PO Box 3379 Honolulu Hawaii 96842 USA
Telephone 808 547 3111 Facsimile 808 547 3145

BHP PETROLEUM AMERICAS REFINING INC.

GROUNDWATER ANALYTICAL RESULTS

AUGUST 1994

CONTENTS

1. Groundwater monitoring well locations.

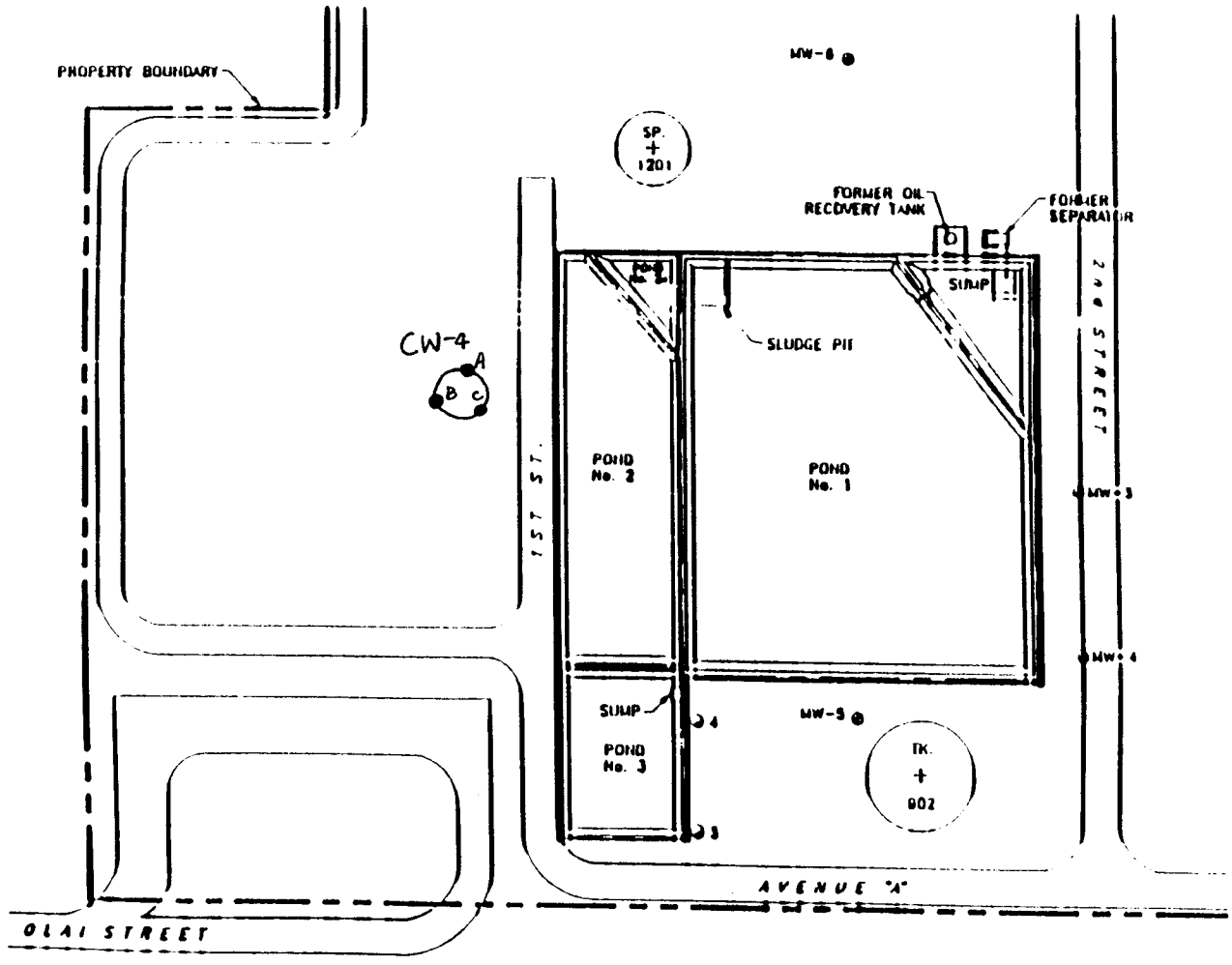
2. Analytical results of groundwater.

3. Analytical results of duplicate groundwater sample from monitoring well No. 4.

4. Analytical results of free product from monitoring wells.

5. Groundwater elevation data.

1. GROUNDWATER MONITORING WELL LOCATIONS



EXPLANATION

MW-6 ● Ground-Water Monitoring
4 ● Injection Well

SCALE

100 50 0 100 FEET

1 INCH = 100 FEET

Figure 3 :

POND NO. 1 WITH GROUND-WAT
MONITORING WELL LOCATIONS

2. ANALYTICAL RESULTS OF GROUNDWATER

AnalyticalTechnologies, Inc. Corporate Offices: 5550 Morehouse Drive San Diego, CA 92121 (619) 458-9141

ATI I.D.: 408168

ust 25, 1994

IRONMENTAL TECHNOLOGIES INT'L, INC.
BISHOP STREET, SUITE 2600
OLULU, HI 96842

ject Name: POND 1 QUARTERLY MONITORING
ject # : PI0200-005

ention: STEPHANIE SAKURAI

lytical Technologies, Inc. has received the following sample(s):

Date Received	Quantity	Matrix
August 11, 1994	10	WATER

sample(s) were analyzed with EPA methodology or equivalent methods as specified in the closed analytical schedule. The symbol for "less than" indicates a value below the reportable ection limit. If any flags appear next to the analytical data in this report, please see the ached list of flag definitions.

results of these analyses and the quality control data are enclosed. Please note that the ple Condition Upon Receipt Checklist is included at the end of this report.

LIE GETMAN
JECT MANAGER

M. E. SHIGLEY
LABORATORY MANAGER

AnalyticalTechnologies,Inc.

SAMPLE CROSS REFERENCE

ent : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
ject # : PIO200-005
ject Name: POND 1 QUARTERLY MONITORING

Report Date: August 25, 1994
ATI I.D. : 408168

#	Client Description	Matrix	Date Collected
	HMW-6	WATER	10-AUG-94
	HMW-5	WATER	10-AUG-94
	HMW-3	WATER	10-AUG-94
	HMW-4	WATER	10-AUG-94
	HFB-1	WATER	10-AUG-94
	LMW-6	WATER	10-AUG-94
	LMW-5	WATER	10-AUG-94
	LMW-3	WATER	10-AUG-94
	LMW-4	WATER	10-AUG-94
	MW-TB/TRIP BLANK(GCMS 9239)	WATER	10-AUG-94
	HMW-6/DISSOLVED 01	WATER	10-AUG-94
	HMW-5/DISSOLVED 02	WATER	10-AUG-94
	HMW-3/DISSOLVED 03	WATER	10-AUG-94
	HMW-4/DISSOLVED 04	WATER	10-AUG-94
	HFB-1/DISSOLVED 05	WATER	10-AUG-94
	LMW-6/DISSOLVED 06	WATER	10-AUG-94
	LMW-5/DISSOLVED 07	WATER	10-AUG-94
	LMW-3/DISSOLVED 08	WATER	10-AUG-94
	LMW-4/DISSOLVED 09	WATER	10-AUG-94

---TOTALS---

Matrix	# Samples
WATER	19

ATI STANDARD DISPOSAL PRACTICE

e sample(s) from this project will be disposed of in twenty-one (21) days from the date of is report. If an extended storage period is required, please contact our sample control partment before the scheduled disposal date.

AnalyticalTechnologies,Inc.

ANALYTICAL SCHEDULE

ien : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
oject # : PIO200-005
oject Name: POND 1 QUARTERLY MONITORING

ATI I.D.: 408168

alysis	Technique/Description
20 ALKILINITY (CARBONATES, BICARBONATES)	TITRIMETRIC
A 160.1 (TOTAL DISSOLVED SOLIDS)	GRAVIMETRIC
A 340.2 (FLUORIDE)	ELECTRODE
A 353.2 (NITRATE-NITRITE AS NITROGEN)	COLORIMETRIC
A 425.1 (SURFACTANTS (MBAS))	COLORIMETRIC
A 6010 (ANTIMONY)	INDUCTIVELY COUPLED ARGON PLASMA
A 6010 (BARIUM)	INDUCTIVELY COUPLED ARGON PLASMA
A 6010 (BERYLLIUM)	INDUCTIVELY COUPLED ARGON PLASMA
A 6010 (CADMIUM)	INDUCTIVELY COUPLED ARGON PLASMA
A 6010 (CHROMIUM)	INDUCTIVELY COUPLED ARGON PLASMA
A 6010 (COBALT)	INDUCTIVELY COUPLED ARGON PLASMA
A 6010 (NICKEL)	INDUCTIVELY COUPLED ARGON PLASMA
A 6010 (VANADIUM)	INDUCTIVELY COUPLED ARGON PLASMA
A 7060 (ARSENIC)	ATOMIC ABSORPTION/GRAPHITE FURNACE
A 7421 (LEAD)	ATOMIC ABSORPTION/GRAPHITE FURNACE
A 7470 (AQUEOUS MERCURY)	ATOMIC ABSORPTION/COLD VAPOR
A 7740 (SELENIUM)	ATOMIC ABSORPTION/GRAPHITE FURNACE
A 8240 (GC/MS FOR VOLATILE ORGANICS)	GC/MASS SPECTROMETER
A 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)	GC/MASS SPECTROMETER
A [illegible]8 (SULFATE)	TURBIDIMETRIC
A [illegible]0 (pH)	ELECTRODE
A 9050 (ELECTRICAL CONDUCTIVITY)	ELECTRODE
A 9253 (CHLORIDE)	TITRIMETRIC, SILVER NITRATE

AnalyticalTechnologies,Inc.

GENERAL CHEMISTRY RESULTS

en : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
ject # : PIO200-005
ject Name: POND 1 QUARTERLY MONITORING

ATI I.D.: 408168

ple Client ID	Matrix	Date Sampled	Date Received
HMW-6	WATER	10-AUG-94	11-AUG-94
HMW-5	WATER	10-AUG-94	11-AUG-94
HMW-3	WATER	10-AUG-94	11-AUG-94
HMW-4	WATER	10-AUG-94	11-AUG-94
HFB-1	WATER	10-AUG-94	11-AUG-94

ameter	Units	1	2	3	4	5
BONATE AS CACO3	MG/L	<5.0	<5.0	<5.0	<5.0	<5.0
CARBONATE AS CACO3	MG/L	1080	520	527	447	<5.0
DROXIDE AS CACO3	MG/L	<5.0	<5.0	<5.0	<5.0	<5.0
AL ALKALINITY AS CACO3	MG/L	1080	520	527	447	<5.0
LORIDE	MG/L	1500	1150	3360	3310	<5.0
ECTRICAL CONDUCTIVITY	UMHOS/CM	6580	6860	12300	12200	6.0
JORIDE	MG/L	0.61	<0.50	<0.50	<0.50	<0.5
RFACTANTS (MBAS)	MG/L	0.35	0.15	0.30	0.16	<0.1
TRATE-NITRITE AS NITROGEN	MG/L	<0.05	<0.05	<0.05	<0.05	<0.05
	UNITS	7.37	7.85	7.79	7.77	6.58
LFATE	MG/L	277	1930	1400	1990	<10.0
TAL DISSOLVED SOLIDS	MG/L	3880	4640	7720	8020	<20

AnalyticalTechnologies,Inc.

GENERAL CHEMISTRY RESULTS

ien : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
oject # : PIO200-005
oject Name: POND 1 QUARTERLY MONITORING

ATI I.D.: 408168

nple Client ID #	Matrix	Date Sampled	Date Received
LMW-6 6	WATER	10-AUG-94	11-AUG-94
LMW-5 7	WATER	10-AUG-94	11-AUG-94
LMW-3 8	WATER	10-AUG-94	11-AUG-94
LMW-4 9	WATER	10-AUG-94	11-AUG-94

rameter	Units	6	7	8	9
RBONATE AS CACO3	MG/L	<5.0	<5.0	<5.0	<5.0
CARBONATE AS CACO3	MG/L	1090	534	544	506
DROXIDE AS CACO3	MG/L	<5.0	<5.0	<5.0	<5.0
TAL ALKALINITY AS CACO3	MG/L	1090	534	544	506
LORIDE	MG/L	1410	1120	3220	2210
ECTRICAL CONDUCTIVITY	UMHOS/CM	6200	6970	11600	9440
UORIDE	MG/L	<0.5	<0.50	<0.50	<0.50
RFACTANTS (MBAS)	MG/L	0.41	0.22	0.26	0.25
TRATE-NITRITE AS NITROGEN	MG/L	<0.05	<0.05	<0.05	<0.05
	UNITS	7.32	7.84	7.81	7.82
LFATE	MG/L	212	1610	1330	1330
TAL DISSOLVED SOLIDS	MG/L	3640	4770	7400	5740

AnalyticalTechnologies,Inc.

GENERAL CHEMISTRY - QUALITY CONTROL

DUP/MS

ient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.

ATI I.D. : 408168

oject # : PIO200-005

oject Name: POND 1 QUARTERLY MONITORING

rameters	REF I.D.	Units	Sample Result	Dup Result	RPD	Spiked Sample	Spike Conc	% Rec
CARBONATE AS CACO3	408168-04	MG/L	447	448	0	N/A	N/A	N/A
CARBONATE AS CACO3	408219-03	MG/L	1670	1670	0	N/A	N/A	N/A
RBONATE AS CACO3	408168-04	MG/L	<5.0	<5.0	0	N/A	N/A	N/A
RBONATE AS CACO3	408219-03	MG/L	44.0	44.0	0	N/A	N/A	N/A
LORIDE	408178-01	MG/L	53.0	51.0	4	90.0	40.0	93
LORIDE	408219-03	MG/L	218	219	0	265	40.0	118
LORIDE	408168-04	MG/L	3310	3320	0	3490	200	90
ECTRICAL CONDUCTIVITY	408168-04	UMHOS/CM	12200	12000	2	N/A	N/A	N/A
ECTRICAL CONDUCTIVITY	408172-06	UMHOS/CM	36500	36500	0	N/A	N/A	N/A
UORIDE	408178-01	MG/L	1.7	1.6	6	6.4	5.0	94
UORIDE	408219-03	MG/L	1.9	2.0	5	6.9	5.0	100
DROXIDE AS CACO3	408168-04	MG/L	<5.0	<5.0	0	N/A	N/A	N/A
DROXIDE AS CACO3	408219-03	MG/L	<5.0	<5.0	0	N/A	N/A	N/A
TRATE-NITRITE AS NITROGEN	408168-04	MG/L	<0.05	<0.05	0	1.4	2.0	70
TRATE-NITRITE AS NITROGEN	408093-14	MG/L	<0.05	<0.05	0	1.8	2.0	90
LFATE	408168-04	MG/L	1990	2120	6	5540	4000	89
LFATE	408178-01	MG/L	186	180	3	616	400	108
RFACTANTS (MBAS)	408168-04	MG/L	0.16	0.16	0	2.4	2.0	112
TA LKALINITY AS CACO3	408168-04	MG/L	447	448	0	N/A	N/A	N/A
TA LKALINITY AS CACO3	408219-03	MG/L	1710	1710	0	N/A	N/A	N/A
TAL DISSOLVED SOLIDS	408168-04	MG/L	8020	7920	1	N/A	N/A	N/A
TAL DISSOLVED SOLIDS	408240-01	MG/L	<20	<20	0	N/A	N/A	N/A
I	408168-04	UNITS	7.77	7.77	0	N/A	N/A	N/A

Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration

PD (Relative % Difference) = (Sample Result - Duplicate Result)*100/Average Result

AnalyticalTechnologies,Inc.

GENERAL CHEMISTRY - QUALITY CONTROL

BLANK SPIKE

ient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
oject # : PIO200-005
oject Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168

rameters	Blank Spike ID#	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
LORIDE	49207	MG/L	<5.0	40.0	40.0	100
LORIDE	49324	MG/L	<5.0	41.0	40.0	103
UORIDE	49257	MG/L	<0.50	4.6	5.0	92
TRATE-NITRITE AS NITROGEN	49247	MG/L	<0.05	2.0	2.0	100
LFATE	49310	MG/L	<10.0	19.3	20.0	97
RFACTANTS (MBAS)	49192	MG/L	<0.1	0.98	1.0	98

Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
D (Relative % Difference) = (Sample Result - Duplicate Result)*100/Average Result

AnalyticalTechnologies,Inc.

METALS RESULTS

ent : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
ject # : PIO200-005
ject Name: POND 1 QUARTERLY MONITORING

ATI I.D.: 408168

ple Client ID	Matrix	Date Sampled	Date Received
HMW-6	WATER	10-AUG-94	11-AUG-94
HMW-5	WATER	10-AUG-94	11-AUG-94
HMW-3	WATER	10-AUG-94	11-AUG-94
HMW-4	WATER	10-AUG-94	11-AUG-94
HFB-1	WATER	10-AUG-94	11-AUG-94

rameter	Units	1	2	3	4	5
SENIC	MG/L	<0.01@H	<0.02@H	<0.02@H	<0.02@H	<0.002
RIUM	MG/L	0.02	0.01	0.03	0.03	<0.01
RYLLIUM	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
OMIUM	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
BALT	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
ROMIUM	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
RCURY	MG/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
CKEL	MG/L	0.01	<0.01	<0.01	<0.01	<0.01
AD	MG/L	<0.002	<0.002S	<0.002	<0.002	<0.002
TIMONY	MG/L	<0.03	<0.03	<0.03	<0.03	<0.03
LEN	MG/L	<0.02@H	<0.02@H	<0.02@H	<0.02@H	<0.002
NAD	MG/L	0.02	0.01	0.02	0.02	<0.01

AnalyticalTechnologies,Inc.

METALS RESULTS

.ent : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
›ject # : PIO200-005
›ject Name: POND 1 QUARTERLY MONITORING

ATI I.D.: 408168

ıple Client ID	Matrix	Date Sampled	Date Received
LMW-6 6	WATER	10-AUG-94	11-AUG-94
LMW-5 7	WATER	10-AUG-94	11-AUG-94
LMW-3 8	WATER	10-AUG-94	11-AUG-94
LMW-4 9	WATER	10-AUG-94	11-AUG-94
HMW-6/DISSOLVED 01	WATER	10-AUG-94	11-AUG-94

;ameter	Units	6	7	8	9	11
SENIC	MG/L	<0.01@H	<0.02@H	<0.02@H	<0.02@H	<0.01@H
RIUM	MG/L	0.01	0.01	0.02	0.02	0.01
RYLLIUM	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
DMIUM	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
BALT	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
ROMIUM	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
RCURY	MG/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
CKEL	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
AD	MG/L	<0.002	0.003S	<0.002	<0.002	<0.002
TIMONY	MG/L	<0.03	<0.03	<0.03	<0.03	<0.03
LEN[illegible]	MG/L	<0.02@H	<0.02@H	<0.02@H	<0.02@H	<0.02@H
NAD[illegible]	MG/L	0.02	0.02	0.01	0.01	0.02

AnalyticalTechnologies,Inc.

METALS RESULTS

ent : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
ject # : PIO200-005
ject Name: POND 1 QUARTERLY MONITORING

ATI I.D.: 408168

ple Client ID #	Matrix	Date Sampled	Date Received
HMW-5/DISSOLVED 02	WATER	10-AUG-94	11-AUG-94
HMW-3/DISSOLVED 03	WATER	10-AUG-94	11-AUG-94
HMW-4/DISSOLVED 04	WATER	10-AUG-94	11-AUG-94
HFB-1/DISSOLVED 05	WATER	10-AUG-94	11-AUG-94
LMW-6/DISSOLVED 06	WATER	10-AUG-94	11-AUG-94

rameter	Units	12	13	14	15	16
SENIC	MG/L	<0.02@H	<0.02@H	<0.02@H	<0.002	<0.01@H
RIUM	MG/L	0.01	0.03	0.03	<0.01	0.01
RYLLIUM	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
DMIUM	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
BALT	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
ROMIUM	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
RCURY	MG/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
CKEL	MG/L	<0.01	<0.01	<0.01	<0.01	0.01
AD	MG/L	<0.003S	<0.002	<0.002S	<0.002	<0.002
TIMONY	MG/L	<0.03	<0.03	<0.03	<0.03	<0.03
LEN M	MG/L	<0.02@H	<0.02@H	<0.02@H	<0.002	<0.02@H
NAD M	MG/L	0.01	<0.01	0.01	<0.01	0.02

AnalyticalTechnologies,Inc.

METALS RESULTS

ent : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.

ATI I.D.: 408168

ject # : PIO200-005

ject Name: POND 1 QUARTERLY MONITORING

ple Client ID	Matrix	Date Sampled	Date Received
LMW-5/DISSOLVED 07	WATER	10-AUG-94	11-AUG-94
LMW-3/DISSOLVED 08	WATER	10-AUG-94	11-AUG-94
LMW-4/DISSOLVED 09	WATER	10-AUG-94	11-AUG-94

rameter	Units	17	18	19
SENIC	MG/L	<0.02@H	<0.02@H	<0.02@H
RIUM	MG/L	0.01	0.02	0.02
RYLLIUM	MG/L	<0.005	<0.005	<0.005
DMIUM	MG/L	<0.005	<0.005	<0.005
BALT	MG/L	<0.01	<0.01	<0.01
ROMIUM	MG/L	<0.01	<0.01	<0.01
RCURY	MG/L	<0.0005	<0.0005	<0.0005
CKEL	MG/L	<0.01	<0.01	<0.01
AD	MG/L	<0.003S	<0.002S	<0.003S
TIMONY	MG/L	<0.03	<0.03	<0.03
LENIUM	MG/L	<0.02@H	<0.02@H	<0.02@H
NADIUM	MG/L	0.02	0.01	0.01

AnalyticalTechnologies,Inc.

METALS - QUALITY CONTROL

DUP/MS

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168

Parameters	REF I.D.	Units	Sample Result	Dup Result	RPD	Spiked Sample	Spike Conc	% Rec
ANTIMONY	408168-04	MG/L	<0.03	<0.03	0	1.86	2.00	93
ANTIMONY	408168-19	MG/L	<0.03	<0.03	0	1.92	2.00	96
ARSENIC	408168-04	MG/L	<0.02@H	<0.02@H	0	1.95	2.00	98
ARSENIC	408168-19	MG/L	<0.02@H	<0.02@H	0	1.97	2.00	99
BARIUM	408168-04	MG/L	0.03	0.03	0	4.95	5.00	98@V
BARIUM	408168-19	MG/L	0.02	0.02	0	4.85	5.00	97@V
BERYLLIUM	408168-04	MG/L	<0.005	<0.005	0	1.76	2.00	88
BERYLLIUM	408168-19	MG/L	<0.005	<0.005	0	1.84	2.00	92
CADMIUM	408168-04	MG/L	<0.005	<0.005	0	1.79	2.00	90
CADMIUM	408168-19	MG/L	<0.005	<0.005	0	1.88	2.00	94
CHROMIUM	408168-04	MG/L	<0.01	<0.01	0	1.75	2.00	88
CHROMIUM	408168-19	MG/L	<0.01	<0.01	0	1.80	2.00	90
COBALT	408168-04	MG/L	<0.01	<0.01	0	3.64	4.00	91
COBALT	408168-19	MG/L	<0.01	<0.01	0	3.80	4.00	95
LEAD	408168-04	MG/L	<0.002	<0.002	0	2.11	2.00	106
LEAD	408168-19	MG/L	<0.003S	<0.003S	0	1.92	2.00	96
MERCURY	408168-04	MG/L	<0.0005	<0.0005	0	0.0017	0.0020	85
NICKEL	408168-04	MG/L	<0.01	<0.01	0	1.78	2.00	89
NICKEL	408168-19	MG/L	<0.01	<0.01	0	1.87	2.00	94
SELENIUM	408168-04	MG/L	<0.02@H	<0.02@H	0	1.13	1.20	94
SELENIUM	408168-19	MG/L	<0.02@H	<0.02@H	0	0.94	1.20	78
VANADIUM	408168-04	MG/L	0.02	0.01	67@R	3.63	4.00	90
VANADIUM	408168-19	MG/L	0.01	0.01	0	3.74	4.00	93

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Sample Result - Duplicate Result)*100/Average Result

AnalyticalTechnologies,Inc.

METALS - QUALITY CONTROL

BLANK SPIKE

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168

Parameters	Blank Spike ID#	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
ANTIMONY	49402	MG/L	<0.03	2.06	2.00	103
ANTIMONY	49403	MG/L	<0.03	2.10	2.00	105
ARSENIC	49302	MG/L	<0.002	2.14	2.00	107
ARSENIC	49303	MG/L	<0.002	2.04	2.00	102
BARIUM	49402	MG/L	<0.01	4.20	4.00	105
BARIUM	49403	MG/L	<0.01	4.19	4.00	105
BERYLLIUM	49402	MG/L	<0.005	1.97	2.00	99
BERYLLIUM	49403	MG/L	<0.005	1.99	2.00	100
CADMIUM	49402	MG/L	<0.005	2.10	2.00	105
CADMIUM	49403	MG/L	<0.005	2.12	2.00	106
CHROMIUM	49402	MG/L	<0.01	2.00	2.00	100
CHROMIUM	49403	MG/L	<0.01	2.01	2.00	101
COBALT	49402	MG/L	<0.01	4.24	4.00	106
COBALT	49403	MG/L	<0.01	4.28	4.00	107
LEAD	49201	MG/L	<0.002	2.20	2.00	110
LEAD	49212	MG/L	<0.002	2.06	2.00	103
MERCURY	49261	MG/L	<0.0005	0.0021	0.0020	105
NICKEL	49402	MG/L	<0.01	2.08	2.00	104
NICKEL	49403	MG/L	<0.01	2.11	2.00	106
SELENIUM	49238	MG/L	<0.002	1.23	1.20	103
SELENIUM	49239	MG/L	<0.002	1.16	1.20	97
VANADIUM	49402	MG/L	<0.01	4.06	4.00	102
VANADIUM	49403	MG/L	<0.01	4.08	4.00	102

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Sample Result - Duplicate Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PI0200-005
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	HMW-6	WATER	10-AUG-94	N/A	18-AUG-94	20.00
2	HMW-5	WATER	10-AUG-94	N/A	19-AUG-94	1.00
3	HMW-3	WATER	10-AUG-94	N/A	19-AUG-94	1.00

Parameter	Units	1	2	3
CARBON DISULFIDE	UG/L	<40	<2	<2
CHLOROFORM	UG/L	<20	<1	<1
2-BUTANONE (MEK)	UG/L	<200	<10	<10
1,2-DICHLOROETHANE	UG/L	<20	<1	<1
BENZENE	UG/L	<20	<1	7
TOLUENE	UG/L	<40	<2	<2
CHLOROBENZENE	UG/L	2200	<1	<1
ETHYLBENZENE	UG/L	<20	5	5
XYLENES (TOTAL)	UG/L	<20	2	<1
STYRENE	UG/L	<40	<2	<2
1,4-DIOXANE	UG/L	<4000	<200	<200
ETHYLENE DIBROMIDE	UG/L	<100	<5	<5
CYCLOHEXANE	UG/L	<200	<10	<10
SURROGATES				
1,2-DICHLOROETHANE-D4	%	96	93	100
TOLUENE-D8	%	104	103	104
BFB	%	92	99	102

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	HMW-4	WATER	10-AUG-94	N/A	19-AUG-94	1.00
5	HFB-1	WATER	10-AUG-94	N/A	22-AUG-94	1.00
6	LMW-6	WATER	10-AUG-94	N/A	18-AUG-94	1.00

Parameter	Units	4	5	6
CARBON DISULFIDE	UG/L	<2	<2	<2
CHLOROFORM	UG/L	<1	<1	<1
2-BUTANONE (MEK)	UG/L	<10	<10	<10
1,2-DICHLOROETHANE	UG/L	<1	<1	<1
BENZENE	UG/L	2	<1	8
TOLUENE	UG/L	<2	<2	<2
CHLOROBENZENE	UG/L	<1	<1	<1
ETHYLBENZENE	UG/L	2	<1	<1
XYLENES (TOTAL)	UG/L	<1	<1	<1
STYRENE	UG/L	<2	<2	<2
1,4-DIOXANE	UG/L	<200	<200	<200
[illegible]YLENE DIBROMIDE	UG/L	<5	<5	<5
[illegible]LOHEXANE	UG/L	<10	<10	<10
SURROGATES				
1,2-DICHLOROETHANE-D4	%	99	98	95
TOLUENE-D8	%	99	102	103
BFB	%	97	95	102

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
7	LMW-5	WATER	10-AUG-94	N/A	18-AUG-94	1.00
8	LMW-3	WATER	10-AUG-94	N/A	18-AUG-94	1.00
9	LMW-4	WATER	10-AUG-94	N/A	19-AUG-94	1.00

Parameter	Units	7	8	9
CARBON DISULFIDE	UG/L	<2	<2	<2
CHLOROFORM	UG/L	<1	<1	<1
2-BUTANONE (MEK)	UG/L	<10	<10	<10
1,2-DICHLOROETHANE	UG/L	<1	<1	<1
BENZENE	UG/L	<1	8	2
TOLUENE	UG/L	<2	<2	<2
CHLOROBENZENE	UG/L	13	<1	<1
ETHYLBENZENE	UG/L	<1	<1	4
XYLENES (TOTAL)	UG/L	<1	<1	<1
STYRENE	UG/L	<2	<2	<2
1,4-DIOXANE	UG/L	<200	<200	<200
[illegible]LENE DIBROMIDE	UG/L	<5	<5	<5
C[illegible]LOHEXANE	UG/L	<10	<10	<10
SURROGATES				
1,2-DICHLOROETHANE-D4	%	97	101	101
TOLUENE-D8	%	106	103	103
BFB	%	101	105	100

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
10	MW-TB/TRIP BLANK(GCMS 9239)	WATER	10-AUG-94	N/A	19-AUG-94	1.00

Parameter	Units	10
CARBON DISULFIDE	UG/L	<2
CHLOROFORM	UG/L	<1
2-BUTANONE (MEK)	UG/L	<10
1,2-DICHLOROETHANE	UG/L	<1
BENZENE	UG/L	<1
TOLUENE	UG/L	<2
CHLOROBENZENE	UG/L	<1
ETHYLBENZENE	UG/L	<1
XYLENES (TOTAL)	UG/L	<1
STYRENE	UG/L	<2
1,4-DIOXANE	UG/L	<200
ETHYLENE DIBROMIDE	UG/L	<5
CYCLOHEXANE	UG/L	<10
SURROGATES		
1,2-DICHLOROETHANE-D4	%	97
TOLUENE-D8	%	104
BFB	%	95

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank I.D. : 31743
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168
Date Extracted: N/A
Date Analyzed : 18-AUG-94
Dil. Factor : 1.00

Parameters	Units	Results
CARBON DISULFIDE	UG/L	<2
CHLOROFORM	UG/L	<1
2-BUTANONE (MEK)	UG/L	<10
1,2-DICHLOROETHANE	UG/L	<1
BENZENE	UG/L	<1
TOLUENE	UG/L	<2
CHLOROBENZENE	UG/L	<1
ETHYLBENZENE	UG/L	<1
XYLENES (TOTAL)	UG/L	<1
STYRENE	UG/L	<2
1,4-DIOXANE	UG/L	<200
ETHYLENE DIBROMIDE	UG/L	<5
CYCLOHEXANE	UG/L	<10
[illegible]OGATES		
1,2-DICHLOROETHANE-D4	%	95
TOLUENE-D8	%	100
BFB	%	89

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank I.D. : 31758
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168
Date Extracted: N/A
Date Analyzed : 19-AUG-94
Dil. Factor : 1.00

Parameters	Units	Results
CARBON DISULFIDE	UG/L	<2
1,4-DIOXANE	UG/L	<200
ETHYLENE DIBROMIDE	UG/L	<5
CHLOROFORM	UG/L	<1
CYCLOHEXANE	UG/L	<10
2-BUTANONE (MEK)	UG/L	<10
1,2-DICHLOROETHANE	UG/L	<1
BENZENE	UG/L	<1
TOLUENE	UG/L	<2
CHLOROBENZENE	UG/L	<1
ETHYLBENZENE	UG/L	<1
XYLENES (TOTAL)	UG/L	<1
STYRENE	UG/L	<2
SURROGATES		
1,2-DICHLOROETHANE-D4	%	97
TOLUENE-D8	%	102
BFB	%	96

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank I.D. : 31780
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168
Date Extracted: N/A
Date Analyzed : 22-AUG-94
Dil. Factor : 1.00

Parameters	Units	Results
CARBON DISULFIDE	UG/L	<2
CHLOROFORM	UG/L	<1
2-BUTANONE (MEK)	UG/L	<10
1,2-DICHLOROETHANE	UG/L	<1
BENZENE	UG/L	<1
TOLUENE	UG/L	<2
CHLOROBENZENE	UG/L	<1
ETHYLBENZENE	UG/L	<1
XYLENES (TOTAL)	UG/L	<1
STYRENE	UG/L	<2
1,4-DIOXANE	UG/L	<200
ETHYLENE DIBROMIDE	UG/L	<5
CYCLOHEXANE	UG/L	<10
ROGATES		
1,2-DICHLOROETHANE-D4	%	94
TOLUENE-D8	%	101
BFB	%	95

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

MSMSD

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
MSMSD # : 66220
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.

Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168
Date Extracted: N/A
Date Analyzed : 22-AUG-94
Sample Matrix : WATER
REF I.D. : 408168-04

Parameters	Units	Sample Result	Conc Spike	Spiked Sample	% Rec	Dup Spike	Dup % Rec	RPD
BENZENE	UG/L	2	50	58	97	58	0	200
TOLUENE	UG/L	<2	50	57	104	55	0	200
CHLOROBENZENE	UG/L	<1	50	52	104	50	0	200

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample Result - Duplicate Spike Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

BLANK SPIKE

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank Spike #: 49333
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name : POND 1 QUARTERLY MONITORING

ATI I.D. : 408168
Date Extracted: N/A
Date Analyzed : 18-AUG-94
Sample Matrix : WATER

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
BENZENE	UG/L	<1	54	50	108
TOLUENE	UG/L	<2	54	50	108
CHLOROBENZENE	UG/L	<1	50	50	100

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

BLANK SPIKE

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank Spike #: 49362
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name : POND 1 QUARTERLY MONITORING

ATI I.D. : 408168
Date Extracted: N/A
Date Analyzed : 19-AUG-94
Sample Matrix : WATER

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
BENZENE	UG/L	<1	54	50	108
TOLUENE	UG/L	<2	54	50	108
CHLOROBENZENE	UG/L	<1	49	50	98

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

BLANK SPIKE

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank Spike #: 49408
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name : POND 1 QUARTERLY MONITORING

ATI I.D. : 408168
Date Extracted: N/A
Date Analyzed : 22-AUG-94
Sample Matrix : WATER

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
BENZENE	UG/L	<1	58	50	116
TOLUENE	UG/L	<2	58	50	116
CHLOROBENZENE	UG/L	<1	53	50	106

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	HMW-6	WATER	10-AUG-94	14-AUG-94	19-AUG-94	2.50
2	HMW-5	WATER	10-AUG-94	14-AUG-94	19-AUG-94	2.50
3	HMW-3	WATER	10-AUG-94	14-AUG-94	19-AUG-94	2.50

Parameter	Units	1	2	3
ANTHRACENE	UG/L	<25	<25	<25
BENZO(a)ANTHRACENE	UG/L	<25	<25	<25
BENZO(b)FLUORANTHENE	UG/L	<25	<25	<25
BENZO(k)FLUORANTHENE	UG/L	<25	<25	<25
BENZO(a)PYRENE	UG/L	<25	<25	<25
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	<25	<25	<25
BUTYLBENZYLPHTHALATE	UG/L	<25	<25	<25
CHRYSENE	UG/L	<25	<25	<25
DIBENZ(a,h)ACRIDINE	UG/L	<25	<25	<25
DIBENZ(a,h)ANTHRACENE	UG/L	<25	<25	<25
1,2-DICHLOROBENZENE	UG/L	<25	<25	<25
1,3-DICHLOROBENZENE	UG/L	<25	<25	<25
1,4-DICHLOROBENZENE	UG/L	<25	<25	<25
DIETHYLPHTHALATE	UG/L	<25	<25	<25
7,12-DIMETHYLBENZO(a)ANTHRACENE	UG/L	<25	<25	<25
DIMETHYLPHTHALATE	UG/L	<25	<25	<25
DI-N-BUTYLPHTHALATE	UG/L	<25	<25	<25
DI-N-OCTYLPHTHALATE	UG/L	<25	<25	<25
FLUORANTHENE	UG/L	<25	<25	<25
NAPHTHALENE	UG/L	42	<25	110
PHENANTHRENE	UG/L	<25	<25	<25
PYRENE	UG/L	<25	<25	<25
2-METHYLNAPHTHALENE	UG/L	<25	<25	26
BENZENETHIOL	UG/L	<25	<25	<25
4-NITROPHENOL	UG/L	<130	<130	<130
2,4-DIMETHYLPHENOL	UG/L	<25	<25	<25
2,4-DINITROPHENOL	UG/L	<130	<130	<130
PHENOL	UG/L	<25	<25	<25
2-METHYLPHENOL	UG/L	<25	<25	<25
3- & 4-METHYLPHENOL	UG/L	<25	<25	<25
INDENE	UG/L	<25	<25	<25
1-METHYLNAPHTHALENE	UG/L	93	73	150
PYRIDINE	UG/L	<130	<130	<130
QUINOLINE	UG/L	<130	<130	<130
6-METHYL CHRYSENE	UG/L	<25	<25	<25
SURROGATES				
NITROBENZENE-D5	%	131*I	120*I	124*I
2-FLUOROBIPHENYL	%	127*I	119	106
[illegible]PHENYL-D14	%	95	94	89

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408168
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	HMW-6	WATER	10-AUG-94	14-AUG-94	19-AUG-94	2.50
2	HMW-5	WATER	10-AUG-94	14-AUG-94	19-AUG-94	2.50
3	HMW-3	WATER	10-AUG-94	14-AUG-94	19-AUG-94	2.50

Parameter	Units	1	2	3
SURROGATES				
PHENOL-D6	%	119	116	107
2-FLUOROPHENOL	%	106	94	87
2,4,6-TRIBROMOPHENOL	%	97	94	85

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408168
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	HMW-4	WATER	10-AUG-94	14-AUG-94	19-AUG-94	2.50
5	HFB-1	WATER	10-AUG-94	14-AUG-94	23-AUG-94	1.00
6	LMW-6	WATER	10-AUG-94	14-AUG-94	23-AUG-94	2.50

Parameter	Units	4	5	6
ANTHRACENE	UG/L	<25	<10	<25
BENZO(a)ANTHRACENE	UG/L	<25	<10	<25
BENZO(b)FLUORANTHENE	UG/L	<25	<10	<25
BENZO(k)FLUORANTHENE	UG/L	<25	<10	<25
BENZO(a)PYRENE	UG/L	<25	<10	<25
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	<25	<10	<25
BUTYLBENZYLPHTHALATE	UG/L	<25	<10	<25
CHRYSENE	UG/L	<25	<10	<25
DIBENZ(a,h)ACRIDINE	UG/L	<25	<10	<25
DIBENZ(a,h)ANTHRACENE	UG/L	<25	<10	<25
1,2-DICHLOROBENZENE	UG/L	<25	<10	<25
1,3-DICHLOROBENZENE	UG/L	<25	<10	<25
1 4-DICHLOROBENZENE	UG/L	<25	<10	<25
THYLPHTHALATE	UG/L	<25	<10	<25
7,12-DIMETHYLBENZO(a)ANTHRACENE	UG/L	<25	<10	<25
DIMETHYLPHTHALATE	UG/L	<25	<10	<25
DI-N-BUTYLPHTHALATE	UG/L	<25	<10	<25
DI-N-OCTYLPHTHALATE	UG/L	<25	<10	<25
FLUORANTHENE	UG/L	<25	<10	<25
NAPHTHALENE	UG/L	49	<10	<25
PHENANTHRENE	UG/L	<25	<10	<25
PYRENE	UG/L	<25	<10	<25
2-METHYLNAPHTHALENE	UG/L	25	<10	<25
BENZENETHIOL	UG/L	<25	<10	<25
4-NITROPHENOL	UG/L	<130	<50	<130
2,4-DIMETHYLPHENOL	UG/L	<25	<10	<25
2,4-DINITROPHENOL	UG/L	<130	<50	<130
PHENOL	UG/L	<25	<10	<25
2-METHYLPHENOL	UG/L	<25	<10	<25
3- & 4-METHYLPHENOL	UG/L	<25	<10	<25
INDENE	UG/L	<25	<10	<25
1-METHYLNAPHTHALENE	UG/L	280	<10	110
PYRIDINE	UG/L	<130	<50	<130
QUINOLINE	UG/L	<130	<50	<130
6-METHYL CHRYSENE	UG/L	<25	<10	<25
SURROGATES				
NITROBENZENE-D5	%	118	78	94
2-FLUOROBIPHENYL	%	134*I	91	119
TERPHENYL-D14	%	94	93	111

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	HMW-4	WATER	10-AUG-94	14-AUG-94	19-AUG-94	2.50
5	HFB-1	WATER	10-AUG-94	14-AUG-94	23-AUG-94	1.00
6	LMW-6	WATER	10-AUG-94	14-AUG-94	23-AUG-94	2.50

Parameter	Units	4	5	6
SURROGATES				
PHENOL-D6	%	104	98	179*I
2-FLUOROPHENOL	%	82	66	158*I
2,4,6-TRIBROMOPHENOL	%	92	87	244*I

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408168
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
7	LMW-5	WATER	10-AUG-94	14-AUG-94	23-AUG-94	2.50
8	LMW-3	WATER	10-AUG-94	14-AUG-94	23-AUG-94	2.50
9	LMW-4	WATER	10-AUG-94	14-AUG-94	23-AUG-94	2.50

Parameter	Units	7	8	9
ANTHRACENE	UG/L	<25	<25	<25
BENZO(a)ANTHRACENE	UG/L	<25	<25	<25
BENZO(b)FLUORANTHENE	UG/L	<25	<25	<25
BENZO(k)FLUORANTHENE	UG/L	<25	<25	<25
BENZO(a)PYRENE	UG/L	<25	<25	<25
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	<25	<25	<25
BUTYLBENZYLPHTHALATE	UG/L	<25	<25	<25
CHRYSENE	UG/L	<25	<25	<25
DIBENZ(a,h)ACRIDINE	UG/L	<25	<25	<25
DIBENZ(a,h)ANTHRACENE	UG/L	<25	<25	<25
1,2-DICHLOROBENZENE	UG/L	<25	<25	<25
1,3-DICHLOROBENZENE	UG/L	<25	<25	<25
1,4-DICHLOROBENZENE	UG/L	<25	<25	<25
DIETHYLPHTHALATE	UG/L	<25	<25	<25
7,12-DIMETHYLBENZO(a)ANTHRACENE	UG/L	<25	<25	<25
DIMETHYLPHTHALATE	UG/L	<25	<25	<25
DI-N-BUTYLPHTHALATE	UG/L	<25	<25	<25
DI-N-OCTYLPHTHALATE	UG/L	<25	<25	<25
FLUORANTHENE	UG/L	<25	<25	<25
NAPHTHALENE	UG/L	<25	110	31
PHENANTHRENE	UG/L	<25	<25	<25
PYRENE	UG/L	<25	<25	<25
2-METHYLNAPHTHALENE	UG/L	<25	38	<25
BENZENETHIOL	UG/L	<25	<25	<25
4-NITROPHENOL	UG/L	<130	<130	<130
2,4-DIMETHYLPHENOL	UG/L	28	<25	<25
2,4-DINITROPHENOL	UG/L	<130	<130	<130
PHENOL	UG/L	<25	<25	<25
2-METHYLPHENOL	UG/L	<25	<25	<25
3- & 4-METHYLPHENOL	UG/L	<25	<25	<25
INDENE	UG/L	<25	<25	<25
1-METHYLNAPHTHALENE	UG/L	64	130	90
PYRIDINE	UG/L	<130	<130	<130
QUINOLINE	UG/L	<130	<130	<130
6-METHYL CHRYSENE	UG/L	<25	<25	<25
SURROGATES				
NITROBENZENE-D5	%	95	102	125*I
2-FLUOROBIPHENYL	%	123	127*I	155*I
TERPHENYL-D14	%	112	113	110

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408168
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
7	LMW-5	WATER	10-AUG-94	14-AUG-94	23-AUG-94	2.50
8	LMW-3	WATER	10-AUG-94	14-AUG-94	23-AUG-94	2.50
9	LMW-4	WATER	10-AUG-94	14-AUG-94	23-AUG-94	2.50

Parameter	Units	7	8	9
SURROGATES				
PHENOL-D6	%	127	149*I	114
2-FLUOROPHENOL	%	110	135*I	98
2,4,6-TRIBROMOPHENOL	%	155*I	156*I	127

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Blank I.D. : 31756
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168
Date Extracted: 14-AUG-94
Date Analyzed : 19-AUG-94
Dil. Factor : 1.00

Parameters	Units	Results
ANTHRACENE	UG/L	<10
BENZO(a)ANTHRACENE	UG/L	<10
BENZO(b)FLUORANTHENE	UG/L	<10
BENZO(k)FLUORANTHENE	UG/L	<10
BENZO(a)PYRENE	UG/L	<10
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	<10
BUTYLBENZYLPHTHALATE	UG/L	<10
CHRYSENE	UG/L	<10
DIBENZ(a,h)ACRIDINE	UG/L	<10
DIBENZ(a,h)ANTHRACENE	UG/L	<10
1,2-DICHLOROBENZENE	UG/L	<10
1,3-DICHLOROBENZENE	UG/L	<10
1,4-DICHLOROBENZENE	UG/L	<10
DIETHYLPHTHALATE	UG/L	<10
7,12-DIMETHYLBENZO(a)ANTHRACENE	UG/L	<10
DIMETHYLPHTHALATE	UG/L	<10
DI-N-BUTYLPHTHALATE	UG/L	<10
DI-N-OCTYLPHTHALATE	UG/L	<10
FLUORANTHENE	UG/L	<10
NAPHTHALENE	UG/L	<10
PHENANTHRENE	UG/L	<10
PYRENE	UG/L	<10
2-METHYLNAPHTHALENE	UG/L	<10
BENZENETHIOL	UG/L	<10
4-NITROPHENOL	UG/L	<50
2,4-DIMETHYLPHENOL	UG/L	<10
2,4-DINITROPHENOL	UG/L	<50
PHENOL	UG/L	<10
2-METHYLPHENOL	UG/L	<10
3- & 4-METHYLPHENOL	UG/L	<10
INDENE	UG/L	<10
1-METHYLNAPHTHALENE	UG/L	<10
PYRIDINE	UG/L	<50
QUINOLINE	UG/L	<50
6-METHYL CHRYSENE	UG/L	<10
SURROGATES		
NITROBENZENE-D5	%	114
2-FLUOROBIPHENYL	%	111
TERPHENYL-D14	%	126
PHENOL-D6	%	104
2-FLUOROPHENOL	%	93
2,4,6-TRIBROMOPHENOL	%	109

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

MSMSD

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
MSMSD # : 66132
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.

Project # : PIO200-005
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 408168
Date Extracted: 14-AUG-94
Date Analyzed : 19-AUG-94
Sample Matrix : WATER
REF I.D. : 408168-04

Parameters	Units	Sample Result	Conc Spike	Spiked Sample	% Rec	Dup Spike	Dup % Rec	RPD
1,4-DICHLOROBENZENE	UG/L	<25	100	110	110*I	91	91	19
PYRENE	UG/L	<25	100	140	140	130	130	7
4-NITROPHENOL	UG/L	<130	150	N/A	N/A*K	N/A	N/A*K	N/A*K
PHENOL	UG/L	<25	100	190	190*I	210	210*I	10

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample Result - Duplicate Spike Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

BLANK SPIKE

st : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
ank Spike #: 49356
.ient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
·oject # : PIO200-005
:oject Name : POND 1 QUARTERLY MONITORING

ATI I.D. : 408168
Date Extracted: 14-AUG-94
Date Analyzed : 19-AUG-94
Sample Matrix : WATER

ırameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
IENOL	UG/L	<10	93	150	62
4-DICHLOROBENZENE	UG/L	<10	74	100	74
-NITROPHENOL	UG/L	<50	140	150	93
;RENE	UG/L	<10	110	100	110

Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
'D (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

ANALYTICAL TECHNOLOGIES, INC.
SAN DIEGO
FLAGS

ORGANICS

FLAG	MESSAGE DESCRIPTION
A	A TIC IS A SUSPECTED ALDOL-CONDENSATION PRODUCT
B	ANALYTE FOUND IN THE ASSOCIATED REAGENT BLANK
C	PESTICIDE, WHERE THE IDENTIFICATION WAS CONFIRMED BY GC/MS
CO	THESE COMPOUNDS CO-ELUTE AND ARE QUANTITATED AS ONE PEAK
D	COMPOUND IDENTIFIED IN AN ANALYSIS AT SECONDARY DILUTION
E	ANALYTE AMOUNT EXCEEDS THE CALIBRATION RANGE
J	ESTIMATED VALUE
H	QUANTIFIED AS DIESEL BUT CHROMATOGRAPHIC PATTERN DOES NOT MATCH THAT OF DIESEL
K	QUANTIFIED AS KEROSENE BUT CHROMATOGRAPHIC PATTERN DOES NOT MATCH THAT OF KEROSENE
L	QUANTIFIED AS GASOLINE BUT CHROMATOGRAPHIC PATTERN DOES NOT MATCH THAT OF GASOLINE
N	PRESUMPTIVE EVIDENCE OF A COMPOUND
P	PESTICIDE/AROCLOR TARGET ANALYTE, WHERE THERE IS GREATER THAN 25% DIFFERENCE FOR DETECTED CONCENTRATION BETWEEN 2 GC COLUMNS
TR	COMPOUND DETECTED AT AN UNQUANTIFIABLE TRACE LEVEL
U	COMPOUND WAS ANALYZED FOR BUT NOT DETECTED
X	SEE CASE NARRATIVE
Y	SEE CASE NARRATIVE
Z	SEE CASE NARRATIVE
*	OUTSIDE OF QUALITY CONTROL LIMITS
*D	COMPOUND ANALYZED FROM A SECONDARY ANALYSIS
*F	RESULT OUTSIDE OF ATI'S QUALITY CONTROL LIMITS
*G	RESULT OUTSIDE QUALITY CONTROL LIMITS. INSUFFICIENT SAMPLE FOR RE-EXTRACTION/ANALYSIS
*H	RESULT OUTSIDE OF LIMITS DUE TO SAMPLE MATRIX INTERFERENCE
*I	BECAUSE OF NECESSARY SAMPLE DILUTION, VALUE WAS OUTSIDE QC LIMITS
*K	DUE TO THE NECESSARY DILUTION OF THE SAMPLE, RESULT WAS NOT ATTAINABLE
*L	ANALYTE IS A SUSPECTED LAB CONTAMINANT
*P	A STANDARD WAS USED TO QUANTITATE THIS VALUE
*R	DATA IS NOT USABLE
*T	SURROGATE RECOVERY IS OUTSIDE QC CONTROL LIMITS. NO CORRECTIVE ACTION INDICATED BY METHOD
*V	SAMPLE RESULT IS >4X SPIKED CONCENTRATION, THEREFORE SPIKE IS NOT DETECTABLE
*Y	RESULT NOT ATTAINABLE DUE TO SAMPLE MATRIX INTERFERENCE
@A	RESULTS OUT OF LIMITS DUE TO SAMPLE NON-HOMOGENEITY
@C	*VARIABLE MESSAGE*
@D	RESULT COULD NOT BE CONFIRMED DUE TO MATRIX INTERFERENCE ON THE CONFIRMATION COLUMN
@E	RESULT MAY BE FALSELY ELEVATED DUE TO SAMPLE MATRIX INTERFERENCE
@F	RESULT OUTSIDE OF CONTRACT SPECIFIED QUALITY CONTROL LIMITS
@G	RESULT OUTSIDE OF CONTRACT SPECIFIED ADVISORY LIMITS
@H	DETECTION LIMIT ELEVATED DUE TO MATRIX INTERFERENCE
@M	RESULT NOT CONFIRMED BY U.V. DUE TO SAMPLE MATRIX INTERFERENCE
@N	RESULT NOT CONFIRMED BY FLUORESCENCE DUE TO SAMPLE MATRIX INTERFERENCE
@P	RESULT QUANTITATED USING FLUORESCENCE ONLY DUE TO THE LOW CONCENTRATION
@Q	DETECTION LIMIT ELEVATED DUE TO LIMITED SAMPLE FOR ANALYSIS
@T	RESULT DUE TO TCLP EXTRACTION MATRIX INTERFERENCE. NO QC LIMITS HAVE BEEN ESTABLISHED
@U	SAMPLE CHROMATOGRAM DOES NOT RESEMBLE COMMON FUEL HYDROCARBON FINGERPRINTS
@Z	SAMPLE CHROMATOGRAM DOES NOT RESEMBLE A FUEL HYDROCARBON

ANALYTICAL TECHNOLOGIES, INC.
SAN DIEGO
FLAGS

INORGANICS

FLAG	MESSAGE DESCRIPTION
B	ABSOLUTE VALUE OF ANALYTE CONCENTRATION IS < CRDL BUT ≥ THE IDL
BB	RESULT BETWEEN IDL AND LOQ
D	POST DIGESTION SPIKE FOR GFAA OUTSIDE LIMITS AFTER 1:25 DILUTION. SAMPLE REPORTED AT ORIGINAL CONCENTRATION.
E	ESTIMATED VALUE DUE TO INTERFERENCE
M	DUPLICATE INJECTION PRECISION NOT MET
N	SPIKED SAMPLE RECOVERY NOT WITHIN CONTROL LIMITS
S	REPORTED VALUE WAS DETERMINED BY METHOD OF STANDARD ADDITIONS
U	COMPOUND WAS ANALYZED FOR BUT NOT DETECTED
W	POST DIGESTION SPIKE OUT OF CONTROL LIMITS; SAMPLE ABSORBANCE < 50% OF SPIKE ABSORBANCE FOR GF/AA
X	ABSOLUTE VALUE OF ANALYTE CONCENTRATION IS LESS THAN 3 TIMES THE MDL
*	DUPLICATE ANALYSIS NOT WITHIN CONTROL LIMITS
+	CORRELATION COEFFICIENT FOR MSA IS LESS THAN 0.995
*H	RESULTS OUTSIDE OF LIMITS DUE TO SAMPLE MATRIX INTERFERENCE
*Q	INSUFFICIENT SAMPLE FOR ANALYSIS
*R	DATA IS NOT USABLE
*V	SAMPLE RESULT IS >4X SPIKED CONCENTRATION, THEREFORE SPIKE IS NOT DETECTABLE
*Y	RESULT NOT ATTAINABLE DUE TO SAMPLE MATRIX INTERFERENCE
@C	*VARIABLE MESSAGE*
@H	DETECTION LIMIT ELEVATED DUE TO MATRIX INTERFERENCE
@Q	DETECTION LIMIT ELEVATED DUE TO LIMITED SAMPLE FOR ANALYSIS
@R	RPD LIMIT IS 67% FOR INORGANIC RESULTS LESS THAN TEN TIMES THE REPORTING DETECTION LIMIT
@S	RPD: ONE RESULT ABOVE AND ONE RESULT BELOW REPORTING LIMIT (RL). RESULT ABOVE SHOULD BE < 5 TIMES RL TO BE IN CONTROL.
@V	PRE-DIGEST SPIKE OUT OF LIMITS. POST DIGESTION SPIKE YIELDED ACCEPTABLE RESULTS
@W	DETECTION LIMIT ELEVATED DUE TO REDUCED SAMPLE WEIGHT
@Y	ION BALANCE OUTSIDE OF ATI'S ACCEPTANCE LIMITS; REANALYSIS CONFIRMED ORIGINAL RESULT
@X	RESULTS VERIFIED BY REDIGESTION AND REANALYSIS

ACCESSION #: 408168

INITIALS: D. S.

SAMPLE CONDITION UPON RECEIPT CHECKLIST
(FOR RE-ACCESSIONS, COMPLETE #7 THRU #9)

1	Does this project require special handling according to NEESA Levels C, D, AFOEHL or CLP protocols? If yes, complete a) thru c) a) Cooler temperature _____ b) pH sample aliquoted: yes / no / n/a c) LOT #'s: _____	YES	NO
2	Are custody seals present on cooler?	YES	NO
	If yes, are seals intact?	YES	NO
3	Are custody seals present on sample containers?	YES	NO
	If yes, are seals intact? N/A	YES	NO
4	Is there a Chain-Of-Custody (COC)*?	YES	NO
5	Is the COC* complete? Relinquished: yes/no Requested analysis: yes/no	YES	NO
6	Is the COC* in agreement with the samples received? # Samples: yes/no Sample ID's: yes/no Date sampled: yes/no Matrix: yes/no # containers: yes/no	YES	NO
7	Are the samples preserved correctly?	YES	NO
8	Is there enough sample for all the requested analyses?	YES	NO
9	Are all samples within holding times for the requested analyses?	YES	NO
10	Cooler temperature: 4.2°C, 4.8°C, 3.8°C, 3.2°C, 3.4°C, 4.1°C		
11	Were all sample containers received intact (ie. not broken, leaking, etc.)?	YES	NO
12	Are samples requiring no headspace, headspace free? N/A	YES	NO
13	Are VOA 1st stickers required?	YES	NO
14	Are there special comments on the Chain of Custody which require client contact?	YES	N/A
15	If yes, was ATI Project Manager notified?	YES	NO

Describe "no" items: _____

Was client contacted? yes / no

If yes, Date: _____ Name of Person contacted: _____

Describe actions taken or client instructions: _____

*Or other representative documents, letters, and/or shipping memos

Analytical Technologies, Inc.

5550 MOREHOUSE DRIVE
SAN DIEGO, CA 92121-1709
(619) 458-9141

Chain of Custody

DATE 8/10/94 PAGE 1 OF 2

PROJECT MANAGER: Stephanie G. Sakurai
COMPANY: Environmental Technologies Int'l
ADDRESS: 733 Bishop Street
Honolulu, HI 96813

BILL TO: Same
COMPANY:
ADDRESS:

Stephanie G. Sakurai — SAMPLERS: (Signature)
(808) 547-3600 — PHONE NUMBER

Recommended Quantity and Preservative (Provide triple volume on QC Samples)

SAMPLE ID	SAMPLE DATE	TIME	MATRIX	LAB ID	Petroleum Hydrocarbons 418.1 (1L (H2 SO4)/100g)	Oil and Grease 413.2 (1L (H2 SO4)/100g)	Gasoline (MOD 8015/DOHS) (4 oz (HCl)/50g)	Diesel (MOD 8015/DOHS) (4 oz (HCl)/50g)	Gasoline/BTXE (MOD 8015/8020) Maximum Contamination Level of Gasoline: 2ppm(water), 50ppm(Soil) (2X40ml (HCl)/50g)	MOD 8015 (Unknown) (4 oz (HCl)/50g)	BTXE (8020) (2X40ml (HCl)/50g)	Chlorinated Hydrocarbons (8010) (2X40ml (HCl)/50g)	Aromatic Hydrocarbons (8020) (2X40ml (HCl)/50g)	Chlorinated/Aromatic Hydrocarbons (8010/8020) (2X40ml (HCl)/50g)	Organic Pb (500ml/50g)		Pesticides/PCB (8080) (1L/50g)	Base/NEU/Acid Cmpds GC/MS (8270) (1L/100g)	Volatile Cmpds GC/MS (8240) (2X40ml (HCl)/100g)	Polynuclear Aromatic (8310) (1L/100g)	CCR Metals (500ml/100g)	Priority Pollutant Metals (500ml/100g)		8240 (Skinner)	8270 (Skinner)	Total Metals (Skinner)	Dissolved Metals (Skinner)	TDS, Alk, F, MBAS, Sp. pH, etc.	Cl-	Nitrate - Nitrite	Number of Containers
HMW-6	8/10/94	842	H2O	01																				X	X	X	X	X	X	X	10
HMW-5	8/10/94	939	H2O	02																				X	X	X	X	X	X	X	10
HMW-3	8/10/94	1025	H2O	03																				X	X	X	X	X	X	X	10
HMW-4	8/10/94	1140	H2O	04																				X	X	X	X	X	X	X	12
HFB-1	8/10/94	1050	H2O	05																				X	X	X	X	X	X	X	10
																															~~70~~ 72

PROJECT INFORMATION		SAMPLE RECEIPT	
PROJECT NUMBER: PI0200-005		TOTAL NUMBER OF CONTAINERS	52
PROJECT NAME: POND NO 3 GEM		CHAIN OF CUSTODY SEALS Y/N/NA	N/A
PURCHASE ORDER NUMBER:		SEALS INTACT? Y/N/NA	N/A
VIA: DHL		RECEIVED GOOD COND./COLD	Y/N
TAT: ☐24HR ☐48HRS ☐72HRS ☐1WK ☐2WK		LAB NUMBER	408168

SAMPLE DISPOSAL INSTRUCTIONS

☐ ATI Disposal @ $5.00 each ☐ Return ☐ Pickup

Comments:
1) Filter and preserve samples for dissolved metals immediately upon receipt.
2) Use HMW-4 for ATI QC. 3) 2 oz poly of samples for ATI EC Check for metals

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature: G. Sakurai — Time: 1930	Signature: — Time:	Signature: — Time:
Printed Name: G. Sakurai — Date: 8/10/94	Printed Name: — Date:	Printed Name: — Date:
Company: ETI	Company:	Company:
RECEIVED BY: 1.	**RECEIVED BY: 2.**	**RECEIVED BY: (LAB) 3.**
Signature: — Time:	Signature: — Time:	Signature: David Schmidt — Time: 9:30
Printed Name: — Date:	Printed Name: — Date:	Printed Name: David Schmidt — Date: 8/11/94
Company:	Company:	Analytical Technologies, Inc.

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Analytical Technologies, Inc.

5550 MOREHOUSE DRIVE
SAN DIEGO, CA 92121-1709
(619) 458-9141

Chain of Custody

DATE 8/10/94 PAGE 2 OF 2

PROJECT MANAGER: Stephanie G. Sakurai
COMPANY: See Page 1.
ADDRESS:

BILL TO:
COMPANY:
ADDRESS:

Stephanie G. Sakurai — SAMPLERS: (Signature)
(808) 547-3600 — PHONE NUMBER

SAMPLE ID	SAMPLE DATE	TIME	MATRIX	LAB ID
LMW-6	8/10/94	1356	H_2O	06
LMW-5	8/10/94	1439	H_2O	07
LMW-3	8/10/94	1539	H_2O	08
LMW-4	8/10/94	1640	H_2O	09
MW-TB	DNA	DNA	H_2O	10

Recommended Quantity and Preservative (Provide triple volume on QC Samples)

Petroleum Hydrocarbons 418.1 (1L (H_2SO_4)/100g)	Oil and Grease 413.2 (1L (H_2SO_4)/100g)	Gasoline (MOD 8015/DOHS) (4 oz (HCl)/50g)	Diesel (MOD 8015/DOHS) (4 oz (HCl)/50g)	Gasoline/BTXE (MOD 8015/8020) Maximum Contamination Level of Gasoline: 2ppm (water), 50ppm (Soil) (2X40ml (HCl)/50g)	MOD 8015 (Unknown) (4 oz (HCl)/50g)	BTXE (8020) (2X40ml (HCl)/50g)	Chlorinated Hydrocarbons (8010) (2X40ml (HCl)/50g)	Aromatic Hydrocarbons (8020) (2X40ml (HCl)/50g)	Chlorinated/Aromatic Hydrocarbons (8010/8020) (2X40ml (HCl)/50g)	Organic Pb (500ml/50g)	Pesticides/PCB (8080) (1L/50g)	Base/NEU/Acid Cmpds GC/MS (8270) (1L/100g)	Volatile Cmpds GC/MS (8240) (2X40ml (HCl)/100g)	Polynuclear Aromatic (8310) (1L/100g)	CCR Metals (500ml/100g)	Priority Pollutant Metals (500ml/100g)	8240 (Skinner's) (2 VOAs/HCl)	8270 (Skinners) (2-1 L A/G)	Total Metals (Skinner) (1-1 L poly w/HNO3, 1-16 oz A/G-HNO3)	Dissolved Metals (Skinner) (1 L poly)	TDS, Alk, F, MBAS, SO4, pH, EC	Cl- (1-1 L poly)	Nitrate-Nitrite (1-4 oz poly 1b SO4)	Number of Containers
																	X	X	X	X	X	X	X	10
																	X	X	X	X	X	X	X	10
																	X	X	X	X	X	X	X	10
																	X	X	X	X	X	X	X	10
																	X							2

PROJECT INFORMATION	
PROJECT NUMBER:	
PROJECT NAME:	See Page 1
PURCHASE ORDER NUMBER:	
VIA:	
TAT: ☐24HR ☐48HRS ☐72HRS ☐1WK ☐2WK	

SAMPLE RECEIPT	
TOTAL NUMBER OF CONTAINERS	42
CHAIN OF CUSTODY SEALS Y/N/NA	N/A
SEALS INTACT? Y/N/NA	N/A
RECEIVED GOOD COND./COLD	Y/Y
LAB NUMBER	408168

SAMPLE DISPOSAL INSTRUCTIONS

☐ ATI Disposal @ $5.00 each ☐ Return ☐ Pickup

Comments:

See Page 1

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature: S. Sakurai Time: 1930	Signature: Time:	Signature: Time:
Printed Name: S. Sakurai Date: 8/10/94	Printed Name: Date:	Printed Name: Date:
Company: ETI	Company:	Company:

RECEIVED BY: 1.	RECEIVED BY: 2.	RECEIVED BY: (LAB) 3.
Signature: Time:	Signature: Time:	Signature: David Schmidt Time: 9:30
Printed Name: Date:	Printed Name: Date:	Printed Name: David Schmidt Date: 8/11/94
Company:	Company:	Analytical Technologies, Inc.

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AnalyticalTechnologies, Inc. Corporate Offices: 5550 Morehouse Drive San Diego, CA 92121 (619) 458-9141

ATI I.D.: 408172

gust 25, 1994

VIRONMENTAL TECHNOLOGIES INT'L, INC.
3 BISHOP STREET, SUITE 2600
NOLULU, HI 96842

oject Name: CLUSTER WELL
oject # : PIO200-006

tention: STEPHANIE SAKURAI

alytical Technologies, Inc. has received the following sample(s):

Date Received	Quantity	Matrix
August 11, 1994	7	WATER

e sample(s) were analyzed with EPA methodology or equivalent methods as specified in the closed analytical schedule. The symbol for "less than" indicates a value below the reportable tection limit. If any flags appear next to the analytical data in this report, please see the tached list of flag definitions.

e results of these analyses and the quality control data are enclosed. Please note that the mple Condition Upon Receipt Checklist is included at the end of this report.

SLIE GETMAN
OJECT MANAGER

M. E. SHIGLEY
LABORATORY MANAGER

AnalyticalTechnologies,Inc.

SAMPLE CROSS REFERENCE

ent : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
oject # : PIO200-006
oject Name: CLUSTER WELL

Report Date: August 25, 1994
ATI I.D. : 408172

[#	Client Description	Matrix	Date Collected
	HCW-4A	WATER	10-AUG-94
	HCW-4B	WATER	10-AUG-94
	HCW-4C	WATER	10-AUG-94
	LCW-4A	WATER	10-AUG-94
	LCW-4B	WATER	10-AUG-94
	LCW-4C	WATER	10-AUG-94
	CW-TB/TRIP BLANK(GCMS92409241)	WATER	10-AUG-94
	HCW-4A/DISSOLVED 01	WATER	10-AUG-94
	HCW-4B/DISSOLVED 02	WATER	10-AUG-94
	HCW-4C/DISSOLVED 03	WATER	10-AUG-94
	LCW-4A/DISSOLVED 04	WATER	10-AUG-94
	LCW-4B/DISSOLVED 05	WATER	10-AUG-94
	LCW-4C/DISSOLVED 06	WATER	10-AUG-94

---TOTALS---

Matrix	# Samples
WATER	13

ATI STANDARD DISPOSAL PRACTICE

ie sample(s) from this project will be disposed of in twenty-one (21) days from the date of iis report. If an extended storage period is required, please contact our sample control epartment before the scheduled disposal date.

AnalyticalTechnologies,Inc.

ANALYTICAL SCHEDULE

.ent : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
›ject # : PIO200-006
›ject Name: CLUSTER WELL

ATI I.D.: 408172

ılysis	Technique/Description
20 ALKILINITY (CARBONATES, BICARBONATES)	TITRIMETRIC
ı 160.1 (TOTAL DISSOLVED SOLIDS)	GRAVIMETRIC
ı 340.2 (FLUORIDE)	ELECTRODE
ı 353.2 (NITRATE-NITRITE AS NITROGEN)	COLORIMETRIC
ı 425.1 (SURFACTANTS (MBAS))	COLORIMETRIC
ı 6010 (ANTIMONY)	INDUCTIVELY COUPLED ARGON PLASMA
A 6010 (BARIUM)	INDUCTIVELY COUPLED ARGON PLASMA
A 6010 (BERYLLIUM)	INDUCTIVELY COUPLED ARGON PLASMA
A 6010 (CADMIUM)	INDUCTIVELY COUPLED ARGON PLASMA
A 6010 (CHROMIUM)	INDUCTIVELY COUPLED ARGON PLASMA
A 6010 (COBALT)	INDUCTIVELY COUPLED ARGON PLASMA
A 6010 (NICKEL)	INDUCTIVELY COUPLED ARGON PLASMA
A 6010 (VANADIUM)	INDUCTIVELY COUPLED ARGON PLASMA
A 7060 (ARSENIC)	ATOMIC ABSORPTION/GRAPHITE FURNACE
A 7421 (LEAD)	ATOMIC ABSORPTION/GRAPHITE FURNACE
A 7470 (AQUEOUS MERCURY)	ATOMIC ABSORPTION/COLD VAPOR
A 7740 (SELENIUM)	ATOMIC ABSORPTION/GRAPHITE FURNACE
A 8240 (GC/MS FOR VOLATILE ORGANICS)	GC/MASS SPECTROMETER
A [illegible] (GC/MS FOR SEMIVOLATILE ORGANICS)	GC/MASS SPECTROMETER
A 9038 (SULFATE)	TURBIDIMETRIC
A 9040 (pH)	ELECTRODE
A 9050 (ELECTRICAL CONDUCTIVITY)	ELECTRODE
A 9253 (CHLORIDE)	TITRIMETRIC, SILVER NITRATE

AnalyticalTechnologies,Inc.

GENERAL CHEMISTRY RESULTS

ient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
oject # : PIO200-006
oject Name: CLUSTER WELL

ATI I.D.: 408172

mple Client ID #	Matrix	Date Sampled	Date Received
HCW-4A	WATER	10-AUG-94	11-AUG-94
HCW-4B	WATER	10-AUG-94	11-AUG-94
HCW-4C	WATER	10-AUG-94	11-AUG-94
LCW-4A	WATER	10-AUG-94	11-AUG-94
LCW-4B	WATER	10-AUG-94	11-AUG-94

rameter	Units	1	2	3	4	5
RBONATE AS CACO3	MG/L	<5.0	<5.0	<5.0	<5.0	<5.0
CARBONATE AS CACO3	MG/L	696	177	140	706	195
DROXIDE AS CACO3	MG/L	<5.0	<5.0	<5.0	<5.0	<5.0
TAL ALKALINITY AS CACO3	MG/L	696	177	140	706	195
LORIDE	MG/L	1880	12700	14100	1850	12300
ECTRICAL CONDUCTIVITY	UMHOS/CM	8440	33800	36500	8140	32800
UORIDE	MG/L	<0.50	<0.50	0.64	<0.50	<0.50
RFACTANTS (MBAS)	MG/L	0.16	<0.1	<0.1	<0.1	<0.1
TRATE-NITRITE AS NITROGEN	MG/L	<0.05	<0.05	1.1	<0.05	0.05
I	UNITS	7.84	7.21	7.44	7.85	7.14
ULF	MG/L	1190	2290	2960	1170	2830
TA ISSOLVED SOLIDS	MG/L	5220	23900	27500	5000	27500

AnalyticalTechnologies,Inc.

GENERAL CHEMISTRY RESULTS

ient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
oject # : PIO200-006
oject Name: CLUSTER WELL

ATI I.D.: 408172

nple Client ID #	Matrix	Date Sampled	Date Received
LCW-4C	WATER	10-AUG-94	11-AUG-94

rameter	Units	6
RBONATE AS CACO3	MG/L	<5.0
CARBONATE AS CACO3	MG/L	135
DROXIDE AS CACO3	MG/L	<5.0
TAL ALKALINITY AS CACO3	MG/L	135
LORIDE	MG/L	14200
ECTRICAL CONDUCTIVITY	UMHOS/CM	36500
UORIDE	MG/L	0.90
RFACTANTS (MBAS)	MG/L	<0.1
TRATE-NITRITE AS NITROGEN	MG/L	1.4
[	UNITS	7.44
LFATE	MG/L	2890
TAL DISSOLVED SOLIDS	MG/L	24600

AnalyticalTechnologies,Inc.

GENERAL CHEMISTRY - QUALITY CONTROL

DUP/MS

ent : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
ject # : PIO200-006
ject Name: CLUSTER WELL

ATI I.D. : 408172

rameters	REF I.D.	Units	Sample Result	Dup Result	RPD	Spiked Sample	Spike Conc	% Rec
CARBONATE AS CACO3	408219-03	MG/L	1670	1670	0	N/A	N/A	N/A
RBONATE AS CACO3	408219-03	MG/L	44.0	44.0	0	N/A	N/A	N/A
LORIDE	408240-01	MG/L	<5.0	<5.0	0	41.0	40.0	103
ECTRICAL CONDUCTIVITY	408172-06	UMHOS/CM	36500	36500	0	N/A	N/A	N/A
UORIDE	408219-03	MG/L	1.9	2.0	5	6.9	5.0	100
UORIDE	408239-01	MG/L	1.5	1.5	0	6.7	5.0	104
DROXIDE AS CACO3	408219-03	MG/L	<5.0	<5.0	0	N/A	N/A	N/A
TRATE-NITRITE AS NITROGEN	408172-04	MG/L	<0.05	<0.05	0	1.6	2.0	80
LFATE	408168-04	MG/L	1990	2120	6	5540	4000	89
LFATE	408179-01	MG/L	<10.0	<10.0	0	21.2	20.0	106
RFACTANTS (MBAS)	408172-06	MG/L	<0.1	<0.1	0	2.2	2.0	110
TAL ALKALINITY AS CACO3	408219-03	MG/L	1710	1710	0	N/A	N/A	N/A
TAL DISSOLVED SOLIDS	408195-01	MG/L	534	540	1	N/A	N/A	N/A
I	408199-03	UNITS	6.36	6.42	1	N/A	N/A	N/A

Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
D lative % Difference) = (Sample Result - Duplicate Result)*100/Average Result

AnalyticalTechnologies,Inc.

GENERAL CHEMISTRY - QUALITY CONTROL

BLANK SPIKE

ient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
oject # : PIO200-006
oject Name: CLUSTER WELL

ATI I.D. : 408172

rameters	Blank Spike ID#	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
LORIDE	49324	MG/L	<5.0	41.0	40.0	103
UORIDE	49257	MG/L	<0.50	4.6	5.0	92
UORIDE	49398	MG/L	<0.50	4.9	5.0	98
TRATE-NITRITE AS NITROGEN	49264	MG/L	<0.05	2.0	2.0	100
LFATE	49310	MG/L	<10.0	19.3	20.0	97
RFACTANTS (MBAS)	49193	MG/L	<0.1	0.97	1.0	97

Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
D (Relative % Difference) = (Sample Result - Duplicate Result)*100/Average Result

AnalyticalTechnologies,Inc.

METALS RESULTS

ient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
oject # : PIO200-006
oject Name: CLUSTER WELL

ATI I.D.: 408172

nple Client ID #	Matrix	Date Sampled	Date Received
HCW-4A	WATER	10-AUG-94	11-AUG-94
HCW-4B	WATER	10-AUG-94	11-AUG-94
HCW-4C	WATER	10-AUG-94	11-AUG-94
LCW-4A	WATER	10-AUG-94	11-AUG-94
LCW-4B	WATER	10-AUG-94	11-AUG-94

rameter	Units	1	2	3	4	5
SENIC	MG/L	<0.02@H	<0.02@H	<0.02@H	<0.02@H	<0.02@H
RIUM	MG/L	<0.01	0.03	0.02	<0.01	0.03
RYLLIUM	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
DMIUM	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
BALT	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
ROMIUM	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
RCURY	MG/L	<0.0005	0.0008	<0.0005	<0.0005	<0.0005
CKEL	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
AD	MG/L	<0.01@H	<0.02@H	<0.02@H	<0.02@H	<0.02@H
TIMONY	MG/L	<0.03	<0.03	<0.03	<0.03	<0.03
LEN UM	MG/L	0.052	0.065	0.043	<0.02@H	<0.04@H
NA M	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01

AnalyticalTechnologies,Inc.

METALS RESULTS

ient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
oject # : PIO200-006
oject Name: CLUSTER WELL

ATI I.D.: 408172

mple Client ID #	Matrix	Date Sampled	Date Received
LCW-4C	WATER	10-AUG-94	11-AUG-94
HCW-4A/DISSOLVED 01	WATER	10-AUG-94	11-AUG-94
HCW-4B/DISSOLVED 02	WATER	10-AUG-94	11-AUG-94
HCW-4C/DISSOLVED 03	WATER	10-AUG-94	11-AUG-94
LCW-4A/DISSOLVED 04	WATER	10-AUG-94	11-AUG-94

rameter	Units	6	8	9	10	11
SENIC	MG/L	<0.02@H	<0.02@H	<0.02@H	<0.02@H	<0.02@H
RIUM	MG/L	0.02	<0.01	0.03	0.02	<0.01
RYLLIUM	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
DMIUM	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
BALT	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
ROMIUM	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
RCURY	MG/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
CKEL	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
AD	MG/L	<0.02@H	<0.02@H	<0.02@H	<0.02@H	<0.02@H
TIMONY	MG/L	<0.03	<0.03	<0.03	<0.03	<0.03
LENIUM	MG/L	0.059	<0.02@H	<0.04@H	<0.04@H	<0.04@H
NAI	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01

AnalyticalTechnologies,Inc.

METALS RESULTS

.ent : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
›ject # : PIO200-006
›ject Name: CLUSTER WELL

ATI I.D.: 408172

ıple Client ID	Matrix	Date Sampled	Date Received
LCW-4B/DISSOLVED 05	WATER	10-AUG-94	11-AUG-94
LCW-4C/DISSOLVED 06	WATER	10-AUG-94	11-AUG-94

:ameter	Units	12	13
SENIC	MG/L	<0.02@H	<0.02@H
RIUM	MG/L	0.03	0.02
RYLLIUM	MG/L	<0.005	<0.005
DMIUM	MG/L	<0.005	<0.005
BALT	MG/L	<0.01	<0.01
ROMIUM	MG/L	<0.01	<0.01
RCURY	MG/L	<0.0005	<0.0005
CKEL	MG/L	<0.01	<0.01
AD	MG/L	<0.02@H	<0.02@H
TIMONY	MG/L	<0.03	<0.03
LENIUM	MG/L	<0.04@H	<0.04@H
NADIUM	MG/L	<0.01	<0.01

AnalyticalTechnologies,Inc.

METALS - QUALITY CONTROL

DUP/MS

ent : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
ject # : PI0200-006
ject Name: CLUSTER WELL

ATI I.D. : 408172

ameters	REF I.D.	Units	Sample Result	Dup Result	RPD	Spiked Sample	Spike Conc	% Rec
IMONY	408172-08	MG/L	<0.03	<0.03	0	1.88	2.00	94
ENIC	408172-08	MG/L	<0.02@H	<0.02@H	0	1.77	2.00	89
IUM	408172-08	MG/L	<0.01	<0.01	0	3.69	4.00	92
YLLIUM	408172-08	MG/L	<0.005	<0.005	0	1.88	2.00	94
MIUM	408172-08	MG/L	<0.005	<0.005	0	1.85	2.00	93
OMIUM	408172-08	MG/L	<0.01	<0.01	0	1.81	2.00	91
ALT	408172-08	MG/L	<0.01	<0.01	0	3.79	4.00	95
D	408172-08	MG/L	<0.02@H	<0.02@H	0	1.83	2.00	92
CURY	408172-13	MG/L	<0.0005	<0.0005	0	0.0019	0.0020	95
KEL	408172-08	MG/L	<0.01	<0.01	0	1.85	2.00	93
ENIUM	408172-08	MG/L	<0.02@H	<0.02	0	1.06	1.20	88
ADIUM	408172-08	MG/L	<0.01	<0.01	0	3.73	4.00	93

Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
D (Relative % Difference) = (Sample Result - Duplicate Result)*100/Average Result

AnalyticalTechnologies,Inc.

METALS - QUALITY CONTROL

BLANK SPIKE

ient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
oject # : PIO200-006
oject Name: CLUSTER WELL

ATI I.D. : 408172

rameters	Blank Spike ID#	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
TIMONY	49409	MG/L	<0.03	1.93	2.00	97
SENIC	49319	MG/L	<0.002	2.02	2.00	101
RIUM	49409	MG/L	<0.01	3.90	4.00	98
RYLLIUM	49409	MG/L	<0.005	1.91	2.00	96
DMIUM	49409	MG/L	<0.005	1.96	2.00	98
ROMIUM	49409	MG/L	<0.01	1.88	2.00	94
BALT	49409	MG/L	<0.01	3.97	4.00	99
AD	49325	MG/L	<0.002	2.04	2.00	102
RCURY	49254	MG/L	<0.0005	0.0020	0.0020	100
CKEL	49409	MG/L	<0.01	1.95	2.00	98
LENIUM	49400	MG/L	<0.002	1.32	1.20	110
NADIUM	49409	MG/L	<0.01	3.79	4.00	95

Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
PD (Relative % Difference) = (Sample Result - Duplicate Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408172
Project # : PIO200-006
Project Name: CLUSTER WELL

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	HCW-4A	WATER	10-AUG-94	N/A	22-AUG-94	1.00
2	HCW-4B	WATER	10-AUG-94	N/A	22-AUG-94	1.00
3	HCW-4C	WATER	10-AUG-94	N/A	22-AUG-94	1.00

Parameter	Units	1	2	3
CARBON DISULFIDE	UG/L	<2	<2	<2
CHLOROFORM	UG/L	<1	<1	<1
2-BUTANONE (MEK)	UG/L	<10	<10	<10
1,2-DICHLOROETHANE	UG/L	<1	<1	<1
BENZENE	UG/L	1	<1	<1
TOLUENE	UG/L	<2	<2	<2
CHLOROBENZENE	UG/L	<1	<1	<1
ETHYLBENZENE	UG/L	2	<1	<1
XYLENES (TOTAL)	UG/L	2	<1	<1
STYRENE	UG/L	<2	<2	<2
1,4-DIOXANE	UG/L	<200	<200	<200
[illegible]YLENE DIBROMIDE	UG/L	<5	<5	<5
[illegible]LOHEXANE	UG/L	<10	<10	<10
SURROGATES				
1,2-DICHLOROETHANE-D4	%	93	95	103
TOLUENE-D8	%	101	101	99
BFB	%	94	96	95

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408172
Project # : PIO200-006
Project Name: CLUSTER WELL

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	LCW-4A	WATER	10-AUG-94	N/A	19-AUG-94	1.00
5	LCW-4B	WATER	10-AUG-94	N/A	22-AUG-94	1.00
6	LCW-4C	WATER	10-AUG-94	N/A	23-AUG-94	1.00

Parameter	Units	4	5	6
CARBON DISULFIDE	UG/L	<2	<2	<2
CHLOROFORM	UG/L	<1	<1	<1
2-BUTANONE (MEK)	UG/L	<10	<10	<10
1,2-DICHLOROETHANE	UG/L	<1	<1	<1
BENZENE	UG/L	1	<1	<1
TOLUENE	UG/L	<2	<2	<2
CHLOROBENZENE	UG/L	<1	<1	<1
ETHYLBENZENE	UG/L	<1	<1	<1
XYLENES (TOTAL)	UG/L	2	<1	<1
STYRENE	UG/L	<2	<2	<2
1,4-DIOXANE	UG/L	<200	<200	<200
ETHYLENE DIBROMIDE	UG/L	<5	<5	<5
CYCLOHEXANE	UG/L	<10	<10	<10
SURROGATES				
1,2-DICHLOROETHANE-D4	%	103	98	97
TOLUENE-D8	%	103	101	102
BFB	%	98	95	97

AnalyticalTechnologies, Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408172
Project # : PIO200-006
Project Name: CLUSTER WELL

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
7	CW-TB/TRIP BLANK(GCMS92409241)	WATER	10-AUG-94	N/A	23-AUG-94	1.00

Parameter	Units	7
CARBON DISULFIDE	UG/L	<2
CHLOROFORM	UG/L	<1
2-BUTANONE (MEK)	UG/L	<10
1,2-DICHLOROETHANE	UG/L	<1
BENZENE	UG/L	<1
TOLUENE	UG/L	<2
CHLOROBENZENE	UG/L	<1
ETHYLBENZENE	UG/L	<1
XYLENES (TOTAL)	UG/L	<1
STYRENE	UG/L	<2
1,4-DIOXANE	UG/L	<200
ETHYLENE DIBROMIDE	UG/L	<5
CYCLOHEXANE	UG/L	<10
SURROGATES		
1,2-DICHLOROETHANE-D4	%	95
TOLUENE-D8	%	103
BFB	%	92

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank I.D. : 31758
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-006
Project Name: CLUSTER WELL

ATI I.D. : 408172
Date Extracted: N/A
Date Analyzed : 19-AUG-94
Dil. Factor : 1.00

Parameters	Units	Results
CARBON DISULFIDE	UG/L	<2
1,4-DIOXANE	UG/L	<200
ETHYLENE DIBROMIDE	UG/L	<5
CHLOROFORM	UG/L	<1
CYCLOHEXANE	UG/L	<10
2-BUTANONE (MEK)	UG/L	<10
1,2-DICHLOROETHANE	UG/L	<1
BENZENE	UG/L	<1
TOLUENE	UG/L	<2
CHLOROBENZENE	UG/L	<1
ETHYLBENZENE	UG/L	<1
XYLENES (TOTAL)	UG/L	<1
STYRENE	UG/L	<2
ROGATES		
-DICHLOROETHANE-D4	%	97
TOLUENE-D8	%	102
BFB	%	96

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank I.D. : 31780
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-006
Project Name: CLUSTER WELL

ATI I.D. : 408172
Date Extracted: N/A
Date Analyzed : 22-AUG-94
Dil. Factor : 1.00

Parameters	Units	Results
CARBON DISULFIDE	UG/L	<2
CHLOROFORM	UG/L	<1
2-BUTANONE (MEK)	UG/L	<10
1,2-DICHLOROETHANE	UG/L	<1
BENZENE	UG/L	<1
TOLUENE	UG/L	<2
CHLOROBENZENE	UG/L	<1
ETHYLBENZENE	UG/L	<1
XYLENES (TOTAL)	UG/L	<1
STYRENE	UG/L	<2
1,4-DIOXANE	UG/L	<200
ETHYLENE DIBROMIDE	UG/L	<5
CYCLOHEXANE	UG/L	<10
SURROGATES		
1,2-DICHLOROETHANE-D4	%	94
TOLUENE-D8	%	101
BFB	%	95

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank I.D. : 31789
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-006
Project Name: CLUSTER WELL

ATI I.D. : 408172
Date Extracted: N/A
Date Analyzed : 23-AUG-94
Dil. Factor : 1.00

Parameters	Units	Results
CARBON DISULFIDE	UG/L	<2
CHLOROFORM	UG/L	<1
2-BUTANONE (MEK)	UG/L	<10
1,2-DICHLOROETHANE	UG/L	<1
BENZENE	UG/L	<1
TOLUENE	UG/L	<2
CHLOROBENZENE	UG/L	<1
ETHYLBENZENE	UG/L	<1
XYLENES (TOTAL)	UG/L	<1
STYRENE	UG/L	<2
1,4-DIOXANE	UG/L	<200
ETHYLENE DIBROMIDE	UG/L	<5
CYCLOHEXANE	UG/L	<10
ROGATES		
-DICHLOROETHANE-D4	%	93
TOLUENE-D8	%	102
BFB	%	96

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

MSMSD

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
MSMSD # : 66220
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.

Project # : PIO200-006
Project Name: CLUSTER WELL

ATI I.D. : 408172
Date Extracted: N/A
Date Analyzed : 22-AUG-94
Sample Matrix : WATER
REF I.D. : 408168-04

Parameters	Units	Sample Result	Conc Spike	Spiked Sample	% Rec	Dup Spike	Dup % Rec	RPD
BENZENE	UG/L	2	58	58	97	58	0	200
TOLUENE	UG/L	<2	55	57	104	55	0	200
CHLOROBENZENE	UG/L	<1	50	52	104	50	0	200

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample Result - Duplicate Spike Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

BLANK SPIKE

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank Spike #: 49362
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-006
Project Name : CLUSTER WELL

ATI I.D. : 408172
Date Extracted: N/A
Date Analyzed : 19-AUG-94
Sample Matrix : WATER

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
BENZENE	UG/L	<1	54	50	108
TOLUENE	UG/L	<2	54	50	108
CHLOROBENZENE	UG/L	<1	49	50	98

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

BLANK SPIKE

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank Spike #: 49408
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-006
Project Name : CLUSTER WELL

ATI I.D. : 408172
Date Extracted: N/A
Date Analyzed : 22-AUG-94
Sample Matrix : WATER

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
BENZENE	UG/L	<1	58	50	116
TOLUENE	UG/L	<2	58	50	116
CHLOROBENZENE	UG/L	<1	53	50	106

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

AnalyticalTechnologies, Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

BLANK SPIKE

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank Spike #: 49421
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-006
Project Name : CLUSTER WELL

ATI I.D. : 408172
Date Extracted: N/A
Date Analyzed : 23-AUG-94
Sample Matrix : WATER

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
BENZENE	UG/L	<1	58	50	116
TOLUENE	UG/L	<2	57	50	114
CHLOROBENZENE	UG/L	<1	52	50	104

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

AnalyticalTechnologies, Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408172
Project # : PIO200-006
Project Name: CLUSTER WELL

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	HCW-4A	WATER	10-AUG-94	17-AUG-94	22-AUG-94	2.00
2	HCW-4B	WATER	10-AUG-94	17-AUG-94	22-AUG-94	1.00
3	HCW-4C	WATER	10-AUG-94	17-AUG-94	22-AUG-94	1.00

Parameter	Units	1	2	3
ANTHRACENE	UG/L	<20	<10	<10
BENZO(a)ANTHRACENE	UG/L	<20	<10	<10
BENZO(b)FLUORANTHENE	UG/L	<20	<10	<10
BENZO(k)FLUORANTHENE	UG/L	<20	<10	<10
BENZO(a)PYRENE	UG/L	<20	<10	<10
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	<20	<10	<10
BUTYLBENZYLPHTHALATE	UG/L	<20	<10	<10
CHRYSENE	UG/L	<20	<10	<10
DIBENZ(a,h)ACRIDINE	UG/L	<20	<10	<10
DIBENZ(a,h)ANTHRACENE	UG/L	<20	<10	<10
1,2-DICHLOROBENZENE	UG/L	<20	<10	<10
1,3-DICHLOROBENZENE	UG/L	<20	<10	<10
1,4-DICHLOROBENZENE	UG/L	<20	<10	<10
DIETHYLPHTHALATE	UG/L	<20	<10	<10
7,12-DIMETHYLBENZO(a)ANTHRACENE	UG/L	<20	<10	<10
DIMETHYLPHTHALATE	UG/L	<20	<10	<10
DI-N-BUTYLPHTHALATE	UG/L	<20	<10	<10
DI-N-OCTYLPHTHALATE	UG/L	<20	<10	<10
FLUORANTHENE	UG/L	<20	<10	<10
NAPHTHALENE	UG/L	<20	<10	<10
PHENANTHRENE	UG/L	<20	<10	<10
PYRENE	UG/L	<20	<10	<10
2-METHYLNAPHTHALENE	UG/L	<20	<10	<10
BENZENETHIOL	UG/L	<20	<10	<10
4-NITROPHENOL	UG/L	<100	<50	<50
2,4-DIMETHYLPHENOL	UG/L	<20	<10	<10
2,4-DINITROPHENOL	UG/L	<100	<50	<50
PHENOL	UG/L	<20	<10	<10
2-METHYLPHENOL	UG/L	<20	<10	<10
3- & 4-METHYLPHENOL	UG/L	<20	<10	<10
INDENE	UG/L	<20	<10	<10
1-METHYLNAPHTHALENE	UG/L	23	<10	<10
PYRIDINE	UG/L	<100	<50	<50
QUINOLINE	UG/L	<100	<50	<50
6-METHYL CHRYSENE	UG/L	<20	<10	<10
SURROGATES				
NITROBENZENE-D5	%	83	121*H	114
2-FLUOROBIPHENYL	%	16*H	119	114
[illegible]PHENYL-D14	%	150*H	152*H	139

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408172
Project # : PIO200-006
Project Name: CLUSTER WELL

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	HCW-4A	WATER	10-AUG-94	17-AUG-94	22-AUG-94	2.00
2	HCW-4B	WATER	10-AUG-94	17-AUG-94	22-AUG-94	1.00
3	HCW-4C	WATER	10-AUG-94	17-AUG-94	22-AUG-94	1.00

Parameter	Units	1	2	3
SURROGATES				
PHENOL-D6	%	153*H	116	109
2-FLUOROPHENOL	%	139*H	99	94
2,4,6-TRIBROMOPHENOL	%	20*H	128	131

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408172
Project # : PIO200-006
Project Name: CLUSTER WELL

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	LCW-4A	WATER	10-AUG-94	17-AUG-94	23-AUG-94	1.00
5	LCW-4B	WATER	10-AUG-94	17-AUG-94	23-AUG-94	1.00
6	LCW-4C	WATER	10-AUG-94	17-AUG-94	23-AUG-94	1.00

Parameter	Units	4	5	6
ANTHRACENE	UG/L	<10	<10	<10
BENZO(a)ANTHRACENE	UG/L	<10	<10	<10
BENZO(b)FLUORANTHENE	UG/L	<10	<10	<10
BENZO(k)FLUORANTHENE	UG/L	<10	<10	<10
BENZO(a)PYRENE	UG/L	<10	<10	<10
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	<10	<10	<10
BUTYLBENZYLPHTHALATE	UG/L	<10	<10	<10
CHRYSENE	UG/L	<10	<10	<10
DIBENZ(a,h)ACRIDINE	UG/L	<10	<10	<10
DIBENZ(a,h)ANTHRACENE	UG/L	<10	<10	<10
1,2-DICHLOROBENZENE	UG/L	<10	<10	<10
[illegible]-DICHLOROBENZENE	UG/L	<10	<10	<10
[illegible]-DICHLOROBENZENE	UG/L	<10	<10	<10
DIETHYLPHTHALATE	UG/L	<10	<10	<10
7,12-DIMETHYLBENZO(a)ANTHRACENE	UG/L	<10	<10	<10
DIMETHYLPHTHALATE	UG/L	<10	<10	<10
DI-N-BUTYLPHTHALATE	UG/L	<10	<10	<10
DI-N-OCTYLPHTHALATE	UG/L	<10	<10	<10
FLUORANTHENE	UG/L	<10	<10	<10
NAPHTHALENE	UG/L	<10	<10	<10
PHENANTHRENE	UG/L	<10	<10	<10
PYRENE	UG/L	<10	<10	<10
2-METHYLNAPHTHALENE	UG/L	<10	<10	<10
BENZENETHIOL	UG/L	<10	<10	<10
4-NITROPHENOL	UG/L	<50	<50	<50
2,4-DIMETHYLPHENOL	UG/L	<10	<10	<10
2,4-DINITROPHENOL	UG/L	<50	<50	<50
PHENOL	UG/L	<10	<10	<10
2-METHYLPHENOL	UG/L	<10	<10	<10
3- & 4-METHYLPHENOL	UG/L	<10	<10	<10
INDENE	UG/L	<10	<10	<10
1-METHYLNAPHTHALENE	UG/L	<10	<10	<10
PYRIDINE	UG/L	<50	<50	<50
QUINOLINE	UG/L	<50	<50	<50
6-METHYL CHRYSENE	UG/L	<10	<10	<10
SURROGATES				
NITROBENZENE-D5	%	100	108	26*T
2-FLUOROBIPHENYL	%	118	116	55
[illegible]PHENYL-D14	%	128	126	66

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-006
Project Name: CLUSTER WELL

ATI I.D. : 408172

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	LCW-4A	WATER	10-AUG-94	17-AUG-94	23-AUG-94	1.00
5	LCW-4B	WATER	10-AUG-94	17-AUG-94	23-AUG-94	1.00
6	LCW-4C	WATER	10-AUG-94	17-AUG-94	23-AUG-94	1.00

Parameter	Units	4	5	6
SURROGATES				
PHENOL-D6	%	127	104	70
2-FLUOROPHENOL	%	120	95	61
2,4,6-TRIBROMOPHENOL	%	140*T	107	57

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Blank I.D. : 31787
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-006
Project Name: CLUSTER WELL

ATI I.D. : 408172
Date Extracted: 17-AUG-94
Date Analyzed : 23-AUG-94
Dil. Factor : 1.00

Parameters	Units	Results
ANTHRACENE	UG/L	<10
BENZO(a)ANTHRACENE	UG/L	<10
BENZO(b)FLUORANTHENE	UG/L	<10
BENZO(k)FLUORANTHENE	UG/L	<10
BENZO(a)PYRENE	UG/L	<10
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	<10
BUTYLBENZYLPHTHALATE	UG/L	<10
CHRYSENE	UG/L	<10
DIBENZ(a,h)ACRIDINE	UG/L	<10
DIBENZ(a,h)ANTHRACENE	UG/L	<10
1,2-DICHLOROBENZENE	UG/L	<10
1,3-DICHLOROBENZENE	UG/L	<10
1,4-DICHLOROBENZENE	UG/L	<10
DIETHYLPHTHALATE	UG/L	<10
7 12-DIMETHYLBENZO(a)ANTHRACENE	UG/L	<10
ETHYLPHTHALATE	UG/L	<10
DI-N-BUTYLPHTHALATE	UG/L	<10
DI-N-OCTYLPHTHALATE	UG/L	<10
FLUORANTHENE	UG/L	<10
NAPHTHALENE	UG/L	<10
PHENANTHRENE	UG/L	<10
PYRENE	UG/L	<10
2-METHYLNAPHTHALENE	UG/L	<10
BENZENETHIOL	UG/L	<10
4-NITROPHENOL	UG/L	<50
2,4-DIMETHYLPHENOL	UG/L	<10
2,4-DINITROPHENOL	UG/L	<50
PHENOL	UG/L	<10
2-METHYLPHENOL	UG/L	<10
3- & 4-METHYLPHENOL	UG/L	<10
INDENE	UG/L	<10
1-METHYLNAPHTHALENE	UG/L	<10
PYRIDINE	UG/L	<50
QUINOLINE	UG/L	<50
6-METHYL CHRYSENE	UG/L	<10
SURROGATES		
NITROBENZENE-D5	%	104
2-FLUOROBIPHENYL	%	99
TERPHENYL-D14	%	124
PHENOL-D6	%	116
2-FLUOROPHENOL	%	109
2,4,6-TRIBROMOPHENOL	%	148*T

*T -

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

MSMSD

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
MSMSD # : 66226
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.

Project # : PIO200-006
Project Name: CLUSTER WELL

ATI I.D. : 408172
Date Extracted: 17-AUG-94
Date Analyzed : 23-AUG-94
Sample Matrix : WATER
REF I.D. : REAGENT WATER

Parameters	Units	Sample Result	Conc Spike	Spiked Sample	% Rec	Dup Spike	Dup % Rec	RPD
PHENOL	UG/L	<10	150	150	100*	140	93	7
1,4-DICHLOROBENZENE	UG/L	<10	100	83	83	100	100	19
4-NITROPHENOL	UG/L	<50	150	160	107	150	100	6
PYRENE	UG/L	<10	100	87	87	110	110	23

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample Result - Duplicate Spike Result)*100/Average Result

ANALYTICAL TECHNOLOGIES, INC.
SAN DIEGO
FLAGS

INORGANICS

FLAG	MESSAGE DESCRIPTION
B	ABSOLUTE VALUE OF ANALYTE CONCENTRATION IS < CRDL BUT ≥ THE IDL
BB	RESULT BETWEEN IDL AND LOQ
D	POST DIGESTION SPIKE FOR GFAA OUTSIDE LIMITS AFTER 1:25 DILUTION. SAMPLE REPORTED AT ORIGINAL CONCENTRATION.
E	ESTIMATED VALUE DUE TO INTERFERENCE
M	DUPLICATE INJECTION PRECISION NOT MET
N	SPIKED SAMPLE RECOVERY NOT WITHIN CONTROL LIMITS
S	REPORTED VALUE WAS DETERMINED BY METHOD OF STANDARD ADDITIONS
U	COMPOUND WAS ANALYZED FOR BUT NOT DETECTED
W	POST DIGESTION SPIKE OUT OF CONTROL LIMITS; SAMPLE ABSORBANCE < 50% OF SPIKE ABSORBANCE FOR GF/AA
X	ABSOLUTE VALUE OF ANALYTE CONCENTRATION IS LESS THAN 3 TIMES THE MDL
*	DUPLICATE ANALYSIS NOT WITHIN CONTROL LIMITS
+	CORRELATION COEFFICIENT FOR MSA IS LESS THAN 0.995
*H	RESULTS OUTSIDE OF LIMITS DUE TO SAMPLE MATRIX INTERFERENCE
*Q	INSUFFICIENT SAMPLE FOR ANALYSIS
*R	DATA IS NOT USABLE
*V	SAMPLE RESULT IS >4X SPIKED CONCENTRATION, THEREFORE SPIKE IS NOT DETECTABLE
*Y	RESULT NOT ATTAINABLE DUE TO SAMPLE MATRIX INTERFERENCE
@C	*VARIABLE MESSAGE*
@H	DETECTION LIMIT ELEVATED DUE TO MATRIX INTERFERENCE
@Q	DETECTION LIMIT ELEVATED DUE TO LIMITED SAMPLE FOR ANALYSIS
@R	RPD LIMIT IS 67% FOR INORGANIC RESULTS LESS THAN TEN TIMES THE REPORTING DETECTION LIMIT
@S	RPD: ONE RESULT ABOVE AND ONE RESULT BELOW REPORTING LIMIT (RL). RESULT ABOVE SHOULD BE < 5 TIMES RL TO BE IN CONTROL.
@V	PRE-DIGEST SPIKE OUT OF LIMITS. POST DIGESTION SPIKE YIELDED ACCEPTABLE RESULTS
@W	DETECTION LIMIT ELEVATED DUE TO REDUCED SAMPLE WEIGHT
@Y	ION BALANCE OUTSIDE OF ATI'S ACCEPTANCE LIMITS; REANALYSIS CONFIRMED ORIGINAL RESULT
@X	RESULTS VERIFIED BY REDIGESTION AND REANALYSIS

ANALYTICAL TECHNOLOGIES, INC.
SAN DIEGO
FLAGS

ORGANICS

FLAG	MESSAGE DESCRIPTION
A	A TIC IS A SUSPECTED ALDOL-CONDENSATION PRODUCT
B	ANALYTE FOUND IN THE ASSOCIATED REAGENT BLANK
C	PESTICIDE, WHERE THE IDENTIFICATION WAS CONFIRMED BY GC/MS
CO	THESE COMPOUNDS CO-ELUTE AND ARE QUANTITATED AS ONE PEAK
D	COMPOUND IDENTIFIED IN AN ANALYSIS AT SECONDARY DILUTION
E	ANALYTE AMOUNT EXCEEDS THE CALIBRATION RANGE
J	ESTIMATED VALUE
H	QUANTIFIED AS DIESEL BUT CHROMATOGRAPHIC PATTERN DOES NOT MATCH THAT OF DIESEL
K	QUANTIFIED AS KEROSENE BUT CHROMATOGRAPHIC PATTERN DOES NOT MATCH THAT OF KEROSENE
L	QUANTIFIED AS GASOLINE BUT CHROMATOGRAPHIC PATTERN DOES NOT MATCH THAT OF GASOLINE
N	PRESUMPTIVE EVIDENCE OF A COMPOUND
P	PESTICIDE/AROCLOR TARGET ANALYTE, WHERE THERE IS GREATER THAN 25% DIFFERENCE FOR DETECTED CONCENTRATION BETWEEN 2 GC COLUMNS
TR	COMPOUND DETECTED AT AN UNQUANTIFIABLE TRACE LEVEL
U	COMPOUND WAS ANALYZED FOR BUT NOT DETECTED
X	SEE CASE NARRATIVE
Y	SEE CASE NARRATIVE
Z	SEE CASE NARRATIVE
*	OUTSIDE OF QUALITY CONTROL LIMITS
*D	COMPOUND ANALYZED FROM A SECONDARY ANALYSIS
*F	RESULT OUTSIDE OF ATI'S QUALITY CONTROL LIMITS
*G	RESULT OUTSIDE QUALITY CONTROL LIMITS. INSUFFICIENT SAMPLE FOR RE-EXTRACTION/ANALYSIS
*H	RESULT OUTSIDE OF LIMITS DUE TO SAMPLE MATRIX INTERFERENCE
*I	BECAUSE OF NECESSARY SAMPLE DILUTION, VALUE WAS OUTSIDE QC LIMITS
*K	DUE TO THE NECESSARY DILUTION OF THE SAMPLE, RESULT WAS NOT ATTAINABLE
*L	ANALYTE IS A SUSPECTED LAB CONTAMINANT
*P	A STANDARD WAS USED TO QUANTITATE THIS VALUE
*R	DATA IS NOT USABLE
*T	SURROGATE RECOVERY IS OUTSIDE QC CONTROL LIMITS. NO CORRECTIVE ACTION INDICATED BY METHOD
*V	SAMPLE RESULT IS >4X SPIKED CONCENTRATION, THEREFORE SPIKE IS NOT DETECTABLE
*Y	RESULT NOT ATTAINABLE DUE TO SAMPLE MATRIX INTERFERENCE
@A	RESULTS OUT OF LIMITS DUE TO SAMPLE NON-HOMOGENEITY
@C	*VARIABLE MESSAGE*
@D	RESULT COULD NOT BE CONFIRMED DUE TO MATRIX INTERFERENCE ON THE CONFIRMATION COLUMN
@E	RESULT MAY BE FALSELY ELEVATED DUE TO SAMPLE MATRIX INTERFERENCE
@F	RESULT OUTSIDE OF CONTRACT SPECIFIED QUALITY CONTROL LIMITS
@G	RESULT OUTSIDE OF CONTRACT SPECIFIED ADVISORY LIMITS
@H	DETECTION LIMIT ELEVATED DUE TO MATRIX INTERFERENCE
@M	RESULT NOT CONFIRMED BY U.V. DUE TO SAMPLE MATRIX INTERFERENCE
@N	RESULT NOT CONFIRMED BY FLUORESCENCE DUE TO SAMPLE MATRIX INTERFERENCE
@P	RESULT QUANTITATED USING FLUORESCENCE ONLY DUE TO THE LOW CONCENTRATION
@Q	DETECTION LIMIT ELEVATED DUE TO LIMITED SAMPLE FOR ANALYSIS
@T	RESULT DUE TO TCLP EXTRACTION MATRIX INTERFERENCE. NO QC LIMITS HAVE BEEN ESTABLISHED
@U	SAMPLE CHROMATOGRAM DOES NOT RESEMBLE COMMON FUEL HYDROCARBON FINGERPRINTS
@Z	SAMPLE CHROMATOGRAM DOES NOT RESEMBLE A FUEL HYDROCARBON

ACCESSION #: 408172

INITIALS: D. S.

SAMPLE CONDITION UPON RECEIPT CHECKLIST (FOR RE-ACCESSIONS, COMPLETE #7 THRU #9)			
1	Does this project require special handling according to NEESA Levels C, D, AFOEHL or CLP protocols? If yes, complete a) thru c) a) Cooler temperature _____ b) pH sample aliquoted: yes / no / n/a c) LOT #'s: _____	YES	NO
2	Are custody seals present on cooler?	YES	NO
	If yes, are seals intact?	YES	NO
3	Are custody seals present on sample containers?	YES	NO
	If yes, are seals intact? N/A	YES	NO
4	Is there a Chain-Of-Custody (COC)*?	YES	NO
5	Is the COC* complete? Relinquished: yes/no Requested analysis: yes/no	YES	NO
6	Is the COC* in agreement with the samples received? # Samples: yes/no Sample ID's: yes/no Date sampled: yes/no Matrix: yes/no # containers: yes/no	YES	NO
7	Are the samples preserved correctly?	YES	NO
8	Is there enough sample for all the requested analyses?	YES	NO
9	Are all samples within holding times for the requested analyses?	YES	NO
10	Cooler temperature: 3.8°C, 3.5°C, 4.3°C		
11	Were all sample containers received intact (ie. not broken, leaking, etc.)?	YES	NO
12	Are samples requiring no headspace, headspace free? N/A	YES	NO
13	Are VOA 1st stickers required?	YES	NO
14	Are there special comments on the Chain of Custody which require client contact?	YES	N/A
15	If yes, was ATI Project Manager notified?	YES	NO

Describe "no" items: _____

Was client contacted? yes / no

If yes, Date: _____ Name of Person contacted: _____

Describe actions taken or client instructions: _____

*Or other representative documents, letters, and/or shipping memos

Analytical Technologies, Inc.

5550 MOREHOUSE DRIVE
SAN DIEGO, CA 92121-1709
(619) 458-9141

Chain of Custody

DATE 8/10/94 PAGE 1 OF 1

PROJECT MANAGER: Stephanie G. Sakurai
COMPANY: Environmental Technologies Int'l
ADDRESS: 733 Bishop Street
Honolulu, HI 96813

BILL TO: Same
COMPANY:
ADDRESS:

DED + REH — SAMPLERS: (Signature)
(808) 547-3600 — PHONE NUMBER

Recommended Quantity and Preservative (Provide triple volume on QC Samples)

SAMPLE ID	SAMPLE DATE	TIME	MATRIX	LAB ID	Petroleum Hydrocarbons 418.1 (1L (H_2SO_4)/100g)	Oil and Grease 413.2 (1L (H_2SO_4)/100g)	Gasoline (MOD 8015/DOHS) (4 oz (HCl)/50g)	Diesel (MOD 8015/DOHS) (4 oz (HCl)/50g)	Gasoline/BTXE (MOD 8015/8020) Maximum Contamination Level of Gasoline: 2ppm (water), 50ppm (Soil) (2X40ml (HCl)/50g)	MOD 8015 (Unknown) (4 oz (HCl)/50g)	BTXE (8020) (2X40ml (HCl)/50g)	Chlorinated Hydrocarbons (8010) (2X40ml (HCl)/50g)	Aromatic Hydrocarbons (8020) (2X40ml (HCl)/50g)	Chlorinated/Aromatic Hydrocarbons (8010/8020) (2X40ml (HCl)/50g)	Organic Pb (500ml/50g)	Pesticides/PCB (8080) (1L/50g)	Base/NEU/Acid Cmpds GC/MS (8270) (1L/100g)	Volatile Cmpds GC/MS (8240) (2X40ml (HCl)/100g)	Polynuclear Aromatic (8310) (1L/100g)	CCR Metals (500ml/100g)	Priority Pollutant Metals (500ml/100g)	8240 (Skinner)	8270 (Skinner)	Total Metals (Skinner)	Dissolved Metals (Skinner)	TDS, Alk, F, MBAS, SO4, PH, EC, Cl-	Nitrate-Nitrite	Number of Containers
HCW-4A	8/10/94	924	H_2O	01																		X	X	X	X	X	X	X	10
HCW-4B	8/10/94	1050	H_2O	02																		X	X	X	X	X	X	X	10
HCW-4C	8/10/94	1150	H_2O	03																		X	X	X	X	X	X	X	~~10~~ 9
LCW-4A	8/10/94	1430	H_2O	04																		X	X	X	X	X	X	X	10
LCW-4B	8/10/94	1555	H_2O	05																		X	X	X	X	X	X	X	10
LCW-4C	8/10/94	1650	H_2O	06																		X	X	X	X	X	X	X	10
CW-TB	DNA	DNA	H_2O	07																		X							2

PROJECT INFORMATION	
PROJECT NUMBER:	PI0200-006
PROJECT NAME:	CLUSTER WELL
PURCHASE ORDER NUMBER:	
VIA:	DHL
TAT:	☐24HR ☐48HRS ☐72HRS ☐1WK ☒2WK

SAMPLE RECEIPT	
TOTAL NUMBER OF CONTAINERS	61
CHAIN OF CUSTODY SEALS Y/N/NA	N/A
SEALS INTACT? Y/N/NA	N/A
RECEIVED GOOD COND./COLD	Y/Y
LAB NUMBER	408172

SAMPLE DISPOSAL INSTRUCTIONS

☐ ATI Disposal @ $5.00 each ☐ Return ☐ Pickup

Comments:
1) Filter and preserve samples for dissolved metals immediately upon receipt.

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature: [signature] Time: 1930	Signature: Time:	Signature: Time:
Printed Name: Robert [illegible] Date: 8/10/94	Printed Name: Date:	Printed Name: Date:
Company: ETI	Company:	Company:

RECEIVED BY: 1.	RECEIVED BY: 2.	RECEIVED BY: (LAB) 3.
Signature: Time:	Signature: Time:	Signature: [signature] Time: 9:30
Printed Name: Date:	Printed Name: Date:	Printed Name: David Schmid Date: 8/11/94
Company:	Company:	Analytical Technologies, Inc.

DISTRIBUTION: White, Canary - ANALYTICAL TECHNOLOGIES, INC. • Pink - ORIGINATOR

3. ANALYTICAL RESULTS OF DUPLICATE GROUNDWATER SAMPLE FROM MONITORING WELL NO. 4

WCAS
WEST COAST ANALYTICAL SERVICE, INC.
ANALYTICAL CHEMISTS

August 30, 1994

ENVIRONMENTAL TECHNOLOGIES INTERNATIONAL
733 Bishop Street, 26th Floor
P. O. Box 3379
Honolulu, HI 96842

Attn: Stephanie Sakurai

JOB NO. 27284 H

LABORATORY REPORT

Samples Received: Ten (10) Water Samples
Date Received: 8-12-94
Project No: PI0200-005

The samples were analyzed as follows:

Samples Analyzed	Analysis	Page
Two (2) waters	Volatile Organics by EPA 624	3 - 6
One (1) water	Semi-Volatile Organics by EPA 625	7 - 11
One (1) water	Anions by EPA 300.0	12
One (1) water	Selected Metals by ICPMS	13 - 14
One (1) water	Dissolved Metals by ICPMS	13 - 14
One (1) water	Alkalinity by SM 2320B	15 - 17
One (1) water	Conductivity by EPA 120.1	15 - 17
One (1) water	Total Dissolved Solids by EPA 160.1	15 - 17

Michael Shelton
Technical Director

D. J. Northington, Ph.D.
President

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9840 Alburtis Avenue • Santa Fe Springs, California 90670 • 310/948-2225 • FAX 310/948-5850

WEST COAST ANALYTICAL SERVICE, INC.

ENVIRONMENTAL TECHNOLOGIES INTERNATIONAL
Ms. Stephanie Sakurai

Job # 27284
August 30, 1994

LABORATORY REPORT

Samples Analyzed	Analysis	Page
One (1) water	pH by EPA 150.1	15 - 17
One (1) water	Surfactants by SM 5540C	15 - 17

WCAS

CLIENT: ENVIRONMENTAL TECHNOLOGIES SAMPLE: HMW-4
WCAS JOB #: 27284

VOLATILE ORGANICS BY EPA 624/8260

DATE RECEIVED:	08/12/94	MATRIX:	WATER
DATE EXTRACTED:	08/17/94	SAMPLE AMOUNT:	5ML
DATE ANALYZED:	08/18/94	RUN NUMBER:	27284B2
INSTRUMENT ID:	4500	UNITS:	UG/L (PPB)

CAS NO.	COMPOUND	CONCENTRATION	DET LIMIT
67-64-1	ACETONE	5.	5.
71-43-2	BENZENE	ND	1.
75-27-4	BROMODICHLOROMETHANE	ND	1.
75-25-2	BROMOFORM	ND	1.
74-83-9	BROMOMETHANE	ND	5.
78-93-3	2-BUTANONE (MEK)	ND	5.
75-15-0	CARBON DISULFIDE	20.	5.
56-23-5	CARBON TETRACHLORIDE	ND	1.
108-90-7	CHLOROBENZENE	ND	1.
75-00-3	CHLOROETHANE	ND	5.
67-66-3	CHLOROFORM	ND	1.
74-87-3	CHLOROMETHANE	ND	5.
108-41-8	CHLOROTOLUENE	ND	1.
110-82-7	CYCLOHEXANE	ND	1.
124-48-1	DIBROMOCHLOROMETHANE	ND	1.
95-50-1	1,2-DICHLOROBENZENE	ND	1.
541-73-1	1,3-DICHLOROBENZENE	ND	1.
106-46-7	1,4-DICHLOROBENZENE	ND	1.
75-34-3	1,1-DICHLOROETHANE	ND	1.
107-06-2	1,2-DICHLOROETHANE	ND	1.
75-35-4	1,1-DICHLOROETHYLENE	ND	1.
156-59-4	CIS-1,2-DICHLOROETHYLENE	ND	1.
156-60-5	TRANS-1,2-DICHLOROETHYLENE	ND	1.
78-87-5	1,2-DICHLOROPROPANE	ND	1.
10061-01-5	CIS-1,3-DICHLOROPROPENE	ND	1.
10061-02-6	TRANS-1,3-DICHLOROPROPENE	ND	1.
123-91-1	1,4-DIOXANE	ND	200.
100-41-4	ETHYLBENZENE	2.	1.
106-93-4	ETHYLENE DIBROMIDE	ND	1.
76-13-1	FREON-TF	ND	1.
119-78-6	2-HEXANONE	ND	5.
75-09-2	METHYLENE CHLORIDE	ND	5.
108-10-1	4-METHYL-2-PENTANONE (MIBK)	ND	5.
100-42-5	STYRENE	ND	1.
79-34-5	1,1,2,2-TETRACHLOROETHANE	ND	1.
127-18-4	TETRACHLOROETHYLENE	ND	1.
109-99-9	TETRAHYDROFURAN	ND	5.
108-88-3	TOLUENE	ND	1.
71-55-6	1,1,1-TRICHLOROETHANE	ND	1.
79-00-5	1,1,2-TRICHLOROETHANE	ND	1.
79-01-6	TRICHLOROETHYLENE	ND	1.
75-69-4	TRICHLOROFLUOROMETHANE	ND	1.
108-05-4	VINYL ACETATE	ND	5.
75-01-4	VINYL CHLORIDE	ND	5.
1330-20-7	TOTAL XYLENES	1.	1.

SURROGATE	1,2-DCA-d4	TOL-d8	BFB
PERCENT RECOVERY	104	97	113 **
CONTROL LIMITS	86-121	84-115	83-112

WCAS

CLIENT: ENVIRONMENTAL TECHNOLOGIES SAMPLE: TRIP BLANK
WCAS JOB #: 27284

VOLATILE ORGANICS BY EPA 624/8260

DATE RECEIVED: 08/12/94
DATE EXTRACTED: 08/17/94
DATE ANALYZED: 08/17/94
INSTRUMENT ID: 4500

MATRIX: WATER
SAMPLE AMOUNT: 5ML
RUN NUMBER: 27284B1
UNITS: UG/L (PPB)

CAS NO.	COMPOUND	CONCENTRATION	DET LIMIT
67-64-1	ACETONE	ND	5.
71-43-2	BENZENE	ND	1.
75-27-4	BROMODICHLOROMETHANE	ND	1.
75-25-2	BROMOFORM	ND	1.
74-83-9	BROMOMETHANE	ND	5.
78-93-3	2-BUTANONE (MEK)	ND	5.
75-15-0	CARBON DISULFIDE	ND	5.
56-23-5	CARBON TETRACHLORIDE	ND	1.
108-90-7	CHLOROBENZENE	ND	1.
75-00-3	CHLOROETHANE	ND	5.
67-66-3	CHLOROFORM	ND	1.
74-87-3	CHLOROMETHANE	ND	5.
108-41-8	CHLOROTOLUENE	ND	1.
110-82-7	CYCLOHEXANE	ND	1.
124-48-1	DIBROMOCHLOROMETHANE	ND	1.
95-50-1	1,2-DICHLOROBENZENE	ND	1.
541-73-1	1,3-DICHLOROBENZENE	ND	1.
106-46-7	1,4-DICHLOROBENZENE	ND	1.
75-34-3	1,1-DICHLOROETHANE	ND	1.
107-06-2	1,2-DICHLOROETHANE	ND	1.
75-35-4	1,1-DICHLOROETHYLENE	ND	1.
156-59-4	CIS-1,2-DICHLOROETHYLENE	ND	1.
156-60-5	TRANS-1,2-DICHLOROETHYLENE	ND	1.
78-87-5	1,2-DICHLOROPROPANE	ND	1.
10061-01-5	CIS-1,3-DICHLOROPROPENE	ND	1.
10061-02-6	TRANS-1,3-DICHLOROPROPENE	ND	1.
123-91-1	1,4-DIOXANE	ND	200.
100-41-4	ETHYLBENZENE	ND	1.
106-93-4	ETHYLENE DIBROMIDE	ND	1.
76-13-1	FREON-TF	ND	1.
119-78-6	2-HEXANONE	ND	5.
75-09-2	METHYLENE CHLORIDE	ND	5.
108-10-1	4-METHYL-2-PENTANONE (MIBK)	ND	5.
100-42-5	STYRENE	ND	1.
79-34-5	1,1,2,2-TETRACHLOROETHANE	ND	1.
127-18-4	TETRACHLOROETHYLENE	ND	1.
109-99-9	TETRAHYDROFURAN	ND	5.
108-88-3	TOLUENE	ND	1.
71-55-6	1,1,1-TRICHLOROETHANE	ND	1.
79-00-5	1,1,2-TRICHLOROETHANE	ND	1.
79-01-6	TRICHLOROETHYLENE	ND	1.
75-69-4	TRICHLOROFLUOROMETHANE	ND	1.
108-05-4	VINYL ACETATE	ND	5.
75-01-4	VINYL CHLORIDE	ND	5.
1330-20-7	TOTAL XYLENES	ND	1.

SURROGATE	1,2-DCA-d4	TOL-d8	BFB
PERCENT RECOVERY	104	97	103
CONTROL LIMITS	86-121	84-115	83-112

WCAS

CLIENT: ENVIRONMENTAL TECHNOLOGIES SAMPLE: LAB BLANK
WCAS JOB #: 27284

VOLATILE ORGANICS BY EPA 624/8260

DATE RECEIVED: 08/17/94
DATE EXTRACTED: 08/17/94
DATE ANALYZED: 08/17/94
INSTRUMENT ID: 4500

MATRIX: WATER
SAMPLE AMOUNT: 5ML
RUN NUMBER: VBLK912
UNITS: UG/L (PPB)

CAS NO.	COMPOUND	CONCENTRATION	DET LIMIT
67-64-1	ACETONE	ND	5.
71-43-2	BENZENE	ND	1.
75-27-4	BROMODICHLOROMETHANE	ND	1.
75-25-2	BROMOFORM	ND	1.
74-83-9	BROMOMETHANE	ND	5.
78-93-3	2-BUTANONE (MEK)	ND	5.
75-15-0	CARBON DISULFIDE	ND	5.
56-23-5	CARBON TETRACHLORIDE	ND	1.
108-90-7	CHLOROBENZENE	ND	1.
75-00-3	CHLOROETHANE	ND	5.
67-66-3	CHLOROFORM	ND	1.
74-87-3	CHLOROMETHANE	ND	5.
108-41-8	CHLOROTOLUENE	ND	1.
110-82-7	CYCLOHEXANE	ND	1.
124-48-1	DIBROMOCHLOROMETHANE	ND	1.
95-50-1	1,2-DICHLOROBENZENE	ND	1.
541-73-1	1,3-DICHLOROBENZENE	ND	1.
106-46-7	1,4-DICHLOROBENZENE	ND	1.
75-34-3	1,1-DICHLOROETHANE	ND	1.
107-06-2	1,2-DICHLOROETHANE	ND	1.
75-35-4	1,1-DICHLOROETHYLENE	ND	1.
156-59-4	CIS-1,2-DICHLOROETHYLENE	ND	1.
156-60-5	TRANS-1,2-DICHLOROETHYLENE	ND	1.
78-87-5	1,2-DICHLOROPROPANE	ND	1.
10061-01-5	CIS-1,3-DICHLOROPROPENE	ND	1.
10061-02-6	TRANS-1,3-DICHLOROPROPENE	ND	1.
123-91-1	1,4-DIOXANE	ND	200.
100-41-4	ETHYLBENZENE	ND	1.
106-93-4	ETHYLENE DIBROMIDE	ND	1.
76-13-1	FREON-TF	ND	1.
119-78-6	2-HEXANONE	ND	5.
75-09-2	METHYLENE CHLORIDE	ND	5.
108-10-1	4-METHYL-2-PENTANONE (MIBK)	ND	5.
100-42-5	STYRENE	ND	1.
79-34-5	1,1,2,2-TETRACHLOROETHANE	ND	1.
127-18-4	TETRACHLOROETHYLENE	ND	1.
109-99-9	TETRAHYDROFURAN	ND	5.
108-88-3	TOLUENE	ND	1.
71-55-6	1,1,1-TRICHLOROETHANE	ND	1.
79-00-5	1,1,2-TRICHLOROETHANE	ND	1.
79-01-6	TRICHLOROETHYLENE	ND	1.
75-69-4	TRICHLOROFLUOROMETHANE	ND	1.
108-05-4	VINYL ACETATE	ND	5.
75-01-4	VINYL CHLORIDE	ND	5.
1330-20-7	TOTAL XYLENES	ND	1.

SURROGATE	1,2-DCA-d4	TOL-d8	BFB
PERCENT RECOVERY	102	94	98
CONTROL LIMITS	86-121	84-115	83-112

WCAS

WEST COAST ANALYTICAL SERVICE

MATRIX SPIKE/MATRIX SPIKE DUPLICATE
PERCENT RECOVERY AND RPD SUMMARY

CLIENT: ENVIRONMENTAL TECH
DATE ANALYZED: 08/18/94
WCAS JOB #: 27284

QC BATCH: 081794W
MATRIX: WATER
UNITS: UG/L (PPB)

VOLATILE COMPOUNDS

COMPOUND	CONC SPIKED	CONC SAMPLE	CONC MS	% REC MS	CONC MSD	% REC MSD	RPD
1,1-DICHLOROETHYLENE	49.9	ND	41.9	84	45.0	90	-7
TRICHLOROETHYLENE	50.3	ND	53.2	106	53.9	107	-1
CHLOROBENZENE	50.4	ND	54.2	108	54.1	107	0
TOLUENE	49.9	ND	53.3	107	52.6	105	1
BENZENE	49.8	ND	54.6	110	55.9	112	-2

WATER QUALITY CONTROL LIMITS

ANALYTE	% RECOVERY WARNING	% RECOVERY CONTROL	RPD WARNING	RPD CONTROL
1,1-DICHLOROETHYLENE	52-155	25-182	24	36
TRICHLOROETHYLENE	59-120	44-135	13	18
CHLOROBENZENE	82-109	75-115	10	14
TOLUENE	80-116	71-125	13	19
BENZENE	73-125	60-138	14	19

CLIENT: ENVIRONMENTAL TECHNOLOGIES SAMPLE: HMW-4
WCAS JOB #: 27284

SEMI-VOLATILE ORGANICS (EPA 625/8270)

DATE RECEIVED:	08/12/94	MATRIX:	WATER
DATE EXTRACTED:	08/15/94	SAMPLE AMOUNT:	1L:1ML,1:3
DATE ANALYZED:	08/22/94	RUN NUMBER:	27284A3
INSTRUMENT ID:	TRI01000	UNITS:	UG/L (PPB)

CAS #	COMPOUND	CONCENTRATION	DET LIMIT
83-32-9	ACENAPHTHENE	ND	3.
208-96-8	ACENAPHTHYLENE	ND	3.
120-12-7	ANTHRACENE	ND	3.
108-98-5	BENZENETHIOL	ND	20.
56-55-3	BENZO(A)ANTHRACENE	ND	3.
205-99-2	BENZO(B & K)FLUORANTHENES	ND	3.
191-24-2	BENZO(G,H,I)PERYLENE	ND	3.
50-32-8	BENZO(A)PYRENE	ND	3.
65-85-0	BENZOIC ACID	ND	20.
100-51-6	BENZYL ALCOHOL	ND	20.
111-91-1	BIS(2-CHLOROETHOXY)METHANE	ND	3.
11-44-1	BIS(2-CHLOROETHYL)ETHER	ND	3.
39638-32-9	BIS(2-CHLOROISOPROPYL)ETHER	ND	3.
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	ND	3.
101-55-3	4-BROMOPHENYL PHENYL ETHER	ND	3.
85-68-7	BUTYL BENZYL PHTHALATE	ND	3.
106-47-8	4-CHLOROANILINE	ND	3.
59-50-7	4-CHLORO-3-METHYLPHENOL	ND	3.
91-58-71	2-CHLORONAPHTHALENE	ND	3.
95-57-8	2-CHLOROPHENOL	ND	3.
7005-72-3	4-CHLOROPHENYL PHENYL ETHER	ND	3.
218-01-9	CHRYSENE	ND	3.
	DIBENZ(A,H)ACRIDINE	ND	20.
53-70-3	DIBENZO(A,H)ANTHRACENE	ND	3.
132-64-9	DIBENZOFURAN	ND	3.
84-74-2	DI-N-BUTYL PHTHALATE	ND	3.
95-50-1	1,2-DICHLOROBENZENE	ND	3.
541-73-1	1,3-DICHLOROBENZENE	ND	3.
106-46-7	1,4-DICHLOROBENZENE	ND	3.
91-94-1	3,3'-DICHLOROBENZIDINE	ND	3.
120-33-2	2,4-DICHLOROPHENOL	ND	3.
84-66-2	DIETHYL PHTHALATE	ND	3.
57-97-6	7,12-DIMETHYLBENZ(A)ANTHRACENE	ND	20.
105-67-9	2,4-DIMETHYLPHENOL	10.	3.
131-11-3	DIMETHYL PHTHALATE	ND	3.
534-52-1	4,6-DINITRO-2-METHYLPHENOL	ND	20.
51-28-5	2,4-DINITROPHENOL	ND	20.
121-14-2	2,4-DINITROTOLUENE	ND	3.
606-20-2	2,6-DINITROTOLUENE	ND	3.
117-84-0	DI-N-OCTYL PHTHALATE	ND	3.
204-44-0	FLUORANTHENE	ND	3.

CLIENT: ENVIRONMENTAL TECHNOLOGIES SAMPLE: HMW-4
WCAS JOB #: 27284

SEMI-VOLATILE ORGANICS (EPA 625/8270)

DATE RECEIVED: 08/12/94
DATE EXTRACTED: 08/15/94
DATE ANALYZED: 08/22/94
INSTRUMENT ID: TRIO1000

MATRIX: WATER
SAMPLE AMOUNT: 1L:1ML,1:3
RUN NUMBER: 27284A3
UNITS: UG/L (PPB)

CAS #	COMPOUND	CONCENTRATION	DET LIMIT
86-73-7	FLUORENE	ND	3.
118-74-1	HEXACHLOROBENZENE	ND	3.
87-68-3	HEXACHLOROBUTADIENE	ND	3.
77-47-4	HEXACHLOROCYCLOPENTADIENE	ND	3.
67-72-1	HEXACHLOROETHANE	ND	3.
95-13-6	INDENE	ND	20.
193-39-5	INDENO(1,2,3-CD)PYRENE	ND	3.
78-59-1	ISOPHORONE	ND	3.
90-12-0	1-METHYLNAPHTHALENE	87.	3.
91-57-6	2-METHYLNAPHTHALENE	10.	3.
95-48-7	2-METHYLPHENOL	ND	3.
	3/4-METHYLPHENOL	ND	3.
91-20-3	NAPHTHALENE	20.	3.
88-74-4	2-NITROANILINE	ND	20.
99-09-2	3-NITROANILINE	ND	20.
100-01-6	4-NITROANILINE	ND	20.
98-95-3	NITROBENZENE	ND	3.
88-75-5	2-NITROPHENOL	ND	3.
100-02-7	4-NITROPHENOL	ND	20.
86-30-6	N-NITROSODIPHENYLAMINE **	ND	3.
621-64-7	N-NITROSODIPROPYLAMINE	ND	3.
87-86-5	PENTACHLOROPHENOL	ND	20.
85-01-8	PHENANTHRENE	ND	3.
108-95-2	PHENOL	ND	3.
129-00-0	PYRENE	ND	3.
110-86-1	PYRIDINE	ND	20.
91-22-5	QUINOLINE	ND	20.
120-82-1	1,2,4-TRICHLOROBENZENE	ND	3.
95-95-4	2,4,5-TRICHLOROPHENOL	ND	20.
88-06-2	2,4,6-TRICHLOROPHENOL	ND	3.

** - Cannot be separated from diphenylamine

SURROGATE	PERCENT RECOVERY	CONTROL LIMIT
PHENOL-d5	67	19-139
2-FLUOROPHENOL	60	21-154
NITROBENZENE-d5	64	35-114
2-FLUOROBIPHENYL	67	43-116
2,4,6-TRIBROMOPHENOL	89	10-123
TERPHENYL-d14	84	44-141

CLIENT: ENVIRONMENTAL TECHNOLOGIES SAMPLE: METHOD BLANK
WCAS JOB #: 27284

SEMI-VOLATILE ORGANICS (EPA 625/8270)

DATE RECEIVED:	08/15/94	MATRIX:	WATER
DATE EXTRACTED:	08/15/94	SAMPLE AMOUNT:	1L:1ML
DATE ANALYZED:	08/22/94	RUN NUMBER:	27284AA1
INSTRUMENT ID:	TRIO1000	UNITS:	UG/L (PPB)

CAS #	COMPOUND	CONCENTRATION	DET LIMIT
83-32-9	ACENAPHTHENE	ND	1.
208-96-8	ACENAPHTHYLENE	ND	1.
120-12-7	ANTHRACENE	ND	1.
108-98-5	BENZENETHIOL	ND	5.
56-55-3	BENZO(A)ANTHRACENE	ND	1.
205-99-2	BENZO(B & K)FLUORANTHENES	ND	1.
191-24-2	BENZO(G,H,I)PERYLENE	ND	1.
50-32-8	BENZO(A)PYRENE	ND	1.
65-85-0	BENZOIC ACID	ND	5.
100-51-6	BENZYL ALCOHOL	ND	5.
111-91-1	BIS(2-CHLOROETHOXY)METHANE	ND	1.
11-44-1	BIS(2-CHLOROETHYL)ETHER	ND	1.
39638-32-9	BIS(2-CHLOROISOPROPYL)ETHER	ND	1.
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	ND	1.
101-55-3	4-BROMOPHENYL PHENYL ETHER	ND	1.
85-68-7	BUTYL BENZYL PHTHALATE	ND	1.
106-47-8	4-CHLOROANILINE	ND	1.
59-50-7	4-CHLORO-3-METHYLPHENOL	ND	1.
91-58-71	2-CHLORONAPHTHALENE	ND	1.
95-57-8	2-CHLOROPHENOL	ND	1.
7005-72-3	4-CHLOROPHENYL PHENYL ETHER	ND	1.
218-01-9	CHRYSENE	ND	1.
	DIBENZ(A,H)ACRIDINE	ND	5.
53-70-3	DIBENZO(A,H)ANTHRACENE	ND	1.
132-64-9	DIBENZOFURAN	ND	1.
84-74-2	DI-N-BUTYL PHTHALATE	ND	1.
95-50-1	1,2-DICHLOROBENZENE	ND	1.
541-73-1	1,3-DICHLOROBENZENE	ND	1.
106-46-7	1,4-DICHLOROBENZENE	ND	1.
91-94-1	3,3'-DICHLOROBENZIDINE	ND	1.
120-33-2	2,4-DICHLOROPHENOL	ND	1.
84-66-2	DIETHYL PHTHALATE	ND	1.
57-97-6	7,12-DIMETHYLBENZ(A)ANTHRACENE	ND	5.
105-67-9	2,4-DIMETHYLPHENOL	ND	1.
131-11-3	DIMETHYL PHTHALATE	ND	1.
534-52-1	4,6-DINITRO-2-METHYLPHENOL	ND	5.
51-28-5	2,4-DINITROPHENOL	ND	5.
121-14-2	2,4-DINITROTOLUENE	ND	1.
606-20-2	2,6-DINITROTOLUENE	ND	1.
117-84-0	DI-N-OCTYL PHTHALATE	ND	1.
204-44-0	FLUORANTHENE	ND	1.

CLIENT: ENVIRONMENTAL TECHNOLOGIES SAMPLE: METHOD BLANK
WCAS JOB #: 27284

SEMI-VOLATILE ORGANICS (EPA 625/8270)

DATE RECEIVED:	08/15/94	MATRIX:	WATER
DATE EXTRACTED:	08/15/94	SAMPLE AMOUNT:	1L:1ML
DATE ANALYZED:	08/22/94	RUN NUMBER:	27284AA1
INSTRUMENT ID:	TRIO1000	UNITS:	UG/L (PPB)

CAS #	COMPOUND	CONCENTRATION	DET LIMIT
86-73-7	FLUORENE	ND	1.
118-74-1	HEXACHLOROBENZENE	ND	1.
87-68-3	HEXACHLOROBUTADIENE	ND	1.
77-47-4	HEXACHLOROCYCLOPENTADIENE	ND	1.
67-72-1	HEXACHLOROETHANE	ND	1.
95-13-6	INDENE	ND	5.
193-39-5	INDENO(1,2,3-CD)PYRENE	ND	1.
78-59-1	ISOPHORONE	ND	1.
90-12-0	1-METHYLNAPHTHALENE	ND	1.
91-57-6	2-METHYLNAPHTHALENE	ND	1.
95-48-7	2-METHYLPHENOL	ND	1.
	3/4-METHYLPHENOL	ND	1.
91-20-3	NAPHTHALENE	ND	1.
88-74-4	2-NITROANILINE	ND	5.
99-09-2	3-NITROANILINE	ND	5.
100-01-6	4-NITROANILINE	ND	5.
98-95-3	NITROBENZENE	ND	1.
88-75-5	2-NITROPHENOL	ND	1.
100-02-7	4-NITROPHENOL	ND	5.
86-30-6	N-NITROSODIPHENYLAMINE **	ND	1.
621-64-7	N-NITROSODIPROPYLAMINE	ND	1.
87-86-5	PENTACHLOROPHENOL	ND	5.
85-01-8	PHENANTHRENE	ND	1.
108-95-2	PHENOL	ND	1.
129-00-0	PYRENE	ND	1.
110-86-1	PYRIDINE	ND	5.
91-22-5	QUINOLINE	ND	5.
120-82-1	1,2,4-TRICHLOROBENZENE	ND	1.
95-95-4	2,4,5-TRICHLOROPHENOL	ND	5.
88-06-2	2,4,6-TRICHLOROPHENOL	ND	1.

** - Cannot be separated from diphenylamine

SURROGATE	PERCENT RECOVERY	CONTROL LIMIT
PHENOL-d5	65	19-139
2-FLUOROPHENOL	59	21-154
NITROBENZENE-d5	66	35-114
2-FLUOROBIPHENYL	58	43-116
2,4,6-TRIBROMOPHENOL	87	10-123
TERPHENYL-d14	96	44-141

WEST COAST ANALYTICAL SERVICE

MATRIX SPIKE (MS AND MSD)
% RECOVERY AND RPD SUMMARY

CLIENT : ENVIRONMENTAL TECH
DATE ANALYZED: 08/22/94
WCAS JOB # : 27284

SAMPLE: METHOD BLANK
MATRIX: WATER
UNITS : UG/L (PPB)

SEMI-VOLATILE COMPOUNDS

COMPOUND	CONC SPIKED	CONC SAMPLE	CONC MS	%REC MS	CONC MSD	%REC MSD	RPD
1,2,4-TRICHLOROBENZE	50.	ND	22.	44	21.	42*	5
ACENAPHTHENE	50.	ND	30.	60	28.	56	7
2,4-DINITROTOLUENE	50.	ND	31.	62	30.	60	3
PYRENE	50.	ND	40.	80	37.	74	8
NITROSOPROPYLAMINE	50.	ND	33.	66	31.	62	6
1,4-DICHLOROBENZENE	50.	ND	19.	38*	18.	36*	5
PENTACHLOROPHENOL	75.	ND	55.	73	53.	71	4
PHENOL	75.	ND	47.	63	43.	57	9
2-CHLOROPHENOL	75.	ND	50.	67	48.	64	4
P-CHLORO-M-CRESOL	75.	ND	51.	68	49.	65	4
4-NITROPHENOL	75.	ND	51.	68	46.	61	10

* - Asterisked Values Are Outside Warning Limits

WATER QUALITY CONTROL LIMITS

	% RECOVERY		RPD	
	WARNING	CONTROL	WARNING	CONTROL
1,2,4-TRICHLOROBENZENE	43- 87	32- 98	21	31
ACENAPHTHENE	54-114	39-129	10	17
2,4-DINITROTOLUENE	51-109	36-124	11	18
PYRENE	56-144	34-166	19	29
NITROSOPROPYLAMINE	47- 96	35-108	14	24
1,4-DICHLOROBENZENE	41- 75	32- 84	23	34
PENTACHLOROPHENOL	20-176	0-215	24	36
PHENOL	55-100	42-113	13	21
2-CHLOROPHENOL	60-114	46-128	10	17
P-CHLORO-M-CRESOL	51- 96	38-110	12	20
4-NITROPHENOL	25-103	6-123	25	38

ENVIRONMENTAL TECHNOLOGIES INTERNATIONAL
Ms. Stephanie Sakurai

Job # 27284
August 30, 1994

LABORATORY REPORT

Anions by EPA 300.0

Parts Per Million (mg/L)

Analyte	HMW-4	Detection Limit
Chloride	3700	2
Fluoride	ND	2
Nitrite	ND	2
Nitrate	ND	2
Sulfate	1300	2

Date Analyzed: 8-17-94

Matrix Spike/Matrix Spike Duplicate Recovery Summary

Sample:Batch QC
Units :ppm (mg/L)

Analyte	Sample Result	Amount Spiked	MS Result	% Rec MS	MSD Result	% Rec MSD	RPD
Chloride	93	100	189	96	193	100	2
Fluoride	ND	100	105	105	112	112	6
Nitrite	ND	100	89	89	88	88	1
Nitrate	ND	100	98	98	96	96	2
Sulfate	120	100	223	103	221	101	1

QC Limits

Analyte	RPD Control	% Recovery Warning		Control	
Chloride	10	73	111	63	121
Fluoride	17	74	122	63	133
Nitrite	15	80	114	72	123
Nitrate	11	77	116	67	126
Sulfate	9	77	112	68	120

ENVIRONMENTAL TECHNOLOGIES INTERNATIONAL
Ms. Stephanie Sakurai

Job # 27284
August 30, 1994

LABORATORY REPORT

Skinner List
Quantitative Analysis Report
Inductively Coupled Plasma-Mass Spectrometry
Parts Per Billion (ug/L)

	HMW-4 (dissolved)	HMW-4 (total)	Blank Detect. Limit
Antimony	0.4	0.5	0.2
Arsenic	11	23.9	0.7
Barium	24.7	24.8	0.9
Beryllium	ND<0.9	ND<0.9	0.9
Cadmium	ND<0.1	0.12	0.1
Chromium	0.6	1.4	0.2
Cobalt	0.12	0.28	0.1
Iron	142	154	7
Lead	ND<0.8	ND<0.8	0.8
Manganese	54.5	54.9	0.2
Mercury	0.5	0.6	0.2
Nickel	ND<4	ND<4	4
Selenium	28	12	10
Sodium	2460000	2570000	1000
Vanadium	9	13	3

Date Analyzed: 8/16/94

WEST COAST ANALYTICAL SERVICE, INC.

ENVIRONMENTAL TECHNOLOGIES INTERNATIONAL
Ms. Stephanie Sakurai

Job # 27284
August 30, 1994

LABORATORY REPORT

Sample: Batch QC
Matrix: Water

Parts Per Billion (ug/L)

	Sample	Duplicate	RPD %	Spike Conc ppb	Spk Rslt	% Recovery	Blank Detect. Limit
Antimony	ND<0.4	ND<0.4		100	99.2	99.2	0.4
Arsenic	3.3	3.3		100	110	106.7	0.7
Barium	38.3	38.7	1	100	142	103.5	0.2
Beryllium	ND<1	ND<1		100	79	79	1
Cadmium	ND<0.4	ND<0.4		100	90.8	90.8	0.4
Chromium	ND<0.5	0.8		100	108	107.6	0.5
Cobalt	0.2	ND<0.2		100	98.6	98.5	0.2
Iron	137	134		10000	9910	97.7	30
Lead	0.3	0.2		100	99.1	98.9	0.1
Manganese	9.3	9.6	3.2	100	107	97.6	0.3
Mercury	ND<0.3	ND<0.3		10	9.6	96	0.3
Nickel	ND<0.9	ND<0.9		100	104	104	1
Selenium	ND<30	ND<30		1000	901	90.1	30
Vanadium	4	5.1		100	104	99.5	2

Date Analyzed: 08/10/94

WEST COAST ANALYTICAL SERVICE, INC.

ENVIRONMENTAL TECHNOLOGIES INTERNATIONAL
Ms. Stephanie Sakurai

Job # 27284
August 30, 1994

LABORATORY REPORT

Sample: HMW-4

Analyte	Result	Units	DL	Method	Date Analyzed
Alkalinity	590	mg CaCO3/L	1	SM 2320B	8/25/94
Conductivity	11800	umho/cm	5	EPA 120.1	8/17/94
Dissolved Solids	770	mg/L	40	EPA 160.1	8/24/94
pH	7.6	units	--	EPA 150.1	8/17/94
Surfactants	1	mg/L	0.1	SM 5540C	8/24/94

Sample/Duplicate Quality Control Table

Sample: Batch QC 081794W

Analyte	Sample Result	Duplicate Result	RPD
CONDUCTIVITY	1840	1780	3

QC Limits

Analyte	RPD Warning	RPD Control
CONDUCTIVITY	15	25

WCAS

LABORATORY REPORT

Matrix Spike/Matrix Spike Duplicate Quality Control Summary

Sample: HMW-4
Units: ppm (mg/L)

Analyte	Sample Result	Amount Spiked	MS Result	% Rec MS	MSD Result	% Rec MSD	RPD
TDS	7700	5000	13000	106	13000	106	0

QC Limits

Analyte	RPD Warning	RPD Control	% Recovery Control
TDS	9	13	89 - 111

Matrix Spike/Matrix Spike Duplicate Quality Control Summary

Sample: QC Batch 082494W
Units: ppm (mg/L)

Analyte	Sample Result	Amount Spiked	MS Result	% Rec MS	MSD Result	% Rec MSD	RPD
SURFACTANTS	27	1000	1082	106	1011	98	7

QC Limits

Analyte	RPD Warning	RPD Control	% Recovery Control
SURFACTANTS	15	23	10 - 165

WEST COAST ANALYTICAL SERVICE, INC.

ENVIRONMENTAL TECHNOLOGIES INTERNATIONAL
Ms. Stephanie Sakurai

Job # 27284
August 30, 1994

LABORATORY REPORT

Sample/Duplicate Quality Control Table

Sample: HMW-4

Analyte	Sample Result	Duplicate Result	RPD
ALKALINITY	258	258	0

QC Limits

Analyte	RPD Warning	RPD Control
ALKALINITY	15	25

WCAS

Abbreviations Summary

General Reporting Abbreviations:

B — Blank - Indicates that the compound was found in both the sample and the blank. The sample value is reported without blank subtraction. If the sample value is less than 10X the blank value times the sample dilution factor, the compound may be present as a laboratory contaminant.

D — Indicates that the sample was diluted, and consequently the surrogates were too dilute to accurately measure.

DL — Detection Limit - Is the minimum value which we believe can be detected in the sample with a high degree of confidence, taking into account dilution factors and interferences. The reported detection limits are equal to or greater than Method Detection Limits (MDL) to allow for day to day and instrument to instrument variations in sensitivity.

J — Indicates that the value is an estimate.

ND — Not Detected - Indicates that the compound was not found in the sample at or above the detection limit.

ppm, ppb — parts per million (billion) in liquids is usually equivalent to mg/l (ug/l), or in solids to mg/kg (ug/kg). In the gas phase it is equivalent to ul/l (ul/m^3).

TR — Trace - Indicates that the compound was observed at a value less than our normal reported Detection Limit (DL), but we feel its presence may be important to you. These values are subject to large errors and low degrees of confidence.

kg kilogram	mg milligram	l liter	m meter
g gram	ug microgram	ul microliter	

QC Abbreviations:

Control — Control Limits are determined from historical data for a QC parameter. The test value must be within this acceptable range for the test to be considered in control. Usually this range corresponds to the 99% confidence interval for the historical data.

% Error — Percent Error - This is a measure of accuracy based on the analysis of a Laboratory Control Standard (LCS). An LCS is a reference sample of known value such as an NIST Standard Reference Material (SRM). The % Error is expressed in percent as the difference between the known value and the experimental value, divided by the known value. The LCS may simply be a solution based standard which confirms calibration (ICV or CCV - initial or continuing calibration verification), or it may be a reference sample taken through preparation and analysis.

QC Abbreviations (continued):

MS(D)	Matrix Spike (Duplicate) - This refers to a quality control sample. It may be a real sample or blank sample spiked with representative target analytes.
% Rec	Percent Recovery - This is a measure of the accuracy of the analysis. It is expressed in percent as the difference between the result of an MS sample and the unspiked sample, divided by the amount spiked.
RPD	Relative Percent Difference - This is a measure of the precision of the analysis. It is the difference between duplicate results divided by the mean of the duplicates.
Warning	Warning limits are determined from historical data, usually representing a 95% confidence interval. This serves to alert the analyst to problems before reaching the control limits. Data "Out of Warning" is still considered in control.

Environmental Abbreviations:

BNA	Base-Neutral/Acid Fraction - Also called the Extractable Semivolatile fraction, represents the pollutants which can be extracted from a sample, but which boil higher than 120 C and still pass through a gas chromatography column.
CAM	California Assessment Manual - The original draft containing the CA hazardous waste rules, one of which was a list of 17 toxic metals. "CAM Metals" is used to refer to this list.
STLC	Soluble Threshold Limit Concentration - According to California's hazardous waste regulations, a waste is considered hazardous if the concentration in the leachate from the Waste Extraction Test (WET) exceeds this limit.
TCLP	Toxicity Characteristic Leaching Procedure - According to EPA regulations, a waste is considered hazardous if the leachate from the TCLP extraction exceeds certain limits.
TTLC	Total Threshold Limit Concentration - According to California's hazardous waste regulations, a waste exceeding this concentration is considered a hazardous waste.
VOA	Volatile Organics Analysis - Represents a group of volatile organic solvents with a boiling range from below room temperature to approximately 150 C.
WET	Waste Extraction Test - See STLC.

BHP

CHAIN OF CUSTODY

Environmental Technologies International, Inc.
~~Mauka Tower 737 Bishop Street, 22nd Floor~~ See Below
P.O. Box 3379 Honolulu, HI 96842
(808) 547-3600 Facsimile: (808) 547-3033

PROJECT NO: PI0200-005
ET CLIENT:

SEND RESULTS TO
Name: Stephanie G. Sakurai
Company: Environmental Technologies Int'l
Address: 733 Bishop Street
City, State, Zip: Honolulu, HI 96813

SEND INVOICE TO
Name: Same
Company:
Address:
City, State, Zip:

	Sample No.	Lab No.	No. Containers	Date	Time	Sample Type/Description	Analysis Required	Sampled By
8	HMW-4		8	8/10/94	1140	Groundwater	8240 (Skinner)	TNW/SGS
							8270 (Skinner)	
							Total Metals (Skinner)	
							Dissolved Metals (Skinner)	
2	TRIP BLANK		2 VOA			FOR 8240 (SKINNER)	TDS, Alk, F⁻, MBAS, SO4,	
							pH, EC, Cl⁻	
							Nitrate-Nitrite	
			* FILTER AND PRESERVE SAMPLE BOTTLE FOR DISSOLVED					
				METALS IMMEDIATELY UPON RECEIPT.				

CUSTODY TRANSFERS

	RELINQUISHED BY: (NAME, SIGNATURE)	DATE	TIME	RECEIVED BY: (NAME, SIGNATURE)	DATE	TIME	COMMENTS
1	S. SAKURAI ~~S. SAKURAI~~ Stephanie Sakurai	8/10/94	1430	Tom WALLIS	8/10/94	1950	REMAIN IN BHP AKI
2							REFRIGERATOR IN
3				WCAS #27284	8/12/94	10:50	LOCKED ROOM
4							OVERNIGHT

SHIPPING DETAILS

DELIVERED TO SHIPPER BY: ~~Stephanie Sakurai~~ Tom WALLIS. DATE ~~8/10/94~~ 8/11/94 TIME ~~1230~~ 2:30 pm
METHOD OF SHIPMENT: ~~DHL~~ FED EX AIRBILL #
RECEIVED FOR LAB: SIGNED DATE TIME
SAMPLE CONDITION UPON RECEIPT:

WHITE - CUSTODY SHEET YELLOW - LAB PINK - ET

4. ANALYTICAL RESULTS OF FREE PRODUDT FROM MONITORING WELLS

AnalyticalTechnologies, Inc. Corporate Offices: 5550 Morehouse Drive San Diego, CA 92121 (619) 458-9141

ATI I.D.: 408152

August 24, 1994

ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
733 BISHOP STREET, SUITE 2600
HONOLULU, HI 96842

Project Name: POND NO.1 QGM
Project # : PIO200-005

Attention: STEPHANIE SAKURAI

Analytical Technologies, Inc. has received the following sample(s):

Date Received	Quantity	Matrix
August 10, 1994	4	PRODUCT
August 10, 1994	1	WATER

The sample(s) were analyzed with EPA methodology or equivalent methods as specified in the enclosed analytical schedule. The symbol for "less than" indicates a value below the reportable detection limit. If any flags appear next to the analytical data in this report, please see the attached list of flag definitions.

The results of these analyses and the quality control data are enclosed. Please note that the Sample Condition Upon Receipt Checklist is included at the end of this report.

Leslie Getman
LESLIE GETMAN
PROJECT MANAGER

M. E. Shigley
M. E. SHIGLEY
LABORATORY MANAGER

AnalyticalTechnologies,Inc.

SAMPLE CROSS REFERENCE

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name: POND NO.1 QGM

Report Date: August 24, 1994
ATI I.D. : 408152

ATI #	Client Description	Matrix	Date Collected
1	MW-6PDT	PRODUCT	09-AUG-94
2	MW-5PDT	PRODUCT	09-AUG-94
3	MW-3PDT	PRODUCT	09-AUG-94
4	MW-4PDT	PRODUCT	09-AUG-94
5	MW-TBPDT/TRIP BLANKGCMS9242	WATER	09-AUG-94

---TOTALS---

Matrix	# Samples
PRODUCT	4
WATER	1

ATI STANDARD DISPOSAL PRACTICE

The sample(s) from this project will be disposed of in twenty-one (21) days from the date of this report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

AnalyticalTechnologies,Inc.

ANALYTICAL SCHEDULE

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name: POND NO.1 QGM

ATI I.D.: 408152

Analysis	Technique/Description
EPA 8240 (GC/MS FOR VOLATILE ORGANICS)	GC/MASS SPECTROMETER
EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)	GC/MASS SPECTROMETER

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408152
Project # : PIO200-005
Project Name: POND NO.1 QGM

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
5	MW-TBPDT/TRIP BLANKGCMS9242	WATER	09-AUG-94	N/A	17-AUG-94	1.00

Parameter	Units	5
CARBON DISULFIDE	UG/L	<2
CHLOROFORM	UG/L	<1
2-BUTANONE (MEK)	UG/L	<10
1,2-DICHLOROETHANE	UG/L	<1
BENZENE	UG/L	<1
TOLUENE	UG/L	<2
CHLOROBENZENE	UG/L	<1
ETHYLBENZENE	UG/L	<1
XYLENES (TOTAL)	UG/L	<1
STYRENE	UG/L	<2
1,4-DIOXANE	UG/L	<200
ETHYLENE DIBROMIDE	UG/L	<5
CYCLOHEXANE	UG/L	<10
ROGATES		
1,2-DICHLOROETHANE-D4	%	105
TOLUENE-D8	%	99
BFB	%	103

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408152
Project # : PI0200-005
Project Name: POND NO.1 QGM

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	MW-6PDT	PRODUCT	09-AUG-94	N/A	20-AUG-94	125.00
2	MW-5PDT	PRODUCT	09-AUG-94	N/A	20-AUG-94	125.00
3	MW-3PDT	PRODUCT	09-AUG-94	N/A	20-AUG-94	125.00

Parameter	Units	1	2	3
CARBON DISULFIDE	MG/KG	<13	<13	<13
1,4-DIOXANE	MG/KG	<1300	<1300	<1300
CHLOROFORM	MG/KG	<6.3	<6.3	<6.3
ETHYLENE DIBROMIDE	MG/KG	<32	<32	<32
2-BUTANONE (MEK)	MG/KG	<63	<63	<63
CYCLOHEXANE	MG/KG	<63	<63	<63
1,2-DICHLOROETHANE	MG/KG	<6.3	<6.3	<6.3
BENZENE	MG/KG	<6.3	<6.3	<6.3
TOLUENE	MG/KG	<13	<13	<13
CHLOROBENZENE	MG/KG	<6.3	<6.3	<6.3
ETHYLBENZENE	MG/KG	<6.3	<6.3	<6.3
XYLENES (TOTAL)	MG/KG	<6.3	<6.3	<6.3
STYRENE	MG/KG	<6.3	<6.3	<6.3
SURROGATES				
1,2-DICHLOROETHANE-D4	%	N/A	N/A	N/A
TOLUENE-D8	%	N/A	N/A	N/A
BFB	%	N/A	N/A	N/A

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408152
Project # : PIO200-005
Project Name: POND NO.1 QGM

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	MW-4PDT	PRODUCT	09-AUG-94	N/A	20-AUG-94	125.00

Parameter	Units	4
CARBON DISULFIDE	MG/KG	<13
1,4-DIOXANE	MG/KG	<1300
CHLOROFORM	MG/KG	<6.3
ETHYLENE DIBROMIDE	MG/KG	<32
2-BUTANONE (MEK)	MG/KG	<63
CYCLOHEXANE	MG/KG	<63
1,2-DICHLOROETHANE	MG/KG	<6.3
BENZENE	MG/KG	<6.3
TOLUENE	MG/KG	<13
CHLOROBENZENE	MG/KG	<6.3
ETHYLBENZENE	MG/KG	<6.3
XYLENES (TOTAL)	MG/KG	<6.3
STYRENE	MG/KG	<6.3
ROGATES		
1,2-DICHLOROETHANE-D4	%	N/A
TOLUENE-D8	%	N/A
BFB	%	N/A

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank I.D. : 31738
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PI0200-005
Project Name: POND NO.1 QGM

ATI I.D. : 408152
Date Extracted: N/A
Date Analyzed : 17-AUG-94
Dil. Factor : 1.00

Parameters	Units	Results
CARBON DISULFIDE	UG/L	<2
CHLOROFORM	UG/L	<1
2-BUTANONE (MEK)	UG/L	<10
1,2-DICHLOROETHANE	UG/L	<1
BENZENE	UG/L	<1
TOLUENE	UG/L	<2
CHLOROBENZENE	UG/L	<1
ETHYLBENZENE	UG/L	<1
XYLENES (TOTAL)	UG/L	<1
STYRENE	UG/L	<2
1,4-DIOXANE	UG/L	<200
ETHYLENE DIBROMIDE	UG/L	<5
CYCLOHEXANE	UG/L	<10
SURROGATES		
1,2-DICHLOROETHANE-D4	%	99
JENE-D8	%	98
[illegible]	%	99

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

MSMSD

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
MSMSD # : 66017
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.

Project # : PIO200-005
Project Name: POND NO.1 QGM

ATI I.D. : 408152
Date Extracted: N/A
Date Analyzed : 17-AUG-94
Sample Matrix : WATER
REF I.D. : 408231-01

Parameters	Units	Sample Result	Conc Spike	Spiked Sample	% Rec	Dup Spike	Dup % Rec	RPD
BENZENE	UG/L	<1	50	54	108	50	100	8
TOLUENE	UG/L	<2	50	55	110	50	100	10
CHLOROBENZENE	UG/L	<1	50	52	104	47	94	10

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample Result - Duplicate Spike Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

BLANK SPIKE

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank Spike #: 49326
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-005
Project Name : POND NO.1 QGM

ATI I.D. : 408152
Date Extracted: N/A
Date Analyzed : 17-AUG-94
Sample Matrix : WATER

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
BENZENE	UG/L	<1	54	50	108
TOLUENE	UG/L	<2	50	50	100
CHLOROBENZENE	UG/L	<1	50	50	100

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408152
Project # : PI0200-005
Project Name: POND NO.1 QGM

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	MW-6PDT	PRODUCT	09-AUG-94	N/A	23-AUG-94	600.00
2	MW-5PDT	PRODUCT	09-AUG-94	N/A	23-AUG-94	600.00
3	MW-3PDT	PRODUCT	09-AUG-94	N/A	23-AUG-94	600.00

Parameter	Units	1	2	3
ANTHRACENE	MG/KG	<100	<100	<100
BENZO(a)ANTHRACENE	MG/KG	<100	<100	<100
BENZO(b)FLUORANTHENE	MG/KG	<100	<100	<100
BENZO(k)FLUORANTHENE	MG/KG	<100	<100	<100
BENZO(a)PYRENE	MG/KG	<100	<100	<100
BIS(2-ETHYLHEXYL)PHTHALATE	MG/KG	<100	210	<100
BUTYLBENZYLPHTHALATE	MG/KG	<100	<100	<100
CHRYSENE	MG/KG	<100	<100	<100
DIBENZ(a,h)ACRIDINE	MG/KG	<100	<100	<100
DIBENZ(a,h)ANTHRACENE	MG/KG	<100	<100	<100
1,2-DICHLOROBENZENE	MG/KG	<100	<100	<100
1,3-DICHLOROBENZENE	MG/KG	<100	<100	<100
1,4-DICHLOROBENZENE	MG/KG	<100	<100	<100
THYLPHTHALATE	MG/KG	<100	<100	<100
7,12-DIMETHYLBENZO(a)ANTHRACENE	MG/KG	<100	<100	<100
DIMETHYLPHTHALATE	MG/KG	<100	<100	<100
DI-N-BUTYLPHTHALATE	MG/KG	<100	<100	<100
DI-N-OCTYLPHTHALATE	MG/KG	<100	<100	<100
2,4-DICHLOROPHENOL	MG/KG	<100	<100	<100
FLUORANTHENE	MG/KG	<100	150	<100
NAPHTHALENE	MG/KG	1400	150	2100
PHENANTHRENE	MG/KG	250	<100	250
PYRENE	MG/KG	<100	230	<100
2-METHYLNAPHTHALENE	MG/KG	1600	340	1300
BENZENETHIOL	MG/KG	<100	<100	<100
4-NITROPHENOL	MG/KG	<510	<510	<510
2,4-DIMETHYLPHENOL	MG/KG	<100	<100	<100
2,4-DINITROPHENOL	MG/KG	<510	<510	<510
PHENOL	MG/KG	<100	<100	<100
2-METHYLPHENOL	MG/KG	<100	<100	<100
3- & 4-METHYLPHENOL	MG/KG	<100	<100	<100
INDENE	MG/KG	<100	<100	<100
1-METHYLNAPHTHALENE	MG/KG	2300	760	2800
PYRIDINE	MG/KG	<100	<100	<100
QUINOLINE	MG/KG	<100	<100	<100
6-METHYLCHRYSENE	MG/KG	<100	<100	<100
SURROGATES				
NITROBENZENE-D5	%	N/A	N/A	N/A
2-FLUOROBIPHENYL	%	N/A	N/A	N/A

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408152
Project # : PIO200-005
Project Name: POND NO.1 QGM

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	MW-6PDT	PRODUCT	09-AUG-94	N/A	23-AUG-94	600.00
2	MW-5PDT	PRODUCT	09-AUG-94	N/A	23-AUG-94	600.00
3	MW-3PDT	PRODUCT	09-AUG-94	N/A	23-AUG-94	600.00

Parameter	Units	1	2	3
SURROGATES				
TERPHENYL-D14	%	N/A	N/A	N/A
PHENOL-D6	%	N/A	N/A	N/A
2-FLUOROPHENOL	%	N/A	N/A	N/A
2,4,6-TRIBROMOPHENOL	%	N/A	N/A	N/A

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408152
Project # : PIO200-005
Project Name: POND NO.1 QGM

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	MW-4PDT	PRODUCT	09-AUG-94	N/A	23-AUG-94	600.00

Parameter	Units	4
ANTHRACENE	MG/KG	<100
BENZO(a)ANTHRACENE	MG/KG	<100
BENZO(b)FLUORANTHENE	MG/KG	<100
BENZO(k)FLUORANTHENE	MG/KG	<100
BENZO(a)PYRENE	MG/KG	<100
BIS(2-ETHYLHEXYL)PHTHALATE	MG/KG	<100
BUTYLBENZYLPHTHALATE	MG/KG	<100
CHRYSENE	MG/KG	<100
DIBENZ(a,h)ACRIDINE	MG/KG	<100
DIBENZ(a,h)ANTHRACENE	MG/KG	<100
1,2-DICHLOROBENZENE	MG/KG	<100
1,3-DICHLOROBENZENE	MG/KG	<100
1,4-DICHLOROBENZENE	MG/KG	<100
DIETHYLPHTHALATE	MG/KG	<100
7,12-DIMETHYLBENZO(a)ANTHRACENE	MG/KG	<100
DIMETHYLPHTHALATE	MG/KG	<100
DI-N-BUTYLPHTHALATE	MG/KG	<100
DI-N-OCTYLPHTHALATE	MG/KG	<100
2,4-DICHLOROPHENOL	MG/KG	<100
FLUORANTHENE	MG/KG	<100
NAPHTHALENE	MG/KG	<100
PHENANTHRENE	MG/KG	150
PYRENE	MG/KG	<100
2-METHYLNAPHTHALENE	MG/KG	<100
BENZENETHIOL	MG/KG	<100
4-NITROPHENOL	MG/KG	<510
2,4-DIMETHYLPHENOL	MG/KG	<100
2,4-DINITROPHENOL	MG/KG	<510
PHENOL	MG/KG	<100
2-METHYLPHENOL	MG/KG	<100
3- & 4-METHYLPHENOL	MG/KG	<100
INDENE	MG/KG	<100
1-METHYLNAPHTHALENE	MG/KG	1600
PYRIDINE	MG/KG	<100
QUINOLINE	MG/KG	<100
6-METHYLCHRYSENE	MG/KG	<100
SURROGATES		
NITROBENZENE-D5	%	N/A
2-FLUOROBIPHENYL	%	N/A

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 408152
Project # : PIO200-005
Project Name: POND NO.1 QGM

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	MW-4PDT	PRODUCT	09-AUG-94	N/A	23-AUG-94	600.00

Parameter	Units	4
SURROGATES		
TERPHENYL-D14	%	N/A
PHENOL-D6	%	N/A
2-FLUOROPHENOL	%	N/A
2,4,6-TRIBROMOPHENOL	%	N/A

ACCESSION #: 408152 INITIALS: Q. S.

SAMPLE CONDITION UPON RECEIPT CHECKLIST
(FOR RE-ACCESSIONS, COMPLETE #7 THRU #9)

1	Does this project require special handling according to NEESA Levels C, D, AFOEHL or CLP protocols? If yes, complete a) thru c) a) Cooler temperature _____ b) pH sample aliquoted: yes / no / n/a c) LOT #'s: _____	YES	NO
2	Are custody seals present on cooler?	YES	NO
	If yes, are seals intact?	YES	NO
3	Are custody seals present on sample containers?	YES	NO
	If yes, are seals intact? N/A	YES	NO
4	Is there a Chain-Of-Custody (COC)*?	YES	NO
5	Is the COC* complete? Relinquished: yes/no Requested analysis: yes/no	YES	NO
6	Is the COC* in agreement with the samples received? # Samples: yes/no Sample ID's: yes/no Date sampled: yes/no Matrix: yes/no # containers: yes/no	YES	NO
7	Are the samples preserved correctly?	YES	NO
8	Is there enough sample for all the requested analyses?	YES	NO
9	Are all samples within holding times for the requested analyses?	YES	NO
10	Cooler temperature: 6°C		
11	Were all sample containers received intact (ie. not broken, leaking, etc.)?	YES	NO
12	Are samples requiring no headspace, headspace free? N/A	YES	NO
13	Are VOA 1st stickers required?	YES	N/A
14	Are there special comments on the Chain of Custody which require client contact?	YES	NO
15	If yes, was ATI Project Manager notified?	YES	NO

Describe "no" items: _____

Was client contacted? yes / no

If yes, Date: _____ Name of Person contacted: _____

Describe actions taken or client instructions: _____

*Or other representative documents, letters, and/or shipping memos

AnalyticalTechnologies,Inc.
5550 MOREHOUSE DRIVE
SAN DIEGO, CA 92121-1709
(619) 458-9141

Chain of Custody

DATE 8/9/94 PAGE 1 OF 1

PROJECT MANAGER: Stephanie G. Sakurai
COMPANY: Environmental Technologies Int'l
ADDRESS: 733 Bishop St
Honolulu, HI 96813

BILL TO: Same
COMPANY:
ADDRESS:

Stephanie Sakurai (808) 547-3600
SAMPLERS: (Signature) PHONE NUMBER

Recommended Quantity and Preservative (Provide triple volume on QC Samples)

SAMPLE ID	SAMPLE DATE	TIME	MATRIX	LAB ID	Petroleum Hydrocarbons 418.1 (1L (H_2SO_4)/100g)	Oil and Grease 413.2 (1L (H_2SO_4)/100g)	Gasoline (MOD 8015/DOHS) (4 oz (HCl)/50g)	Diesel (MOD 8015/DOHS) (4 oz (HCl)/50g)	Gasoline/BTXE (MOD 8015/8020) Maximum Contamination Level of Gasoline:2ppm(water),50ppm(Soil) (2X40ml (HCl)/50g)	MOD 8015 (Unknown) (4 oz (HCl)/50g)	BTXE (8020) (2X40ml (HCl)/50g)	Chlorinated Hydrocarbons (8010) (2X40ml (HCl)/50g)	Aromatic Hydrocarbons (8020) (2X40ml (HCl)/50g)	Chlorinated/Aromatic Hydrocarbons (8010/8020) (2X40ml (HCl)/50g)	Organic Pb (500ml/50g)		Pesticides/PCB (8080) (1L/50g)	Base/NEU/Acid Cmpds GC/MS (8270) (1L/100g)	Volatile Cmpds GC/MS (8240) (2X40ml (HCl)/100g)	Polynuclear Aromatic (8310) (1L/100g)	CCR Metals (500ml/100g)	Priority Pollutant Metals (500ml/100g)								Number of Containers
MW-6PDT	8/9/94	1025	liquid	01														X	X												2
MW-5PDT	8/9/94	1125	liquid	02														X	X												2
MW-3PDT	8/9/94	1305	liquid	03														X	X												2
MW-4PDT	8/9/94	1350	liquid	04														X	X												2
MW-TBPDT	PNA	PNA	H_2O	05															X												2

PROJECT INFORMATION	SAMPLE RECEIPT	
PROJECT NUMBER: PI0200-005	TOTAL NUMBER OF CONTAINERS	10
PROJECT NAME: Pond No. 1 QGM	CHAIN OF CUSTODY SEALS Y/N/NA	N/A
PURCHASE ORDER NUMBER:	SEALS INTACT? Y/N/NA	N/A
VIA: Fedex	RECEIVED GOOD COND./COLD	Y/Y
TAT: ☐24HR ☐48HRS ☐72HRS ☐1WK ☒2WK	LAB NUMBER 408152	

SAMPLE DISPOSAL INSTRUCTIONS

☐ ATI Disposal @ $5.00 each ☐ Return ☐ Pickup

Comments:
ANALYZE PRODUCT ONLY. DO NOT ANALYZE WATER PORTION OF SAMPLE.

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature: S Sakurai Time: 1530	Signature: Time:	Signature: Time:
Printed Name: S. SAKURAI Date: 8/9/94	Printed Name: Date:	Printed Name: Date:
Company: ETI	Company:	Company:
RECEIVED BY: 1.	**RECEIVED BY: 2.**	**RECEIVED BY: (LAB) 3.**
Signature: Time:	Signature: Time:	Signature: David Schmidt Time: 9:30
Printed Name: Date:	Printed Name: Date:	Printed Name: David Schmidt Date: 8/10/94
Company:	Company:	Analytical Technologies, Inc.

DISTRIBUTION: White, Canary - ANALYTICAL TECHNOLOGIES, INC. • Pink - ORIGINATOR

5. GROUNDWATER ELEVATION DATA

BHP PETROLEUM AMERICAS REFINING INC.
GROUNDWATER ELEVATION DATA

Well I.D. No.	Date [a]	Time [a]	Top of Stainless Steel or PVC Casing Elevation (ft,MSL) [b]	Top of Concrete Apron Elevation (ft,MSL) [c]	Ground Surface Elevation (ft,MSL) [c]	Depth to Oil (ft)	Depth to Water (ft)	Oil Thickness (ft)	Corrected Depth to Water (ft) [d]	Corrected Water Table Elevation (ft,MSL) [e]
MW-3	8/10/94	10:25am	12.81	11.76	11.11	12.00	12.08	0.08	12.01	0.80
		15:39pm				12.17	12.27	0.10	12.18	0.63
MW-4	8/10/94	11:40am	13.29	12.15	11.75	12.45	12.93	0.48	12.51	0.78
		16:40pm				12.45	12.86	0.41	12.50	0.79
MW-5	8/10/94	9:39am	13.58	11.85	11.05	12.66	12.66	0.0	12.66	0.92
		14:39pm				12.89	12.89	0.0	12.89	0.69
MW-6	8/10/94	8:42am	13.12	11.58	11.28	12.30	12.39	0.09	12.31	0.81
		13:56pm				12.53	12.64	0.11	12.54	0.58
CW4A	8/10/94	9:24am	12.24	N/A	10.07	N/A	11.07	0.0	11.07	1.17
		14:30pm					11.25	0.0	11.25	0.99
CW4B	8/10/94	10:50am	12.01	N/A	9.68	N/A	10.92	0.0	10.92	1.09
		15:55pm					11.13	0.0	11.13	0.88
CW4C	8/10/94	11:50am	12.13	N/A	9.74	N/A	11.35	0.0	11.35	0.78
		16:50pm					11.37	0.0	11.37	0.76

(a) Date and time of water level measurements; all oil samples were taken on August 9, 1994

(b) Survey conducted in 8/87 for MW-3, MW-4, MW-5, MW-6; and in 6/92 for CW-4A, CW-4B, and CW-4C

(c) Survey conducted 9/17/91

(d) Corrected depth to water = depth to water-(oil thickness x specific gravity)
Note: Specific gravities of oils were measured by the laboratory to be 0.88 for MW-3, MW-4, and MW-5; and 0.87 for MW-6.

(e) Corrected water table elevation = top of casing elevation - corrected depth to water

Quality Assurance Investigation

Date: 9/19/94
by: Pat Schroder/Leslie Getman
Subject Chlorobenzene in water sample

Client: Environmental Technologies, Inc.
Accession: 408168
Project: Pond 1 Quarterly Monitoring

Problem: A 2200ppb hit for Chlorobenzene was reported for 8240 analysis of sample 408168-01 (HMW-6). The client was not expecting this and questioned the validity of the result.

Action 1: Raw Data Review: Original runs diluted by a factor 50 and 20 were reviewed. A large hit was seen for Chlorobenzene that was run just prior to the 50X dilution (screen) of the sample. The rerun (analysis #2: 20X) followed a 500ppb hit for Chlorobenzene. (There is a also possibility of cross contamination from the 5ml loading syringe and the 500ul sample delivery syringe, since these samples were loaded after one another). Most samples run in the tubes prior to this accession's first and second runs had hits of Chlorobenzene. The 50X run followed a 3200ppb Chlorobenzene; it showed a 39ppb hit (X50 = 1950ppb). The 20X run followed a 500ppb hit for Chlorobenzene; it showed 112ppb hit (X20 = 2240ppb).

Action 2: Reanalysis of Sample Past Holding Time :Additional sample from a liter bottle with no head space was run and Chlorobenzene was not found (<1ug/L). The VOA vials were then located. The second, previously unopened vial (no head space), was then run at 1:20 and no Chlorobenzene was found (<20ug/L). The original bottle, whose septa had been pierced with a needle during the original 50X and 20X runs, was rerun straight. No Chlorobenzene was seen (<1ug/L). These reruns were made after the holding time expired. A second analysis (at 1X) is now being run. VOA vials were checked and found to be preserved properly (9/19/94).

Discussion of Results: These results are contradictory and therefore inconclusive.

Point A: The results of the two initial runs match very closely which one would not expect to happen with random carry over at two different dilutions. It should also be pointed out that if 39 ppb carried over after 3200ppb hit, on the second run 112ppb would not be expected to carry over from a hit of 500ppb. We would expect at least some system contamination after a 3200ppb hit, but we would expect it to start out high and to get incrementally smaller.

Point B: If 2200ppb were found in a sample, reanalysis of a preserved sample three to four weeks later would be expected to show at least 20 to 50 % of that value, even past the 14 day holding time.

Conclusion: Possibility of contamination from carryover cannot be ruled out. If resampling is possible ATI will expedite an 8240 analysis at no charge.

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BHP

CERTIFIED MAIL NO. P-101-726-878
RETURN RECEIPT REQUESTED

August 3, 1994

Americas Division
BHP Petroleum

Mr. Mitch Kaplan
Arizona, Nevada, and Pacific Islands Section (H-3-2)
Hazardous Waste Management Division
U.S. Environmental Protection Agency
75 Hawthorne Street
San Francisco, California 94105

Dear Mr. Kaplan:

Revisions to Groundwater Monitoring Plan,
October 19, 1993
HID 056-786-395

This letter is about a modification proposed by BHP Petroleum Americas Refining Inc. (BHPPAR) regarding the Groundwater Monitoring Plan (GMP), which was submitted to EPA on October 19, 1993. As it was discussed in the telephone conversation between Tony Shan, staff hydrogeologist of BHPPAR, and Mr. Mitch Kaplan of EPA on Wednesday, August 3, 1994, BHPPAR proposes to install a dedicated bladder pump with a packer in each of the "C" wells specified in the GMP. This will shorten purge time during sampling of the "C" wells which have a total depth approximately 50 feet below groundwater table. The volume of standing water in the well and filter pack between the packer and the bottom of the well is approximately 20 gallons without subtracting the volume of the pump. There is no change to the "A" and "B" wells, that is, only dedicated pumps will be installed in those wells as specified in the GMP. BHPPAR will purge and sample the "C" wells in the same way of the "A" and "B" wells as specified in the GMP when sampling.

We appreciate your comments on our GMP and look forward to working with you on future hydrogeologic issues. Please contact Mr. Tony Shan at (808) 547-3804 with any questions you or your staff may have with respect to the above issues.

Sincerely,

J. Kapel /FOC

Frank D. Clouse
Refinery Manager

cc: Ms. Paula Bisson, EPA
Ms. Nicole Moutoux, EPA
Mr. Steve Chang, HDOH

BHP Petroleum Americas (Hawaii) Inc
733 Bishop Street Honolulu Hawaii 96813 USA
PO Box 3379 Honolulu Hawaii 96842 USA
Telephone 808 547 3111 Facsimile 808 547 3145

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BHP

Americas Division
BHP Petroleum

CERTIFIED MAIL NO. P-101-726-862
RETURN RECEIPT REQUESTED

July 19, 1994

Mr. Mitch Kaplan
Arizona, Nevada, and Pacific Islands Section (H-3-2)
Hazardous Waste Management Division
U.S. Environmental Protection Agency
75 Hawthorne Street
San Francisco, California 94105

Dear Mr. Kaplan:

Revisions to Groundwater Monitoring Plan,
October 19, 1993
HID 056-786-395

This letter is in reply to EPA letter (dated July 1, 1994) received by BHP Petroleum Americas Refining Inc. (BHPPAR) on July 6, 1994 regarding the Groundwater Monitoring Plan (GMP), which was submitted to EPA on October 19, 1993. In the July 6, 1994 letter, EPA recommend that BHPPAR use EPA method 8015B for testing of free product instead of ASTM D2887 as proposed by BHPPAR in the GMP. As discussed in the conference call with Mr. Mitch Kaplan and Ms. Nicole Moutoux of EPA on Tuesday July 12, 1994, BHPPAR will use EPA method 8015B for testing of free product (if free product is found in the GMP wells) instead of ASTM D2887 method as originally proposed by BHPPAR.

Another issue that was discussed and agreed by EPA in the conference call is regarding GMP groundwater sampling. It was proposed in the GMP that "For the first quarterly sampling event, sample sets will be collected at each monitoring well twice in the same 24-hour period to account for the possible dilutionary effects of tidal influences". Now BHPPAR proposes to collect the sample sets twice at each monitoring well in the same 24-hour period at our next regular quarterly sampling event in August, 1994 prior to the implementation of the GMP; and the analytical results of the two sets of samples will help BHPPAR to make a decision on whether to sample once or twice at each monitoring well in the same 24-hour period during the implementation of GMP. If the difference is significant (e.g. there is a change of 20% or greater between a particular constituent concentration taken at high vs. low tide in over 90% of the samples as proposed in the GMP), BHPPAR will sample twice at each monitoring well within the same 24-hour period; otherwise, BHPPAR will conduct sampling only once in the same 24-hour period.

BHP Petroleum Americas (Hawaii) Inc
733 Bishop Street Honolulu Hawaii 96813 USA
PO Box 3379 Honolulu Hawaii 96842 USA
Telephone 808 547 3111 Facsimile 808 547 3145

The third issue that was discussed and agreed by EPA in the telephone conversation between Tony Shan, staff hydrogeologist of BHPPAR, and Mr. Mitch Kaplan of EPA on Tuesday, July 19, 1994, is regarding a change of drilling method that will be used in the GMP. We originally proposed to use 12-inch diameter core barrel to finish the well after diamond coring of the well. However, it was found that the drilling companies with the 12-inch core barrel do not meet OSHA safety and health requirements (some of the drilling staff do not have the OSHA training certificates). Therefore, we would like to have the option to finish the well by reaming the hole to 12-inch diameter as specified in the GMP with a hollow stem auger after diamond coring being conducted. The two drilling companies with hollow stem auger here do meet OSHA safety and health requirements and are specialized in environmental drilling. This modification of drilling method will not alter or change the GMP well construction or well quality.

We appreciate your comments on our GMP and look forward to working with you on future hydrogeologic issues. Please contact Mr. Tony Shan at (808) 547-3804 with any questions you or your staff may have with respect to the above issues.

Sincerely,

Frank D. Clouse

Frank D. Clouse
Refinery Manager

Attachments

cc: Ms. Paula Bisson, EPA
Ms. Nicole Moutoux, EPA

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BHP Petroleum Americas Refining Inc.
91-325 Komohana Street
Kapolei, Hawaii 96707
Telephone **(808) 547-3900**
Fax (808) 547-3068

April 27, 1994

BHP Petroleum Americas

CERTIFIED MAIL NO. P-101-726-846
RETURN RECEIPT REQUESTED

Ms. Paula Bisson, Chief
Arizona, Nevada, Pacific Island Section (H-2-2)
U.S. Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, California 94105

Dear Ms. Bisson:

Groundwater Analytical Results
HID 056786395

BHP Petroleum Americas Refining Inc., submits, for your review, the enclosed report on the above subject for February 1994. Pursuant to 40 CFR 265.92(b), parameters establishing groundwater quality were also measured during this quarterly groundwater monitoring event to comply with the annual requirement for 1994.

Please contact Mr. Leonard Young at (808) 547-3942 should you have any questions.

Sincerely,

Frank D. Clouse

Frank D. Clouse
Refinery Manager

LKY:dak

Enclosure

cc: Mr. Steven Y. K. Chang, HDOH
CERTIFIED MAIL NO. P-101-726-847
RETURN RECEIPT REQUESTED

BHP PETROLEUM AMERICAS REFINING INC.

GROUNDWATER ANALYTICAL RESULTS

FEBRUARY 1994

CONTENTS

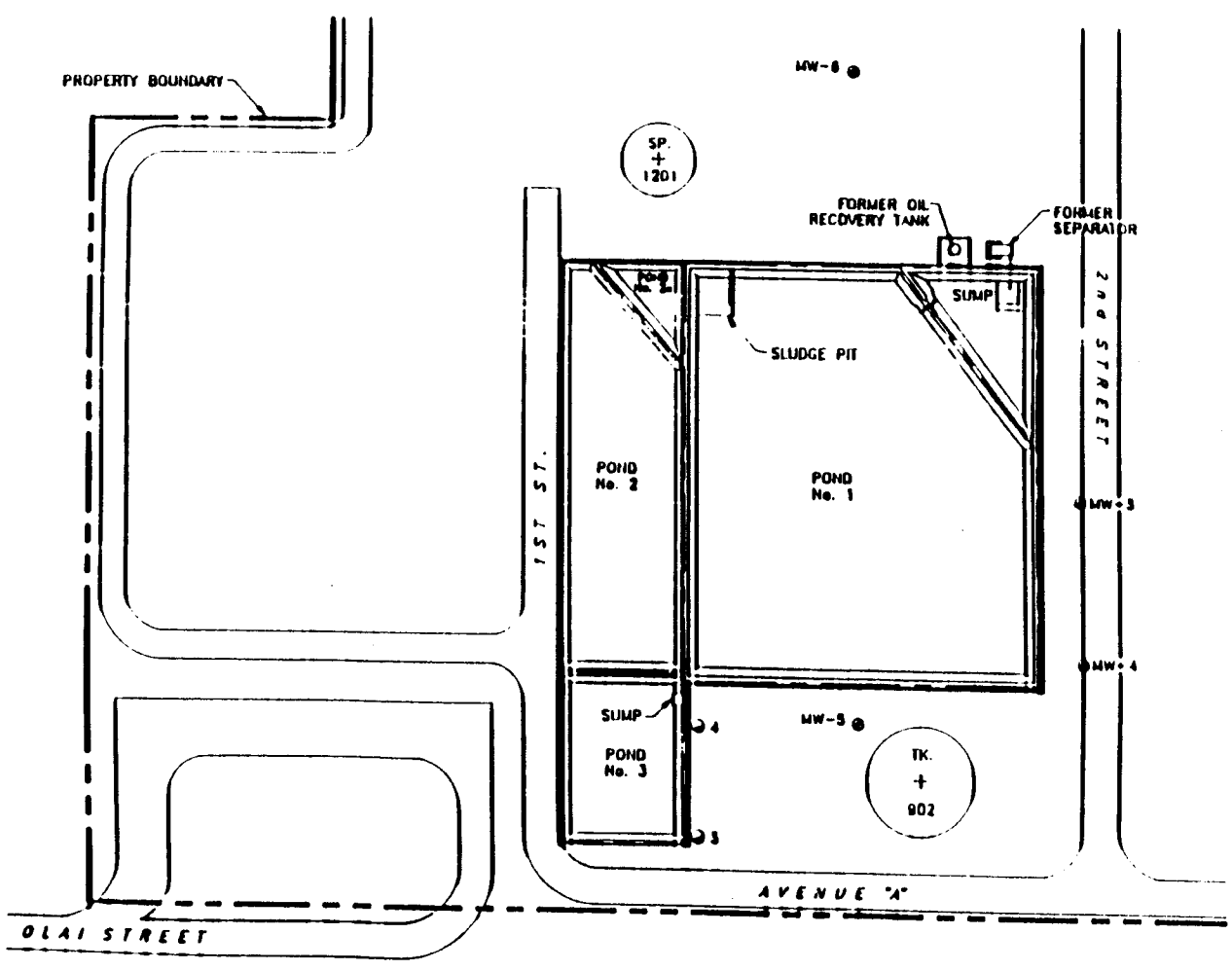
1. Groundwater monitoring well locations.

2. Analytical results of groundwater.

3. Analytical results of duplicate groundwater sample from monitoring well No. 4.

4. Groundwater elevation data.

1. GROUNDWATER MONITORING WELL LOCATIONS



EXPLANATION

MW-6 ● Ground-Water Monitoring

4 ⊖ Injection Well

SCALE

100 50 0 100 FEET

1 INCH = 100 FEET

24

Figure 3 :

POND NO. 1 WITH GROUND-WAT
MONITORING WELL LOCATIONS

2. ANALYTICAL RESULTS OF GROUNDWATER

AnalyticalTechnologies, Inc. Corporate Offices: 5550 Morehouse Drive San Diego, CA 92121 (619) 458-9141

ATI I.D.: 402297

arch 09, 1994

NVIRONMENTAL TECHNOLOGIES INT'L, INC.
P.O. BOX 3379
HONOLULU, HI 96842

roject Name: POND 1 QUARTERLY MONITORING
Project # : PIO200-001A

ttention: STEPHANIE SAKURAI

Analytical Technologies, Inc. has received the following sample(s):

Date Received	Quantity	Matrix
February 23, 1994	6	WATER

he sample(s) were analyzed with EPA methodology or equivalent methods as specified in the enclosed analytical schedule. The symbol for "less than" indicates a value below the reportable detection limit. If any flags appear next to the analytical data in this report, please see the ttached list of flag definitions.

The results of these analyses and the quality control data are enclosed. Please note that the Sample Condition Upon Receipt Checklist is included at the end of this report.

LESLIE GETMAN
PROJECT MANAGER

M. E. SHIGLEY
LABORATORY MANAGER

AnalyticalTechnologies,Inc.

SAMPLE CROSS REFERENCE

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

Report Date: March 09, 1994
ATI I.D. : 402297

ATI #	Client Description	Matrix	Date Collected
1	MW-6	WATER	22-FEB-94
2	MW-5	WATER	22-FEB-94
3	MW-3	WATER	22-FEB-94
4	FB-1	WATER	22-FEB-94
5	MW-4	WATER	22-FEB-94
6	MW-6/DISSOLVED 01	WATER	22-FEB-94
7	MW-5/DISSOLVED 02	WATER	22-FEB-94
8	MW-3/DISSOLVED 03	WATER	22-FEB-94
9	FB-1/DISSOLVED 04	WATER	22-FEB-94
10	MW-4/DISSOLVED 05	WATER	22-FEB-94
11	TB-222/SDBTXE8247,8250	WATER	22-FEB-94

---TOTALS---

Matrix	# Samples
WATER	11

ATI STANDARD DISPOSAL PRACTICE

The sample(s) from this project will be disposed of in twenty-one (21) days from the date of this report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

AnalyticalTechnologies,Inc.

ANALYTICAL SCHEDULE

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D.: 402297

Analysis	Technique/Description
EPA 6010 (ANTIMONY)	INDUCTIVELY COUPLED ARGON PLASMA
EPA 6010 (BARIUM)	INDUCTIVELY COUPLED ARGON PLASMA
EPA 6010 (BERYLLIUM)	INDUCTIVELY COUPLED ARGON PLASMA
EPA 6010 (CHROMIUM)	INDUCTIVELY COUPLED ARGON PLASMA
EPA 6010 (COBALT)	INDUCTIVELY COUPLED ARGON PLASMA
EPA 6010 (NICKEL)	INDUCTIVELY COUPLED ARGON PLASMA
EPA 6010 (VANADIUM)	INDUCTIVELY COUPLED ARGON PLASMA
EPA 7060 (ARSENIC)	ATOMIC ABSORPTION/GRAPHITE FURNACE
EPA 6010 (CADMIUM)	INDUCTIVELY COUPLED ARGON PLASMA
EPA 7421 (LEAD)	ATOMIC ABSORPTION/GRAPHITE FURNACE
EPA 7470 (AQUEOUS MERCURY)	ATOMIC ABSORPTION/COLD VAPOR
EPA 7740 (SELENIUM)	ATOMIC ABSORPTION/GRAPHITE FURNACE
EPA 8240 (GC/MS FOR VOLATILE ORGANICS)	GC/MASS SPECTROMETER
EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)	GC/MASS SPECTROMETER

AnalyticalTechnologies,Inc.

METALS RESULTS

lient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
roject # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D.: 402297

ample #	Client ID	Matrix	Date Sampled	Date Received
	MW-6	WATER	22-FEB-94	23-FEB-94
	MW-5	WATER	22-FEB-94	23-FEB-94
3	MW-3	WATER	22-FEB-94	23-FEB-94
4	FB-1	WATER	22-FEB-94	23-FEB-94
	MW-4	WATER	22-FEB-94	23-FEB-94

Parameter	Units	1	2	3	4	5
RSENIC	MG/L	<0.003*S	0.015*S	0.003*S	<0.002	<0.004*S
ARIUM	MG/L	0.01	0.01	<0.01	<0.01	<0.01
BERYLLIUM	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
ADMIUM	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
OBALT	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
CHROMIUM	MG/L	0.02	<0.01	<0.01	<0.01	<0.01
MERCURY	MG/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
ICKEL	MG/L	0.03	0.02	<0.01	<0.01	<0.01
EAD	MG/L	<0.002	<0.002*S	<0.002	<0.002	0.003
ANTIMONY	MG/L	<0.03	<0.03	<0.03	<0.03	<0.03
SELENIUM	MG/L	0.005*S	0.013*S	<0.003*S	<0.002	<0.003*S
ANADIUM	MG/L	0.01	0.02	0.01	<0.01	0.01

*S DUE TO MATRIX INTERFERENCE, THE REPORTED VALUE WAS DETERMINED BY METHOD OF STANDARD ADDITIONS

AnalyticalTechnologies,Inc.

METALS RESULTS

lient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
roject # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D.: 402297

ample #	Client ID	Matrix	Date Sampled	Date Received
6	MW-6/DISSOLVED 01	WATER	22-FEB-94	23-FEB-94
7	MW-5/DISSOLVED 02	WATER	22-FEB-94	23-FEB-94
8	MW-3/DISSOLVED 03	WATER	22-FEB-94	23-FEB-94
9	FB-1/DISSOLVED 04	WATER	22-FEB-94	23-FEB-94
10	MW-4/DISSOLVED 05	WATER	22-FEB-94	23-FEB-94

Parameter	Units	6	7	8	9	10
RSENIC	MG/L	<0.002	0.011	0.004*S	<0.002	0.006*S
ARIUM	MG/L	0.01	0.01	<0.01	<0.01	<0.01
BERYLLIUM	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
ADMIUM	MG/L	<0.005	<0.005	<0.005	<0.005	<0.005
OBALT	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
HROMIUM	MG/L	<0.01	<0.01	<0.01	<0.01	<0.01
MERCURY	MG/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
ICKEL	MG/L	0.02	<0.01	<0.01	<0.01	<0.01
EAD	MG/L	<0.002	<0.002*S	<0.002	<0.002	<0.002
ANTIMONY	MG/L	<0.03	<0.03	<0.03	<0.03	<0.03
SELENIUM	MG/L	<0.002*S	0.013*S	<0.002*S	<0.002	<0.003*S
ANADIUM	MG/L	0.02	0.02	0.01	<0.01	0.01

*S DUE TO MATRIX INTERFERENCE, THE REPORTED VALUE WAS DETERMINED BY METHOD OF STANDARD ADDITIONS

AnalyticalTechnologies,Inc.

METALS - QUALITY CONTROL

DUP/MS

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-001A
roject Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 402297

Parameters	REF I.D.	Units	Sample Result	Dup Result	RPD	Spiked Sample	Spike Conc	% Rec
ANTIMONY	402310-01	MG/L	<0.03	<0.03	0	2.04	2.00	102
ARSENIC	402297-05	MG/L	<0.004 *S	<0.004*S	0	1.85	2.00	93
ARIUM	402310-01	MG/L	0.01	0.01	0	4.20	4.00	105
ERYLLIUM	402310-01	MG/L	<0.005	<0.005	0	2.04	2.00	102
CADMIUM	402310-01	MG/L	<0.005	<0.005	0	2.03	2.00	102
CHROMIUM	402310-01	MG/L	<0.01	<0.01	0	2.00	2.00	100
OBALT	402310-01	MG/L	<0.01	<0.01	0	4.08	4.00	102
EAD	402297-05	MG/L	0.003	<0.002	0	2.02	2.00	101
MERCURY	402297-04	MG/L	<0.0005	<0.0005	0	0.0021	0.0020	105
ICKEL	402310-01	MG/L	<0.01	<0.01	0	2.03	2.00	102
ELENIUM	402297-05	MG/L	<0.003*S	<0.003*S	0	1.04	1.20	87
ANADIUM	402310-01	MG/L	<0.01	<0.01	0	4.09	4.00	102

Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
PD (Relative % Difference) = (Sample Result - Duplicate Result)*100/Average Result

S DUE TO MATRIX INTERFERENCE, THE REPORTED VALUE WAS DETERMINED BY METHOD OF STANDARD ADDITIONS

AnalyticalTechnologies,Inc.

METALS - QUALITY CONTROL

BLANK SPIKE

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 402297

Parameters	Blank Spike ID#	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
ANTIMONY	44426	MG/L	<0.03	1.94	2.00	97
ARSENIC	44419	MG/L	<0.002	2.03	2.00	102
BARIUM	44426	MG/L	<0.01	3.93	4.00	98
BERYLLIUM	44426	MG/L	<0.005	1.98	2.00	99
CADMIUM	44426	MG/L	<0.005	2.01	2.00	101
CHROMIUM	44426	MG/L	<0.01	1.98	2.00	99
COBALT	44426	MG/L	<0.01	4.05	4.00	101
LEAD	44418	MG/L	<0.002	2.02	2.00	101
MERCURY	44568	MG/L	<0.0005	0.0021	0.0021	100
NICKEL	44426	MG/L	<0.01	2.02	2.00	101
SELENIUM	44424	MG/L	<0.002	1.21	1.20	101
VANADIUM	44426	MG/L	<0.01	3.95	4.00	99

Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Sample Result - Duplicate Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 402297
Project # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	MW-6	WATER	22-FEB-94	N/A	24-FEB-94	1.00
2	MW-5	WATER	22-FEB-94	N/A	25-FEB-94	1.00
3	MW-3	WATER	22-FEB-94	N/A	25-FEB-94	1.00

Parameter	Units	1	2	3
CARBON DISULFIDE	UG/L	3	3	<2
CHLOROFORM	UG/L	<1	<1	<1
2-BUTANONE (MEK)	UG/L	<10	<10	<10
1,2-DICHLOROETHANE	UG/L	<1	<1	<1
BENZENE	UG/L	13	1	2
TOLUENE	UG/L	<2	4	<2
CHLOROBENZENE	UG/L	<1	<1	<1
ETHYLBENZENE	UG/L	1	14	2
XYLENES (TOTAL)	UG/L	<1	3	<1
STYRENE	UG/L	<2	<2	<2
1,4-DIOXANE	UG/L	<200	<200	<200
ETHYLENE DIBROMIDE	UG/L	<5	<5	<5
CYCLOHEXANE	UG/L	<10	<10	<10
SURROGATES				
1,2-DICHLOROETHANE-D4	%	94	99	92
TOLUENE-D8	%	104	102	100
BFB	%	95	86	90

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 402297
Project # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	FB-1	WATER	22-FEB-94	N/A	24-FEB-94	1.00
5	MW-4	WATER	22-FEB-94	N/A	25-FEB-94	1.00
11	TB-222/SDBTXE8247,8250	WATER	22-FEB-94	N/A	24-FEB-94	1.00

Parameter	Units	4	5	11
CARBON DISULFIDE	UG/L	<2	3	<2
CHLOROFORM	UG/L	<1	<1	<1
2-BUTANONE (MEK)	UG/L	<10	<10	<10
1,2-DICHLOROETHANE	UG/L	<1	<1	<1
BENZENE	UG/L	<1	2	<1
TOLUENE	UG/L	<2	<2	<2
CHLOROBENZENE	UG/L	<1	<1	<1
ETHYLBENZENE	UG/L	<1	2	<1
XYLENES (TOTAL)	UG/L	<1	1	<1
STYRENE	UG/L	<2	<2	<2
1,4-DIOXANE	UG/L	<200	<200	<200
ETHYLENE DIBROMIDE	UG/L	<5	<5	<5
CYCLOHEXANE	UG/L	<10	<10	<10
SURROGATES				
1,2-DICHLOROETHANE-D4	%	93	86	97
TOLUENE-D8	%	103	97	103
BFB	%	92	86	92

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank I.D. : 29053
lient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
roject # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 402297
Date Extracted: N/A
Date Analyzed : 24-FEB-94
Dil. Factor : 1.00

arameters	Units	Results
ARBON DISULFIDE	UG/L	<2
HLOROFORM	UG/L	<1
2-BUTANONE (MEK)	UG/L	<10
1,2-DICHLOROETHANE	UG/L	<1
ENZENE	UG/L	<1
OLUENE	UG/L	<2
CHLOROBENZENE	UG/L	<1
THYLBENZENE	UG/L	<1
YLENES (TOTAL)	UG/L	<1
TYRENE	UG/L	<2
1,4-DIOXANE	UG/L	<200
THYLENE DIBROMIDE	UG/L	<5
YCLOHEXANE	UG/L	<10
SURROGATES		
,2-DICHLOROETHANE-D4	%	92
OLUENE-D8	%	101
BFB	%	89

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank I.D. : 29093
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 402297
Date Extracted: N/A
Date Analyzed : 25-FEB-94
Dil. Factor : 1.00

Parameters	Units	Results
CARBON DISULFIDE	UG/L	<2
CHLOROFORM	UG/L	<1
2-BUTANONE (MEK)	UG/L	<10
1,2-DICHLOROETHANE	UG/L	<1
BENZENE	UG/L	<1
TOLUENE	UG/L	<2
CHLOROBENZENE	UG/L	<1
ETHYLBENZENE	UG/L	<1
XYLENES (TOTAL)	UG/L	<1
STYRENE	UG/L	<2
1,4-DIOXANE	UG/L	<200
ETHYLENE DIBROMIDE	UG/L	<5
CYCLOHEXANE	UG/L	<10
SURROGATES		
1,2-DICHLOROETHANE-D4	%	92
TOLUENE-D8	%	102
BFB	%	94

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

MSMSD

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
MSMSD # : 59827
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.

Project # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 402297
Date Extracted: N/A
Date Analyzed : 24-FEB-94
Sample Matrix : WATER
REF I.D. : 402297-02

Parameters	Units	Sample Result	Conc Spike	Spiked Sample	% Rec	Dup Spike	Dup % Rec	RPD
BENZENE	UG/L	<1	50	55	110	56	112	2
TOLUENE	UG/L	<2	50	55	110	56	112	2
CHLOROBENZENE	UG/L	<10	50	53	106	56	112	6

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample Result - Duplicate Spike Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

BLANK SPIKE

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank Spike #: 44392
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-001A
Project Name : POND 1 QUARTERLY MONITORING

ATI I.D. : 402297
Date Extracted: N/A
Date Analyzed : 24-FEB-94
Sample Matrix : WATER

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
BENZENE	UG/L	<1	54	50	108
TOLUENE	UG/L	<2	53	50	106
CHLOROBENZENE	UG/L	<1	58	50	116

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

BLANK SPIKE

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank Spike #: 44456
lient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
roject # : PIO200-001A
Project Name : POND 1 QUARTERLY MONITORING

ATI I.D. : 402297
Date Extracted: N/A
Date Analyzed : 25-FEB-94
Sample Matrix : WATER

arameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
ENZENE	UG/L	<1	49	50	98
OLUENE	UG/L	<2	50	50	100
CHLOROBENZENE	UG/L	<1	53	50	106

Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

ıst : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
ıient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 402297
Project # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

ımple #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
	MW-6	WATER	22-FEB-94	24-FEB-94	01-MAR-94	1.00
	MW-5	WATER	22-FEB-94	24-FEB-94	01-MAR-94	2.00
3	MW-3	WATER	22-FEB-94	24-FEB-94	01-MAR-94	1.00

ırameter	Units	1	2	3
ANTHRACENE	UG/L	<10	<20	<10
ENZO(a)ANTHRACENE	UG/L	<10	<20	<10
ENZO(b)FLUORANTHENE	UG/L	<10	<20	<10
BENZO(k)FLUORANTHENE	UG/L	<10	<20	<10
ENZO(a)PYRENE	UG/L	<10	<20	<10
IS(2-ETHYLHEXYL)PHTHALATE	UG/L	<10	<20	<10
UTYLBENZYLPHTHALATE	UG/L	<10	<20	<10
CHRYSENE	UG/L	<10	<20	<10
IBENZ(a,h)ACRIDINE	UG/L	<10	<20	<10
IBENZ(a,h)ANTHRACENE	UG/L	<10	<20	<10
1,2-DICHLOROBENZENE	UG/L	<10	<20	<10
1,3-DICHLOROBENZENE	UG/L	<10	<20	<10
,4-DICHLOROBENZENE	UG/L	<10	<20	<10
IETHYLPHTHALATE	UG/L	<10	<20	<10
7,12-DIMETHYLBENZO(a)ANTHRACENE	UG/L	<10	<20	<10
DIMETHYLPHTHALATE	UG/L	<10	<20	<10
I-N-BUTYLPHTHALATE	UG/L	<10	<20	<10
I-N-OCTYLPHTHALATE	UG/L	<10	<20	<10
FLUORANTHENE	UG/L	<10	<20	<10
APHTHALENE	UG/L	54	<20	190
IENANTHRENE	UG/L	<10	<20	<10
PYRENE	UG/L	<10	<20	<10
2-METHYLNAPHTHALENE	UG/L	25	<20	53
ENZENETHIOL	UG/L	<10	<20	<10
-NITROPHENOL	UG/L	<50	<100	<50
2,4-DIMETHYLPHENOL	UG/L	<10	<20	<10
2,4-DINITROPHENOL	UG/L	<50	<100	<50
IENOL	UG/L	<10	<20	<10
-METHYLPHENOL	UG/L	<10	<20	<10
3- & 4-METHYLPHENOL	UG/L	<10	<20	<10
NDENE	UG/L	<10	<20	<10
-METHYLNAPHTHALENE	UG/L	140	96	210
PYRIDINE	UG/L	<50	<100	<50
QUINOLINE	UG/L	<50	<100	<50
-METHYL CHRYSENE	UG/L	<10	<20	<10
SURROGATES				
NITROBENZENE-D5	%	112	87	109
-FLUOROBIPHENYL	%	96	109	107
ERPHENYL-D14	%	70	77	72

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

est : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
lient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 402297
Project # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

ample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
	MW-6	WATER	22-FEB-94	24-FEB-94	01-MAR-94	1.00
	MW-5	WATER	22-FEB-94	24-FEB-94	01-MAR-94	2.00
3	MW-3	WATER	22-FEB-94	24-FEB-94	01-MAR-94	1.00

arameter	Units	1	2	3
URROGATES				
HENOL-D6	%	103	106	105
2-FLUOROPHENOL	%	84	92	88
2,4,6-TRIBROMOPHENOL	%	80	49	84

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 402297
Project # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
	FB-1	WATER	22-FEB-94	24-FEB-94	01-MAR-94	1.00
	MW-4	WATER	22-FEB-94	24-FEB-94	01-MAR-94	2.00

Parameter	Units	4	5
ANTHRACENE	UG/L	<10	<20
BENZO(a)ANTHRACENE	UG/L	<10	<20
BENZO(b)FLUORANTHENE	UG/L	<10	<20
BENZO(k)FLUORANTHENE	UG/L	<10	<20
BENZO(a)PYRENE	UG/L	<10	<20
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	<10	<20
BUTYLBENZYLPHTHALATE	UG/L	<10	<20
CHRYSENE	UG/L	<10	<20
DIBENZ(a,h)ACRIDINE	UG/L	<10	<20
DIBENZ(a,h)ANTHRACENE	UG/L	<10	<20
1,2-DICHLOROBENZENE	UG/L	<10	<20
1,3-DICHLOROBENZENE	UG/L	<10	<20
1,4-DICHLOROBENZENE	UG/L	<10	<20
DIETHYLPHTHALATE	UG/L	<10	<20
7,12-DIMETHYLBENZO(a)ANTHRACENE	UG/L	<10	<20
DIMETHYLPHTHALATE	UG/L	<10	<20
DI-N-BUTYLPHTHALATE	UG/L	<10	<20
DI-N-OCTYLPHTHALATE	UG/L	<10	<20
FLUORANTHENE	UG/L	<10	<20
NAPHTHALENE	UG/L	<10	59
PHENANTHRENE	UG/L	<10	<20
PYRENE	UG/L	<10	<20
2-METHYLNAPHTHALENE	UG/L	<10	<20
BENZENETHIOL	UG/L	<10	<20
4-NITROPHENOL	UG/L	<50	<100
2,4-DIMETHYLPHENOL	UG/L	<10	<20
2,4-DINITROPHENOL	UG/L	<50	<100
PHENOL	UG/L	<10	<20
2-METHYLPHENOL	UG/L	<10	<20
3- & 4-METHYLPHENOL	UG/L	<10	<20
INDENE	UG/L	<10	<20
1-METHYLNAPHTHALENE	UG/L	<10	190
PYRIDINE	UG/L	<50	<100
QUINOLINE	UG/L	<50	<100
6-METHYL CHRYSENE	UG/L	<10	<20
SURROGATES			
NITROBENZENE-D5	%	118	102
2-FLUOROBIPHENYL	%	100	111
TERPHENYL-D14	%	97	59

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 402297
Project # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	FB-1	WATER	22-FEB-94	24-FEB-94	01-MAR-94	1.00
5	MW-4	WATER	22-FEB-94	24-FEB-94	01-MAR-94	2.00

Parameter	Units	4	5
SURROGATES			
PHENOL-D6	%	94	107
2-FLUOROPHENOL	%	91	100
2,4,6-TRIBROMOPHENOL	%	71	87

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
Blank I.D. : 29110
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 402297
Date Extracted: 24-FEB-94
Date Analyzed : 01-MAR-94
Dil. Factor : 1.00

Parameters	Units	Results
ANTHRACENE	UG/L	<10
BENZO(a)ANTHRACENE	UG/L	<10
BENZO(b)FLUORANTHENE	UG/L	<10
BENZO(k)FLUORANTHENE	UG/L	<10
BENZO(a)PYRENE	UG/L	<10
BIS(2-ETHYLHEXYL)PHTHALATE	UG/L	<10
BUTYLBENZYLPHTHALATE	UG/L	<10
CHRYSENE	UG/L	<10
DIBENZ(a,h)ACRIDINE	UG/L	<10
DIBENZ(a,h)ANTHRACENE	UG/L	<10
1,2-DICHLOROBENZENE	UG/L	<10
1,3-DICHLOROBENZENE	UG/L	<10
1,4-DICHLOROBENZENE	UG/L	<10
DIETHYLPHTHALATE	UG/L	<10
7,12-DIMETHYLBENZO(a)ANTHRACENE	UG/L	<10
DIMETHYLPHTHALATE	UG/L	<10
DI-N-BUTYLPHTHALATE	UG/L	<10
DI-N-OCTYLPHTHALATE	UG/L	<10
FLUORANTHENE	UG/L	<10
NAPHTHALENE	UG/L	<10
PHENANTHRENE	UG/L	<10
PYRENE	UG/L	<10
2-METHYLNAPHTHALENE	UG/L	<10
BENZENETHIOL	UG/L	<10
4-NITROPHENOL	UG/L	<50
2,4-DIMETHYLPHENOL	UG/L	<10
2,4-DINITROPHENOL	UG/L	<50
PHENOL	UG/L	<10
2-METHYLPHENOL	UG/L	<10
3- & 4-METHYLPHENOL	UG/L	<10
INDENE	UG/L	<10
1-METHYLNAPHTHALENE	UG/L	<10
PYRIDINE	UG/L	<50
QUINOLINE	UG/L	<50
6-METHYL CHRYSENE	UG/L	<10
SURROGATES		
NITROBENZENE-D5	%	109
2-FLUOROBIPHENYL	%	89
TERPHENYL-D14	%	87
PHENOL-D6	%	84
2-FLUOROPHENOL	%	79
2,4,6-TRIBROMOPHENOL	%	79

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

MSMSD

Test : EPA 8270 (GC/MS FOR SEMIVOLATILE ORGANICS)
MSMSD # : 59987
lient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.

Project # : PIO200-001A
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 402297
Date Extracted: 02-FEB-94
Date Analyzed : 28-FEB-94
Sample Matrix : WATER
REF I.D. : REAGENT WATER

arameters	Units	Sample Result	Conc Spike	Spiked Sample	% Rec	Dup Spike	Dup % Rec	RPD
,4-DICHLOROBENZENE	UG/L	<10	100	79	79	77	77	3
YRENE	UG/L	<10	100	95	95	94	94	1
4-NITROPHENOL	UG/L	<50	150	83	55	84	56	1
HENOL	UG/L	<10	150	130	87	130	87	0

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
PD (Relative % Difference) = (Spiked Sample Result - Duplicate Spike Result)*100/Average Result

ACCESSION #: 4 12247

INITIALS: MK

SAMPLE CONDITION UPON RECEIPT CHECKLIST (FOR RE-ACCESSIONS, COMPLETE #7 THRU #9)			
1	Does this project require special handling according to NEESA Levels C, D, AFOEHL or CLP protocols? If yes, complete a) thru c) a) Cooler temperature _____ b) pH sample aliquoted: yes / no / n/a c) LOT #'s: _____	YES	NO
2	Are custody seals present on cooler?	YES	NO
	If yes, are seals intact?	YES	NO
3	Are custody seals present on sample containers?	YES	NO
	If yes, are seals intact? N/A	YES	NO
4	Is there a Chain-Of-Custody (COC)*?	YES	NO
5	Is the COC* complete? Relinquished: yes/no Requested analysis: yes/no	YES	NO
6	Is the COC* in agreement with the samples received? # Samples: yes/no Sample ID's: yes/no Date sampled: yes/no Matrix: yes/no # containers: yes/no	YES	NO
7	Are the samples preserved correctly?	YES	NO
8	Is there enough sample for all the requested analyses?	YES	NO
9	Are all samples within holding times for the requested analyses?	YES	NO
10	Cooler temperature: cooler #s 46 [illegible] 372 all 2°C		
11	Were all sample containers received intact (ie. not broken, leaking, etc.)?	YES	NO
12	Are samples requiring no headspace, headspace free? N/A	YES	NO
13	Are VOA 1st stickers required?	YES	NO
14	Are there special comments on the Chain of Custody which require client contact?	YES	N/A
15	If yes, was ATI Project Manager notified?	YES	NO

Describe "no" items: _____

Was client contacted? yes / no

If yes, Date: _____ Name of Person contacted: _____

Describe actions taken or client instructions: _____

*Or other representative documents, letters, and/or shipping memos

ATIFRM902 (11/92)

Analytical Technologies, Inc.

5550 MOREHOUSE DRIVE
SAN DIEGO, CA 92121-1709
(619) 458-9141

Chain of Custody

DATE 2/22/94 PAGE 1 OF 1

PROJECT MANAGER: Stephanie G. Sakurai
COMPANY: Environmental Technologies Int'l
ADDRESS: 733 Bishop Street
Honolulu, HI 96813

BILL TO: Same
COMPANY:
ADDRESS:

Stephanie Sakurai — SAMPLERS: (Signature)
(808) 547-3600 — PHONE NUMBER

Recommended Quantity and Preservative (Provide triple volume on QC Samples)

SAMPLE ID	SAMPLE DATE	TIME	MATRIX	LAB ID	Petroleum Hydrocarbons 418.1 (1L (H_2SO_4)/100g)	Oil and Grease 413.2 (1L (H_2SO_4)/100g)	Gasoline (MOD 8015/DOHS) (4 oz (HCl)/50g)	Diesel (MOD 8015/DOHS) (4 oz (HCl)/50g)	Gasoline/BTXE (MOD 8015/8020) Maximum Contamination Level of Gasoline: 2ppm (water), 50ppm (Soil) (2X40ml (HCl)/50g)	MOD 8015 (Unknown) (4 oz (HCl)/50g)	BTXE (8020) (2X40ml (HCl)/50g)	Chlorinated Hydrocarbons (8010) (2X40ml (HCl)/50g)	Aromatic Hydrocarbons (8020) (2X40ml (HCl)/50g)	Chlorinated/Aromatic Hydrocarbons (8010/8020) (2X40ml (HCl)/50g)	Organic Pb (500ml/50g)		Pesticides/PCB (8080) (1L/50g)	Base/NEU/Acid Cmpds GC/MS (8270) (1L/100g)	Volatile Cmpds GC/MS (8240) (2X40ml (HCl)/100g)	Polynuclear Aromatic (8310) (1L/100g)	CCR Metals (500ml/100g)	Priority Pollutant Metals (500ml/100g)		8240 (Skinner's List) (2 VOA/HCL)	8270 (Skinner's List) (2 1L Ag/None)	Total Metals (Skinner's) (1-1L poly/HNO3)	Dissolved Metals (Skinner's) (1-1L poly/None)				Number of Containers
MW-6	2/22/94	1025	H2O	01																				X	X	X	X					6
MW-5	2/22/94	1130	H2O	02																				X	X	X	X					6
MW-3	2/22/94	1355	H2O	03																				X	X	X	X					6
FB-1	2/22/94	1425	H2O	04																				X	X	X	X					6
MW-4	2/22/94	1520	H2O	05																				X	X	X	X					6
TB-222	2/22/94	DNA	H2O	~~07~~ ~~06~~ 11																				X								2

PROJECT INFORMATION	
PROJECT NUMBER: PI0200-001A	
PROJECT NAME: POND 1 QUARTERLY MONT.	
PURCHASE ORDER NUMBER:	
VIA: DHL	
TAT: ☐24HR ☐48HRS ☐72HRS ☐1WK ☒2WK	

SAMPLE RECEIPT	
TOTAL NUMBER OF CONTAINERS	32
CHAIN OF CUSTODY SEALS Y/N/NA	Y
SEALS INTACT? Y/N/NA	Y
RECEIVED GOOD COND./COLD	Y/Y
LAB NUMBER	402297

SAMPLE DISPOSAL INSTRUCTIONS

☐ ATI Disposal @ $5.00 each ☐ Return ☐ Pickup

Comments:
Filter and preserve samples for dissolved metals immediately upon receipt

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature: S. Sakurai Time: 1830	Signature: Time:	Signature: Time:
Printed Name: Stephanie Sakurai Date: 2/22/94	Printed Name: Date:	Printed Name: Date:
Company: ETI	Company:	Company:
RECEIVED BY: 1.	**RECEIVED BY: 2.**	**RECEIVED BY: (LAB) 3.**
Signature: Time:	Signature: Time:	Signature: Time: 1810
Printed Name: Date:	Printed Name: Date:	Printed Name: Date: 2/23/94
Company:	Company:	Analytical Technologies, Inc.

DISTRIBUTION: White, Canary - ANALYTICAL TECHNOLOGIES, INC. • Pink - ORIGINATOR

AnalyticalTechnologies, Inc. Corporate Offices: 5550 Morehouse Drive San Diego, CA 92121 (619) 458-9141

ATI I.D.: 402313

March 08, 1994

ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
P.O. BOX 3379
HONOLULU, HI 96842

Project Name: POND 1 QUARTERLY MONITORING
Project # : PI0200-001B

Attention: STEPHANIE SAKURAI

Analytical Technologies, Inc. has received the following sample(s):

Date Received	Quantity	Matrix
February 23, 1994	5	WATER

The sample(s) were analyzed with EPA methodology or equivalent methods as specified in the enclosed analytical schedule. The symbol for "less than" indicates a value below the reportable detection limit. Please note that the Sample Condition Upon Receipt Checklist is included at the end of this report.

The results of these analyses and the quality control data are enclosed.

LESLIE GETMAN
PROJECT MANAGER

M. E. SHIGLEY
LABORATORY MANAGER

AnalyticalTechnologies,Inc.

SAMPLE CROSS REFERENCE

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
roject # : PIO200-001B
roject Name: POND 1 QUARTERLY MONITORING

Report Date: March 08, 1994
ATI I.D. : 402313

TI #	Client Description	Matrix	Date Collected
1	MW-6	WATER	22-FEB-94
2	MW-5	WATER	22-FEB-94
3	MW-3	WATER	22-FEB-94
4	FB-1	WATER	22-FEB-94
5	MW-4	WATER	22-FEB-94

---TOTALS---

Matrix	# Samples
WATER	5

ATI STANDARD DISPOSAL PRACTICE

The sample(s) from this project will be disposed of in twenty-one (21) days from the date of his report. If an extended storage period is required, please contact our sample control epartment before the scheduled disposal date.

AnalyticalTechnologies,Inc.

ANALYTICAL SCHEDULE

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-001B
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D.: 402313

Analysis	Technique/Description
EPA 160.1 (TOTAL DISSOLVED SOLIDS)	GRAVIMETRIC
EPA 6010 (IRON)	INDUCTIVELY COUPLED ARGON PLASMA
EPA 6010 (MANGANESE)	INDUCTIVELY COUPLED ARGON PLASMA
EPA 6010 (SODIUM)	INDUCTIVELY COUPLED ARGON PLASMA
EPA 9038 (SULFATE)	TURBIDIMETRIC
EPA 9066 (PHENOLS, TOTAL)	COLORIMETRIC
EPA 9253 (CHLORIDE)	TITRIMETRIC, SILVER NITRATE

AnalyticalTechnologies,Inc.

GENERAL CHEMISTRY RESULTS

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-001B
roject Name: POND 1 QUARTERLY MONITORING

ATI I.D.: 402313

Sample #	Client ID	Matrix	Date Sampled	Date Received
	MW-6	WATER	22-FEB-94	23-FEB-94
2	MW-5	WATER	22-FEB-94	23-FEB-94
3	MW-3	WATER	22-FEB-94	23-FEB-94
	FB-1	WATER	22-FEB-94	23-FEB-94
5	MW-4	WATER	22-FEB-94	23-FEB-94

arameter	Units	1	2	3	4	5
CHLORIDE	MG/L	1080	975	645	<5.0	617
PHENOLS, TOTAL	MG/L	<0.04@H	<0.08@H	0.16	<0.02	<0.20@H
ULFATE	MG/L	87.2	1160	190	<10.0	329
OTAL DISSOLVED SOLIDS	MG/L	2840	3500	2040	<20	2400

@H DETECTION LIMIT ELEVATED DUE TO MATRIX INTERFERENCE

Analytical Technologies, Inc.

GENERAL CHEMISTRY - QUALITY CONTROL

DUP/MS

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-001B
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 402313

Parameters	REF I.D.	Units	Sample Result	Dup Result	RPD	Spiked Sample	Spike Conc	% Rec
CHLORIDE	402313-04	MG/L	<5.0	<5.0	0	39.0	40.0	98
PHENOLS, TOTAL	402313-01	MG/L	<0.04@H	<0.04@H	0	1.0	1.0	100
SULFATE	402265-01	MG/L	<10.0	<10.0	0	20.2	20.0	101
TOTAL DISSOLVED SOLIDS	402289-03	MG/L	<20	<20	0	N/A	N/A	N/A

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Sample Result - Duplicate Result)*100/Average Result

@H DETECTION LIMIT ELEVATED DUE TO MATRIX INTERFERENCE

AnalyticalTechnologies,Inc.

GENERAL CHEMISTRY - QUALITY CONTROL

BLANK SPIKE

lient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
roject # : PIO200-001B
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 402313

arameters	Blank Spike ID#	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
HLORIDE	44377	MG/L	<5.0	41.0	40.0	103
HENOLS, TOTAL	44612	MG/L	<0.02	0.48	0.50	96
SULFATE	44378	MG/L	<10.0	21.3	20.0	107

Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Sample Result - Duplicate Result)*100/Average Result

AnalyticalTechnologies,Inc.

METALS RESULTS

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-001B
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D.: 402313

Sample #	Client ID	Matrix	Date Sampled	Date Received
[illegible]	MW-6	WATER	22-FEB-94	23-FEB-94
2	MW-5	WATER	22-FEB-94	23-FEB-94
3	MW-3	WATER	22-FEB-94	23-FEB-94
4	FB-1	WATER	22-FEB-94	23-FEB-94
5	MW-4	WATER	22-FEB-94	23-FEB-94

Parameter	Units	1	2	3	4	5
IRON	MG/L	0.10	0.03	0.02	<0.01	0.06
MANGANESE	MG/L	0.11	0.02	0.03	<0.01	0.02
SODIUM	MG/L	929	1200	580	1.0	610

AnalyticalTechnologies,Inc.

METALS - QUALITY CONTROL

DUP/MS

lient : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
roject # : PIO200-001B
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 402313

arameters	REF I.D.	Units	Sample Result	Dup Result	RPD	Spiked Sample	Spike Conc	% Rec
RON	402313-05	MG/L	0.06	0.07	15	4.05	4.00	100
ANGANESE	402313-05	MG/L	0.02	0.02	0	3.99	4.00	99
SODIUM	402313-05	MG/L	610	614	1	638	25.0	112

Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
PD (Relative % Difference) = (Sample Result - Duplicate Result)*100/Average Result

AnalyticalTechnologies,Inc.

METALS - QUALITY CONTROL

BLANK SPIKE

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : PIO200-001B
Project Name: POND 1 QUARTERLY MONITORING

ATI I.D. : 402313

Parameters	Blank Spike ID#	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
IRON	44660	MG/L	<0.01	4.00	4.00	100
MANGANESE	44660	MG/L	<0.01	4.03	4.00	101
SODIUM	44660	MG/L	<0.1	26.3	25.0	105

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Sample Result - Duplicate Result)*100/Average Result

ACCESSION #: 412313

INITIALS: MK

SAMPLE CONDITION UPON RECEIPT CHECKLIST (FOR RE-ACCESSIONS, COMPLETE #7 THRU #9)			
1	Does this project require special handling according to NEESA Levels C, D, AFOEHL or CLP protocols? If yes, complete a) thru c) a) Cooler temperature _____ b) pH sample aliquoted: yes / no / n/a c) LOT #'s: _____	YES	NO
2	Are custody seals present on cooler?	YES	NO
	If yes, are seals intact?	YES	NO
3	Are custody seals present on sample containers?	YES	NO
	If yes, are seals intact? n/a	YES	NO
4	Is there a Chain-Of-Custody (COC)*?	YES	NO
5	Is the COC* complete? Relinquished: yes/no Requested analysis: yes/no	YES	NO
6	Is the COC* in agreement with the samples received? # Samples: yes/no Sample ID's: yes/no Date sampled: yes/no Matrix: yes/no # containers: yes/no	YES	NO
7	Are the samples preserved correctly?	YES	NO
8	Is there enough sample for all the requested analyses?	YES	NO
9	Are all samples within holding times for the requested analyses?	YES	NO
10	Cooler temperature: cooler #'s 44, 119, 377: all 2°C		
11	Were all sample containers received intact (ie. not broken, leaking, etc.)?	YES	NO
12	Are samples requiring no headspace, headspace free? N/A	YES	NO
13	Are VOA 1st stickers required?	YES	NO
14	Are there special comments on the Chain of Custody which require client contact?	YES	N/A
15	If yes, was ATI Project Manager notified?	YES	NO

Describe "no" items: _____

Was client contacted? yes / no

If yes, Date: _____ Name of Person contacted: _____

Describe actions taken or client instructions: _____

*Or other representative documents, letters, and/or shipping memos

Analytical Technologies, Inc.

5550 MOREHOUSE DRIVE
SAN DIEGO, CA 92121-1709
(619) 458-9141

Chain of Custody

DATE 2/22/94 PAGE 1 OF 1

PROJECT MANAGER: Stephanie G. Sakurai
COMPANY: Environmental Technologies Int'l
ADDRESS: 733 Bishop Street
Honolulu, HI 96813

BILL TO: Same
COMPANY:
ADDRESS:

Stephanie Sakurai — SAMPLERS: (Signature)
(808) 547-3600 — PHONE NUMBER

Recommended Quantity and Preservative (Provide triple volume on QC Samples)

SAMPLE ID	SAMPLE DATE	TIME	MATRIX	LAB ID	Petroleum Hydrocarbons 418.1 (1L (H_2SO_4)/100g)	Oil and Grease 413.2 (1L (H_2SO_4)/100g)	Gasoline (MOD 8015/DOHS) (4 oz (HCl)/50g)	Diesel (MOD 8015/DOHS) (4 oz (HCl)/50g)	Gasoline/BTXE (MOD 8015/8020) Maximum Contamination Level of Gasoline: 2ppm (water), 50ppm (Soil) (2X40ml (HCl)/50g)	MOD 8015 (Unknown) (4 oz (HCl)/50g)	BTXE (8020) (2X40ml (HCl)/50g)	Chlorinated Hydrocarbons (8010) (2X40ml (HCl)/50g)	Aromatic Hydrocarbons (8020) (2X40ml (HCl)/50g)	Chlorinated/Aromatic Hydrocarbons (8010/8020) (2X40ml (HCl)/50g)	Organic Pb (500ml/50g)	Pesticides/PCB (8080) (1L/50g)	Base/NEU/Acid Cmpds GC/MS (8270) (1L/100g)	Volatile Cmpds GC/MS (8240) (2X40ml (HCl)/100g)	Polynuclear Aromatic (8310) (1L/100g)	CCR Metals (500ml/100g)	Priority Pollutant Metals (500ml/100g)	TDS, Cl, SO4	Phenols (9066)	Total Fe, Mn, Na	Number of Containers
MW-6	2/22/94	1025	H_2O	01																		X	X	X	3
MW-5	2/22/94	1130	H_2O	02																		X	X	X	3
MW-3	2/22/94	1355	H_2O	03																		X	X	X	3
FB-1	2/22/94	1425	H_2O	04																		X	X	X	3
MW-4	2/22/94	1520	H_2O	05																		X	X	X	3

PROJECT INFORMATION	SAMPLE RECEIPT	
PROJECT NUMBER: PI0200-001B	TOTAL NUMBER OF CONTAINERS	15
PROJECT NAME: POND 1 QUARTERLY MONT.	CHAIN OF CUSTODY SEALS Y/N/NA	Y
PURCHASE ORDER NUMBER:	SEALS INTACT? Y/N/NA	Y
VIA: DHL	RECEIVED GOOD COND./COLD	Y/Y
TAT: ☐24HR ☐48HRS ☐72HRS ☐1WK ☒2WK	LAB NUMBER	4022 ~~97~~ 3/3

SAMPLE DISPOSAL INSTRUCTIONS

☐ ATI Disposal @ $5.00 each ☐ Return ☐ Pickup

Comments:

{ 441 / 019, 377 } all are 2 °C

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature: S Sakurai Time: 1830	Signature: Time:	Signature: Time:
Printed Name: Stephanie Sakurai Date: 2/22/94	Printed Name: Date:	Printed Name: Date:
Company: ETI	Company:	Company:

RECEIVED BY: 1.	RECEIVED BY: 2.	RECEIVED BY: (LAB) 3.
Signature: Time:	Signature: Time:	Signature: [signature] Time: 1015
Printed Name: Date:	Printed Name: Date:	Printed Name: Michael Halloran Date: 2/23/94
Company:	Company:	Analytical Technologies, Inc.

DISTRIBUTION: White, Canary - ANALYTICAL TECHNOLOGIES, INC. • Pink - ORIGINATOR

3. ANALYTICAL RESULTS OF DUPLICATE GROUNDWATER SAMPLE FROM MONITORING WELL NO. 4

WCAS
WEST COAST ANALYTICAL SERVICE, INC.
ANALYTICAL CHEMISTS

March 8, 1994

ENVIRONMENTAL TECHNOLOGIES INTERNATIONAL, INC.
737 Bishop Street, Suite 2600
P. O. Box 3379
Honolulu, HI 96842

Attn: Stephanie Sakurai

JOB NO. 25867 H

LABORATORY REPORT

Samples Received: Eight (8) Water Samples
Date Received: 2-23-94
Project: #PI0200-001A

The samples were analyzed as follows:

Samples Analyzed	Analysis	Results
Two (2) samples	Volatile Organics by EPA 624	Data Sheets
One (1) sample	Semi-Volatile Organics by EPA 625	Data Sheets
One (1) sample	Total Selected Metals by ICPMS	Data Sheets
One (1) sample	Dissolved Selected Metals by ICPMS	Data Sheets

Michael Shelton
Technical Director

D. J. Northington, Ph.D.
President

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9840 Alburtis Avenue ▪ Santa Fe Springs, California 90670 ▪ 310/948-2225 ▪ FAX 310/948-5850

CLIENT: ENVIRONMENTAL TECH SAMPLE: MW-4
WCAS JOB #: 25867

VOLATILE ORGANICS BY EPA 624/8260

DATE RECEIVED: 02/23/94
DATE EXTRACTED: 02/24/94
DATE ANALYZED: 02/24/94
INSTRUMENT ID: 4500

MATRIX: WATER
SAMPLE AMOUNT: 5ML
RUN NUMBER: 25867B2
UNITS: UG/L (PPB)

CAS NO.	COMPOUND	CONCENTRATION	DET LIMIT
67-64-1	ACETONE	20.	5.
71-43-2	BENZENE	1.	1.
75-27-4	BROMODICHLOROMETHANE	ND	1.
75-25-2	BROMOFORM	ND	1.
74-83-9	BROMOMETHANE	ND	5.
78-93-3	2-BUTANONE (MEK)	ND	5.
75-15-0	CARBON DISULFIDE	8.	1.
56-23-5	CARBON TETRACHLORIDE	ND	1.
108-90-7	CHLOROBENZENE	ND	1.
75-00-3	CHLOROETHANE	ND	5.
67-66-3	CHLOROFORM	ND	1.
74-87-3	CHLOROMETHANE	ND	5.
108-41-8	CHLOROTOLUENE	ND	1.
110-82-7	CYCLOHEXANE	2.	1.
124-48-1	DIBROMOCHLOROMETHANE	ND	1.
95-50-1	1,2-DICHLOROBENZENE	ND	1.
541-73-1	1,3-DICHLOROBENZENE	ND	1.
106-46-7	1,4-DICHLOROBENZENE	ND	1.
75-34-3	1,1-DICHLOROETHANE	ND	1.
107-06-2	1,2-DICHLOROETHANE	ND	1.
75-35-4	1,1-DICHLOROETHYLENE	ND	1.
156-59-4	CIS-1,2-DICHLOROETHYLENE	ND	1.
156-60-5	TRANS-1,2-DICHLOROETHYLENE	ND	1.
78-87-5	1,2-DICHLOROPROPANE	ND	1.
10061-01-5	CIS-1,3-DICHLOROPROPENE	ND	1.
10061-02-6	TRANS-1,3-DICHLOROPROPENE	ND	1.
123-91-1	1,4-DIOXANE	ND	200.
100-41-4	ETHYLBENZENE	2.	1.
106-93-4	ETHYLENE DIBROMIDE	ND	1.
76-13-1	FREON-TF	ND	1.
119-78-6	2-HEXANONE	ND	5.
75-09-2	METHYLENE CHLORIDE	ND	1.
108-10-1	4-METHYL-2-PENTANONE (MIBK)	ND	5.
100-42-5	STYRENE	ND	1.
79-34-5	1,1,2,2-TETRACHLOROETHANE	ND	1.
127-18-4	TETRACHLOROETHYLENE	ND	1.
109-99-9	TETRAHYDROFURAN	ND	5.
108-88-3	TOLUENE	ND	1.
71-55-6	1,1,1-TRICHLOROETHANE	ND	1.
79-00-5	1,1,2-TRICHLOROETHANE	ND	1.
79-01-6	TRICHLOROETHYLENE	ND	1.
75-69-4	TRICHLOROFLUOROMETHANE	ND	1.
108-05-4	VINYL ACETATE	ND	5.
75-01-4	VINYL CHLORIDE	ND	5.
1330-20-7	TOTAL XYLENES	1.	1.

SURROGATE	1,2-DCA-d4	TOL-d8	BFB
PERCENT RECOVERY	99	98	97
CONTROL LIMITS	86-121	84-115	83-112

WCAS

CLIENT: ENVIRONMENTAL TECH SAMPLE: TB-WCAS
WCAS JOB #: 25867

VOLATILE ORGANICS BY EPA 624/8260

DATE RECEIVED: 02/23/94
DATE EXTRACTED: 02/24/94
DATE ANALYZED: 02/24/94
INSTRUMENT ID: 4500

MATRIX: WATER
SAMPLE AMOUNT: 5ML
RUN NUMBER: 25867B1
UNITS: UG/L (PPB)

CAS NO.	COMPOUND	CONCENTRATION	DET LIMIT
67-64-1	ACETONE	10.	5.
71-43-2	BENZENE	ND	1.
75-27-4	BROMODICHLOROMETHANE	ND	1.
75-25-2	BROMOFORM	ND	1.
74-83-9	BROMOMETHANE	ND	5.
78-93-3	2-BUTANONE (MEK)	9.	5.
75-15-0	CARBON DISULFIDE	ND	1.
56-23-5	CARBON TETRACHLORIDE	ND	1.
108-90-7	CHLOROBENZENE	ND	1.
75-00-3	CHLOROETHANE	ND	5.
67-66-3	CHLOROFORM	ND	1.
74-87-3	CHLOROMETHANE	ND	5.
108-41-8	CHLOROTOLUENE	ND	1.
110-82-7	CYCLOHEXANE	ND	1.
124-48-1	DIBROMOCHLOROMETHANE	ND	1.
95-50-1	1,2-DICHLOROBENZENE	ND	1.
541-73-1	1,3-DICHLOROBENZENE	ND	1.
106-46-7	1,4-DICHLOROBENZENE	ND	1.
75-34-3	1,1-DICHLOROETHANE	ND	1.
107-06-2	1,2-DICHLOROETHANE	ND	1.
75-35-4	1,1-DICHLOROETHYLENE	ND	1.
156-59-4	CIS-1,2-DICHLOROETHYLENE	ND	1.
156-60-5	TRANS-1,2-DICHLOROETHYLENE	ND	1.
78-87-5	1,2-DICHLOROPROPANE	ND	1.
10061-01-5	CIS-1,3-DICHLOROPROPENE	ND	1.
10061-02-6	TRANS-1,3-DICHLOROPROPENE	ND	1.
123-91-1	1,4-DIOXANE	ND	200.
100-41-4	ETHYLBENZENE	ND	1.
106-93-4	ETHYLENE DIBROMIDE	ND	1.
76-13-1	FREON-TF	ND	1.
119-78-6	2-HEXANONE	ND	5.
75-09-2	METHYLENE CHLORIDE	ND	1.
108-10-1	4-METHYL-2-PENTANONE (MIBK)	ND	5.
100-42-5	STYRENE	ND	1.
79-34-5	1,1,2,2-TETRACHLOROETHANE	ND	1.
127-18-4	TETRACHLOROETHYLENE	ND	1.
109-99-9	TETRAHYDROFURAN	ND	5.
108-88-3	TOLUENE	ND	1.
71-55-6	1,1,1-TRICHLOROETHANE	ND	1.
79-00-5	1,1,2-TRICHLOROETHANE	ND	1.
79-01-6	TRICHLOROETHYLENE	ND	1.
75-69-4	TRICHLOROFLUOROMETHANE	ND	1.
108-05-4	VINYL ACETATE	ND	5.
75-01-4	VINYL CHLORIDE	ND	5.
1330-20-7	TOTAL XYLENES	ND	1.

SURROGATE	1,2-DCA-d4	TOL-d8	BFB
PERCENT RECOVERY	100	98	96
CONTROL LIMITS	86-121	84-115	83-112

WCAS

CLIENT: ENVIRONMENTAL TECH SAMPLE: LAB BLANK
WCAS JOB #: 25867

VOLATILE ORGANICS BY EPA 624/8260

DATE RECEIVED: 02/24/94 MATRIX: WATER
DATE EXTRACTED: 02/24/94 SAMPLE AMOUNT: 5ML
DATE ANALYZED: 02/24/94 RUN NUMBER: VBLK766
INSTRUMENT ID: 4500 UNITS: UG/L (PPB)

CAS NO.	COMPOUND	CONCENTRATION	DET LIMIT
67-64-1	ACETONE	ND	5.
71-43-2	BENZENE	ND	1.
75-27-4	BROMODICHLOROMETHANE	ND	1.
75-25-2	BROMOFORM	ND	1.
74-83-9	BROMOMETHANE	ND	5.
78-93-3	2-BUTANONE (MEK)	ND	5.
75-15-0	CARBON DISULFIDE	ND	1.
56-23-5	CARBON TETRACHLORIDE	ND	1.
108-90-7	CHLOROBENZENE	ND	1.
75-00-3	CHLOROETHANE	ND	5.
67-66-3	CHLOROFORM	ND	1.
74-87-3	CHLOROMETHANE	ND	5.
108-41-8	CHLOROTOLUENE	ND	1.
110-82-7	CYCLOHEXANE	ND	1.
124-48-1	DIBROMOCHLOROMETHANE	ND	1.
95-50-1	1,2-DICHLOROBENZENE	ND	1.
541-73-1	1,3-DICHLOROBENZENE	ND	1.
106-46-7	1,4-DICHLOROBENZENE	ND	1.
75-34-3	1,1-DICHLOROETHANE	ND	1.
107-06-2	1,2-DICHLOROETHANE	ND	1.
75-35-4	1,1-DICHLOROETHYLENE	ND	1.
156-59-4	CIS-1,2-DICHLOROETHYLENE	ND	1.
156-60-5	TRANS-1,2-DICHLOROETHYLENE	ND	1.
78-87-5	1,2-DICHLOROPROPANE	ND	1.
10061-01-5	CIS-1,3-DICHLOROPROPENE	ND	1.
10061-02-6	TRANS-1,3-DICHLOROPROPENE	ND	1.
123-91-1	1,4-DIOXANE	ND	200.
100-41-4	ETHYLBENZENE	ND	1.
106-93-4	ETHYLENE DIBROMIDE	ND	1.
76-13-1	FREON-TF	ND	1.
119-78-6	2-HEXANONE	ND	5.
75-09-2	METHYLENE CHLORIDE	ND	1.
108-10-1	4-METHYL-2-PENTANONE (MIBK)	ND	5.
100-42-5	STYRENE	ND	1.
79-34-5	1,1,2,2-TETRACHLOROETHANE	ND	1.
127-18-4	TETRACHLOROETHYLENE	ND	1.
109-99-9	TETRAHYDROFURAN	ND	5.
108-88-3	TOLUENE	ND	1.
71-55-6	1,1,1-TRICHLOROETHANE	ND	1.
79-00-5	1,1,2-TRICHLOROETHANE	ND	1.
79-01-6	TRICHLOROETHYLENE	ND	1.
75-69-4	TRICHLOROFLUOROMETHANE	ND	1.
108-05-4	VINYL ACETATE	ND	5.
75-01-4	VINYL CHLORIDE	ND	5.
1330-20-7	TOTAL XYLENES	ND	1.

SURROGATE	1,2-DCA-d4	TOL-d8	BFB
PERCENT RECOVERY	98	99	99
CONTROL LIMITS	86-121	84-115	83-112

WCAS

WEST COAST ANALYTICAL SERVICE

MATRIX SPIKE/MATRIX SPIKE DUPLICATE
PERCENT RECOVERY AND RPD SUMMARY

CLIENT:	ENVIRONMENTAL TECH	QC BATCH:	022494W
DATE ANALYZED:	02/24/94	MATRIX:	WATER
WCAS JOB #:	25867	UNITS:	UG/L (PPB)

VOLATILE COMPOUNDS

COMPOUND	CONC SPIKED	CONC SAMPLE	CONC MS	% REC MS	CONC MSD	% REC MSD	RPD
1,1-DICHLOROETHYLENE	50.3	ND	54.8	109	56.6	113	-3
TRICHLOROETHYLENE	49.6	ND	45.2	91	47.8	96	-6
CHLOROBENZENE	50.1	ND	49.1	98	49.5	99	-1
TOLUENE	50.2	ND	51.0	102	52.9	105	-4
BENZENE	50.3	1.3	47.9	93	49.6	96	-3

WATER QUALITY CONTROL LIMITS

ANALYTE	% RECOVERY WARNING	% RECOVERY CONTROL	RPD WARNING	RPD CONTROL
1,1-DICHLOROETHYLENE	52-155	25-182	24	36
TRICHLOROETHYLENE	59-120	44-135	13	18
CHLOROBENZENE	82-109	75-115	10	15
TOLUENE	80-116	71-125	13	19
BENZENE	73-125	60-138	14	19

CLIENT: ENVIRONMENTAL TECHNOLOGIES SAMPLE: MW-4
WCAS JOB #: 25867

SEMI-VOLATILE ORGANICS (EPA 625/8270)

DATE RECEIVED:	02/23/94	MATRIX:	WATER
DATE EXTRACTED:	02/28/94	SAMPLE AMOUNT:	1L:1ML,1:3
DATE ANALYZED:	03/04/94	RUN NUMBER:	25867A4
INSTRUMENT ID:	TRIO1000	UNITS:	UG/L (PPB)

CAS #	COMPOUND	CONCENTRATION	DET LIMIT
83-32-9	ACENAPHTHENE	ND	3.
208-96-8	ACENAPHTHYLENE	ND	3.
120-12-7	ANTHRACENE	ND	3.
108-98-5	BENZENETHIOL	ND	20.
56-55-3	BENZO(A)ANTHRACENE	ND	3.
205-99-2	BENZO(B & K)FLUORANTHENES	ND	3.
191-24-2	BENZO(G,H,I)PERYLENE	ND	3.
50-32-8	BENZO(A)PYRENE	ND	3.
65-85-0	BENZOIC ACID	ND	20.
100-51-6	BENZYL ALCOHOL	ND	20.
111-91-1	BIS(2-CHLOROETHOXY)METHANE	ND	3.
11-44-1	BIS(2-CHLOROETHYL)ETHER	ND	3.
39638-32-9	BIS(2-CHLOROISOPROPYL)ETHER	ND	3.
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	ND	3.
101-55-3	4-BROMOPHENYL PHENYL ETHER	ND	3.
85-68-7	BUTYL BENZYL PHTHALATE	ND	3.
106-47-8	4-CHLOROANILINE	ND	3.
59-50-7	4-CHLORO-3-METHYLPHENOL	ND	3.
91-58-71	2-CHLORONAPHTHALENE	ND	3.
95-57-8	2-CHLOROPHENOL	ND	3.
7005-72-3	4-CHLOROPHENYL PHENYL ETHER	ND	3.
218-01-9	CHRYSENE	ND	3.
	DIBENZ(A,H)ACRIDINE	ND	20.
53-70-3	DIBENZO(A,H)ANTHRACENE	ND	3.
132-64-9	DIBENZOFURAN	ND	3.
84-74-2	DI-N-BUTYL PHTHALATE	ND	3.
95-50-1	1,2-DICHLOROBENZENE	ND	3.
541-73-1	1,3-DICHLOROBENZENE	ND	3.
106-46-7	1,4-DICHLOROBENZENE	ND	3.
91-94-1	3,3'-DICHLOROBENZIDINE	ND	3.
120-33-2	2,4-DICHLOROPHENOL	ND	3.
84-66-2	DIETHYL PHTHALATE	ND	3.
57-97-6	7,12-DIMETHYLBENZ(A)ANTHRACENE	ND	20.
105-67-9	2,4-DIMETHYLPHENOL	ND	3.
131-11-3	DIMETHYL PHTHALATE	ND	3.
534-52-1	4,6-DINITRO-2-METHYLPHENOL	ND	20.
51-28-5	2,4-DINITROPHENOL	ND	20.
121-14-2	2,4-DINITROTOLUENE	ND	3.
606-20-2	2,6-DINITROTOLUENE	ND	3.
117-84-0	DI-N-OCTYL PHTHALATE	ND	3.
204-44-0	FLUORANTHENE	ND	3.

CLIENT: ENVIRONMENTAL TECHNOLOGIES SAMPLE: MW-4
WCAS JOB #: 25867

SEMI-VOLATILE ORGANICS (EPA 625/8270)

DATE RECEIVED:	02/23/94	MATRIX:	WATER
DATE EXTRACTED:	02/28/94	SAMPLE AMOUNT:	1L:1ML,1:3
DATE ANALYZED:	03/04/94	RUN NUMBER:	25867A4
INSTRUMENT ID:	TRIO1000	UNITS:	UG/L (PPB)

CAS #	COMPOUND	CONCENTRATION	DET LIMIT
86-73-7	FLUORENE	ND	3.
118-74-1	HEXACHLOROBENZENE	ND	3.
87-68-3	HEXACHLOROBUTADIENE	ND	3.
77-47-4	HEXACHLOROCYCLOPENTADIENE	ND	3.
67-72-1	HEXACHLOROETHANE	ND	3.
95-13-6	INDENE	ND	20.
193-39-5	INDENO(1,2,3-CD)PYRENE	ND	3.
78-59-1	ISOPHORONE	ND	3.
90-12-0	1-METHYLNAPHTHALENE	200.	3.
91-57-6	2-METHYLNAPHTHALENE	10.	3.
95-48-7	2-METHYLPHENOL	ND	3.
	3/4-METHYLPHENOL	ND	3.
91-20-3	NAPHTHALENE	43.	3.
88-74-4	2-NITROANILINE	ND	20.
99-09-2	3-NITROANILINE	ND	20.
100-01-6	4-NITROANILINE	ND	20.
98-95-3	NITROBENZENE	ND	3.
88-75-5	2-NITROPHENOL	ND	3.
100-02-7	4-NITROPHENOL	ND	20.
86-30-6	N-NITROSODIPHENYLAMINE **	ND	3.
621-64-7	N-NITROSODIPROPYLAMINE	ND	3.
87-86-5	PENTACHLOROPHENOL	ND	20.
85-01-8	PHENANTHRENE	ND	3.
108-95-2	PHENOL	ND	3.
129-00-0	PYRENE	ND	3.
110-86-1	PYRIDINE	ND	20.
91-22-5	QUINOLINE	ND	20.
120-82-1	1,2,4-TRICHLOROBENZENE	ND	3.
95-95-4	2,4,5-TRICHLOROPHENOL	ND	20.
88-06-2	2,4,6-TRICHLOROPHENOL	ND	3.

** - Cannot be separated from diphenylamine

SURROGATE	PERCENT RECOVERY	CONTROL LIMIT
PHENOL-d5	112	19-139
2-FLUOROPHENOL	98	21-154
NITROBENZENE-d5	102	35-114
2-FLUOROBIPHENYL	76	43-116
2,4,6-TRIBROMOPHENOL	96	10-123
TERPHENYL-d14	92	44-141

CLIENT: ENVIRONMENTAL TECHNOLOGIES SAMPLE: METHOD BLANK
WCAS JOB #: 25867

SEMI-VOLATILE ORGANICS (EPA 625/8270)

DATE RECEIVED:	02/28/94	MATRIX:	WATER
DATE EXTRACTED:	02/28/94	SAMPLE AMOUNT:	1L:1ML
DATE ANALYZED:	03/04/94	RUN NUMBER:	25867AA1
INSTRUMENT ID:	TRIO1000	UNITS:	UG/L (PPB)

CAS #	COMPOUND	CONCENTRATION	DET LIMIT
83-32-9	ACENAPHTHENE	ND	1.
208-96-8	ACENAPHTHYLENE	ND	1.
120-12-7	ANTHRACENE	ND	1.
108-98-5	BENZENETHIOL	ND	5.
56-55-3	BENZO(A)ANTHRACENE	ND	1.
205-99-2	BENZO(B & K)FLUORANTHENES	ND	1.
191-24-2	BENZO(G,H,I)PERYLENE	ND	1.
50-32-8	BENZO(A)PYRENE	ND	1.
65-85-0	BENZOIC ACID	ND	5.
100-51-6	BENZYL ALCOHOL	ND	5.
111-91-1	BIS(2-CHLOROETHOXY)METHANE	ND	1.
11-44-1	BIS(2-CHLOROETHYL)ETHER	ND	1.
39638-32-9	BIS(2-CHLOROISOPROPYL)ETHER	ND	1.
117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	ND	1.
101-55-3	4-BROMOPHENYL PHENYL ETHER	ND	1.
85-68-7	BUTYL BENZYL PHTHALATE	ND	1.
106-47-8	4-CHLOROANILINE	ND	1.
59-50-7	4-CHLORO-3-METHYLPHENOL	ND	1.
91-58-71	2-CHLORONAPHTHALENE	ND	1.
95-57-8	2-CHLOROPHENOL	ND	1.
7005-72-3	4-CHLOROPHENYL PHENYL ETHER	ND	1.
218-01-9	CHRYSENE	ND	1.
	DIBENZ(A,H)ACRIDINE	ND	5.
53-70-3	DIBENZO(A,H)ANTHRACENE	ND	1.
132-64-9	DIBENZOFURAN	ND	1.
84-74-2	DI-N-BUTYL PHTHALATE	ND	1.
95-50-1	1,2-DICHLOROBENZENE	ND	1.
541-73-1	1,3-DICHLOROBENZENE	ND	1.
106-46-7	1,4-DICHLOROBENZENE	ND	1.
91-94-1	3,3'-DICHLOROBENZIDINE	ND	1.
120-33-2	2,4-DICHLOROPHENOL	ND	1.
84-66-2	DIETHYL PHTHALATE	ND	1.
57-97-6	7,12-DIMETHYLBENZ(A)ANTHRACENE	ND	5.
105-67-9	2,4-DIMETHYLPHENOL	ND	1.
131-11-3	DIMETHYL PHTHALATE	ND	1.
534-52-1	4,6-DINITRO-2-METHYLPHENOL	ND	5.
51-28-5	2,4-DINITROPHENOL	ND	5.
121-14-2	2,4-DINITROTOLUENE	ND	1.
606-20-2	2,6-DINITROTOLUENE	ND	1.
117-84-0	DI-N-OCTYL PHTHALATE	ND	1.
204-44-0	FLUORANTHENE	ND	1.

CLIENT: ENVIRONMENTAL TECHNOLOGIES SAMPLE: METHOD BLANK
WCAS JOB #: 25867

SEMI-VOLATILE ORGANICS (EPA 625/8270)

DATE RECEIVED:	02/28/94	MATRIX:	WATER
DATE EXTRACTED:	02/28/94	SAMPLE AMOUNT:	1L:1ML
DATE ANALYZED:	03/04/94	RUN NUMBER:	25867AA1
INSTRUMENT ID:	TRIO1000	UNITS:	UG/L (PPB)

CAS #	COMPOUND	CONCENTRATION	DET LIMIT
86-73-7	FLUORENE	ND	1.
118-74-1	HEXACHLOROBENZENE	ND	1.
87-68-3	HEXACHLOROBUTADIENE	ND	1.
77-47-4	HEXACHLOROCYCLOPENTADIENE	ND	1.
67-72-1	HEXACHLOROETHANE	ND	1.
95-13-6	INDENE	ND	5.
193-39-5	INDENO(1,2,3-CD)PYRENE	ND	1.
78-59-1	ISOPHORONE	ND	1.
90-12-0	1-METHYLNAPHTHALENE	ND	1.
91-57-6	2-METHYLNAPHTHALENE	ND	1.
95-48-7	2-METHYLPHENOL	ND	1.
	3/4-METHYLPHENOL	ND	1.
91-20-3	NAPHTHALENE	ND	1.
88-74-4	2-NITROANILINE	ND	5.
99-09-2	3-NITROANILINE	ND	5.
100-01-6	4-NITROANILINE	ND	5.
98-95-3	NITROBENZENE	ND	1.
88-75-5	2-NITROPHENOL	ND	1.
100-02-7	4-NITROPHENOL	ND	5.
86-30-6	N-NITROSODIPHENYLAMINE **	ND	1.
621-64-7	N-NITROSODIPROPYLAMINE	ND	1.
87-86-5	PENTACHLOROPHENOL	ND	5.
85-01-8	PHENANTHRENE	ND	1.
108-95-2	PHENOL	ND	1.
129-00-0	PYRENE	ND	1.
110-86-1	PYRIDINE	ND	5.
91-22-5	QUINOLINE	ND	5.
120-82-1	1,2,4-TRICHLOROBENZENE	ND	1.
95-95-4	2,4,5-TRICHLOROPHENOL	ND	5.
88-06-2	2,4,6-TRICHLOROPHENOL	ND	1.

** - Cannot be separated from diphenylamine

SURROGATE	PERCENT RECOVERY	CONTROL LIMIT
PHENOL-d5	120	19-139
2-FLUOROPHENOL	109	21-154
NITROBENZENE-d5	113	35-114
2-FLUOROBIPHENYL	89	43-116
2,4,6-TRIBROMOPHENOL	104	10-123
TERPHENYL-d14	124	44-141

WEST COAST ANALYTICAL SERVICE

MATRIX SPIKE (MS AND MSD)
% RECOVERY AND RPD SUMMARY

CLIENT : ENVIRONMENTAL TECH
DATE ANALYZED: 03/04/94
WCAS JOB # : 25867

SAMPLE: METHOD BLANK
MATRIX: WATER
UNITS : UG/L (PPB)

SEMI-VOLATILE COMPOUNDS

COMPOUND	CONC SPIKED	CONC SAMPLE	CONC MS	%REC MS	CONC MSD	%REC MSD	RPD
1,2,4-TRICHLOROBENZE	51.	ND	31.	61	32.	63	-3
ACENAPHTHENE	50.	ND	42.	84	46.	92	-9
2,4-DINITROTOLUENE	50.	ND	44.	88	44.	88	0
PYRENE	50.	ND	50.	99	62.	123	-21*
NITROSOPROPYLAMINE	51.	ND	51.	101*	51.	101*	0
1,4-DICHLOROBENZENE	51.	ND	28.	55	29.	57	-4
PENTACHLOROPHENOL	100.	ND	72.	72	76.	76	-5
PHENOL	100.	ND	92.	92	96.	96	-4
2-CHLOROPHENOL	100.	ND	84.	84	90.	90	-7
P-CHLORO-M-CRESOL	100.	ND	82.	82	88.	88	-7
4-NITROPHENOL	100.	ND	51.	51	55.	55	-8

* - Asterisked Values Are Outside Warning Limits

WATER QUALITY CONTROL LIMITS

	% RECOVERY		RPD	
	WARNING	CONTROL	WARNING	CONTROL
1,2,4-TRICHLOROBENZENE	43- 87	32- 98	21	31
ACENAPHTHENE	54-114	39-129	10	17
2,4-DINITROTOLUENE	51-109	36-124	11	18
PYRENE	56-144	34-166	19	29
NITROSOPROPYLAMINE	47- 96	35-108	14	24
1,4-DICHLOROBENZENE	41- 75	32- 84	23	34
PENTACHLOROPHENOL	20-176	0-215	24	36
PHENOL	55-100	42-113	13	21
2-CHLOROPHENOL	60-114	46-128	10	17
P-CHLORO-M-CRESOL	51- 96	38-110	12	20
4-NITROPHENOL	25-103	6-123	25	38

WEST COAST ANALYTICAL SERVICE, INC.

ENVIORNMENTAL TECHNOLOGIES INTERNATIONAL, INC. Job # 25867
Ms. Stephanie Sakurai March 8, 1994

LABORATORY REPORT

Skinner List Metals
Quantitative Analysis Report
Inductively Coupled Plasma-Mass Spectrometry

Parts Per Billion (ug/L)

	MW-4 Dissolved	MW-4 Total	Blank Detect. Limit
Antimony	ND<2	ND<0.5	0.5
Arsenic	16	15	5
Barium	7	8	2
Beryllium	ND<0.6	ND<0.2	0.2
Cadmium	ND<0.1	ND<0.1	0.1
Chromium	1.1	7	0.5
Cobalt	0.2	0.2	0.1
Lead	0.1	0.2	0.1
Mercury	0.4	ND<0.2	0.2
Nickel	4	6	1
Selenium	7	12	4
Vanadium	13	12	9

Date Analyzed: 2-25-94

WEST COAST ANALYTICAL SERVICE, INC.

ENVIORNMENTAL TECHNOLOGIES INTERNATIONAL, INC. Job # 25867
Ms. Stephanie Sakurai March 8, 1994

LABORATORY REPORT

Sample: MW-4
Matrix: Water

Parts Per Billion (ug/L)

	Sample	Duplicate	RPD %	Spike Conc ppb	Spk Rslt	% Recovery	Blank Detect. Limit
Antimony	ND<0.5	ND<0.5		100	ND<0.5	0***	0.5
Arsenic	15	17		100	128	112	4
Barium	8	7		100	114	106.5	2
Beryllium	ND<0.2	ND<0.2		100	119	119	0.2
Cadmium	ND<0.1	ND<0.1		100	92.8	92.8	0.1
Chromium	7	6.6		100	108	101.2	0.5
Cobalt	0.2	0.2		100	96.4	96.2	0.1
Iron	104	114		10000	9310	92	10
Lead	0.2	0.2		100	70.8	70.6	0.1
Manganese	21.2	21.5	1.4	100	114	92.7	0.1
Mercury	ND<0.2	ND<0.2		10	ND<0.2	0***	0.2
Nickel	6	6		100	103	97	2
Selenium	12	13		1000	22	1***	4
Vanadium	12	ND<10		100	115	109	10

Date Analyzed: 2-25-94

*** - Outside control limits due to matrix effect

Abbreviations Summary

General Reporting Abbreviations:

B — Blank - Indicates that the compound was found in both the sample and the blank. The sample value is reported without blank subtraction. If the sample value is less than 10X the blank value times the sample dilution factor, the compound may be present as a laboratory contaminant.

D — Indicates that the sample was diluted, and consequently the surrogates were too dilute to accurately measure.

DL — Detection Limit - Is the minimum value which we believe can be detected in the sample with a high degree of confidence, taking into account dilution factors and interferences. The reported detection limits are equal to or greater than Method Detection Limits (MDL) to allow for day to day and instrument to instrument variations in sensitivity.

J — Indicates that the value is an estimate.

ND — Not Detected - Indicates that the compound was not found in the sample at or above the detection limit.

ppm, ppb — parts per million (billion) in liquids is usually equivalent to mg/l (ug/l), or in solids to mg/kg (ug/kg). In the gas phase it is equivalent to ul/l (ul/m^3).

TR — Trace - Indicates that the compound was observed at a value less than our normal reported Detection Limit (DL), but we feel its presence may be important to you. These values are subject to large errors and low degrees of confidence.

kg kilogram	mg milligram	l liter	m meter
g gram	ug microgram	ul microliter	

QC Abbreviations:

Control — Control Limits are determined from historical data for a QC parameter. The test value must be within this acceptable range for the test to be considered in control. Usually this range corresponds to the 99% confidence interval for the historical data.

% Error — Percent Error - This is a measure of accuracy based on the analysis of a Laboratory Control Standard (LCS). An LCS is a reference sample of known value such as an NIST Standard Reference Material (SRM). The % Error is expressed in percent as the difference between the known value and the experimental value, divided by the known value. The LCS may simply be a solution based standard which confirms calibration (ICV or CCV - initial or continuing calibration verification), or it may be a reference sample taken through preparation and analysis.

QC Abbreviations (continued):

MS(D)	Matrix Spike (Duplicate) - This refers to a quality control sample. It may be a real sample or blank sample spiked with representative target analytes.
% Rec	Percent Recovery - This is a measure of the accuracy of the analysis. It is expressed in percent as the difference between the result of an MS sample and the unspiked sample, divided by the amount spiked.
RPD	Relative Percent Difference - This is a measure of the precision of the analysis. It is the difference between duplicate results divided by the mean of the duplicates.
Warning	Warning limits are determined from historical data, usually representing a 95% confidence interval. This serves to alert the analyst to problems before reaching the control limits. Data "Out of Warning" is still considered in control.

Environmental Abbreviations:

BNA	Base-Neutral/Acid Fraction - Also called the Extractable Semivolatile fraction, represents the pollutants which can be extracted from a sample, but which boil higher than 120 C and still pass through a gas chromatography column.
CAM	California Assessment Manual - The original draft containing the CA hazardous waste rules, one of which was a list of 17 toxic metals. "CAM Metals" is used to refer to this list.
STLC	Soluble Threshold Limit Concentration - According to California's hazardous waste regulations, a waste is considered hazardous if the concentration in the leachate from the Waste Extraction Test (WET) exceeds this limit.
TCLP	Toxicity Characteristic Leaching Procedure - According to EPA regulations, a waste is considered hazardous if the leachate from the TCLP extraction exceeds certain limits.
TTLC	Total Threshold Limit Concentration - According to California's hazardous waste regulations, a waste exceeding this concentration is considered a hazardous waste.
VOA	Volatile Organics Analysis - Represents a group of volatile organic solvents with a boiling range from below room temperature to approximately 150 C.
WET	Waste Extraction Test - See STLC.

BHP

CHAIN OF CUSTODY

Environmental Technologies International, Inc.
Mauka Tower 737 Bishop Street, 22nd Floor
P.O. Box 3379 Honolulu, HI 96842
(808) 547-3600 Facsimile: (808) 547-3033

Project Name: Pond No. 1 Groundwater Monitoring
PROJECT NO: PI0200-001A
ET CLIENT:

SEND RESULTS TO
Name: Stephanie G. Sakurai
Company: Environmental Technologies Int'l
Address: 733 Bishop Street
City, State, Zip: Honolulu, HI 96813

SEND INVOICE TO
Name: Same
Company:
Address:
City, State, Zip:

Sample No.	~~Lab No.~~ Preservative	No. Containers	Date	Time	Sample Type/Description	Analysis Required	Sampled By
MW-4	HCL	2-VOA	2/22/94	1520	Groundwater	8240 (Skinner's List)	SGS/JS
MW-4	None	2-1LA/G	2/22/94	1520	"	8270 (Skinner's List)	SGS/JS
MW-4	HNO_3	1-1L poly	2/22/94	1520	"	Total Metals (Skinner's List)	SGS/JS
MW-4	None	1-1L/poly	2/22/94	1520	"	* Dissolved Metals (Skinner's List)	SGS/JS
						* Filter and preserve sample for dissolved metals immediately upon receipt.	
TB-WCAS	HCL	2-VOA	DNA	DNA	TRIPBLANK	8240 (Skinner's List)	

CUSTODY TRANSFERS #25867

	RELINQUISHED BY: (NAME, SIGNATURE)		DATE	TIME	RECEIVED BY: (NAME, SIGNATURE)		DATE	TIME	COMMENTS
1	Stephanie Sakurai	Stephanie Sakurai	2/22/94	1830	Jennifer Holmes	[illegible]	2/23	12:38	
2									
3									
4									

SHIPPING DETAILS

DELIVERED TO SHIPPER BY: Stephanie Sakurai DATE 2/22/94 TIME 1830
METHOD OF SHIPMENT: DHL AIRBILL #
RECEIVED FOR LAB: SIGNED DATE TIME
SAMPLE CONDITION UPON RECEIPT:

WHITE - CUSTODY SHEET YELLOW - LAB PINK - ET

WEST COAST ANALYTICAL SERVICE, INC.

ENVIRONMENTAL TECHNOLOGIES INTERNATIONAL, INC. Job # 25867
Ms. Stephanie Sakurai March 8, 1994

LABORATORY REPORT

Table 1

Total Dissolved Solids by EPA 160.1

Sample ID	Parts Per Million (mg/L)
MW-4	2350
Detection Limit	10

Date Analyzed: 3/3/94

Table 2

Total Phenols by EPA 9065

Sample ID	Parts Per Million (mg/L)
MW-4	0.07
Detection Limit	0.02

Date Analyzed: 3/2/94

WEST COAST ANALYTICAL SERVICE, INC.

ENVIRONMENTAL TECHNOLOGIES INTERNATIONAL, INC. Job # 25867
Ms. Stephanie Sakurai March 8, 1994

LABORATORY REPORT

Matrix Spike/Matrix Spike Duplicate Quality Control Summary

Sample: MW-4

Analyte	Sample Result	Amount Spiked	MS Result	% Rec MS	MSD Result	% Rec MSD	RPD
PHENOLS	0.07	0.8	0.73	83	0.78	89	7

QC Limits

Analyte	RPD Warning	RPD Control	% Recovery Control
PHENOLS	10	15	55 - 125

Analyte	Sample Result	Amount Spiked	MS Result	% Rec MS	MSD Result	% Rec MSD	RPD
TDS	2350	2000	4538	109	4302	98	5

QC Limits

Analyte	RPD Warning	RPD Control	% Recovery Control
TDS	9	13	89 - 111

WEST COAST ANALYTICAL SERVICE, INC.

ENVIRONMENTAL TECHNOLOGIES INTERNATIONAL, INC. Job # 25867
Ms. Stephanie Sakurai March 8, 1994

LABORATORY REPORT

Anions by EPA 300.0

Parts Per Million (mg/L)

Analyte	MW-4	Detection Limit
Chloride	520	2
Sulfate	320	2

Date Analyzed: 3-1-94

Matrix Spike/Matrix Spike Duplicate Recovery Summary

Sample:BATCH QC
Units :ppm (mg/L)

Analyte	Sample Result	Amount Spiked	MS Result	% Rec MS	MSD Result	% Rec MSD	RPD
Chloride	19	1000	1080	106	1060	104	2
Sulfate	0.69	1000	1010	101	1020	102	1

QC Limits

Analyte	RPD Control	% Recovery Warning		Control	
Chloride	10	66	114	54	126
Sulfate	10	69	116	57	128

WEST COAST ANALYTICAL SERVICE, INC.

ENVIRONMENTAL TECHNOLOGIES INTERNATIONAL, INC. Job # 25867
Ms. Stephanie Sakurai March 8, 1994

LABORATORY REPORT

Selected Metals
Quantitative Analysis Report
Inductively Coupled Plasma-Mass Spectrometry

Parts Per Billion (ug/L)

	MW-4	Blank Detect. Limit
Iron	104	10
Manganese	21.2	0.1
Sodium	954000	1000

WCAS

WEST COAST ANALYTICAL SERVICE, INC.

ENVIRONMENTAL TECHNOLOGIES INTERNATIONAL, INC. Job # 25867
Ms. Stephanie Sakurai March 8, 1994

LABORATORY REPORT

Sample: MW-4
Matrix: Water

Parts Per Billion (ug/L)

	Sample	Duplicate	RPD %	Spike Conc ppb	Spk Rslt	% Recovery	Blank Detect. Limit
Antimony	ND<0.5	ND<0.5		100	ND<0.5	0***	0.5
Arsenic	15	17		100	128	112	4
Barium	8	7		100	114	106.5	2
Beryllium	ND<0.2	ND<0.2		100	119	119	0.2
Cadmium	ND<0.1	ND<0.1		100	92.8	92.8	0.1
Chromium	7	6.6		100	108	101.2	0.5
Cobalt	0.2	0.2		100	96.4	96.2	0.1
Iron	104	114		10000	9310	92	10
Lead	0.2	0.2		100	70.8	70.6	0.1
Manganese	21.2	21.5	1.4	100	114	92.7	0.1
Mercury	ND<0.2	ND<0.2		10	ND<0.2	0***	0.2
Nickel	6	6		100	103	97	2
Selenium	12	13		1000	22	1***	4
Vanadium	12	ND<10		100	115	109	10

Date Analyzed: 2-25-94

*** - Outside control limits due to matrix effect

WCAS

Abbreviations Summary

General Reporting Abbreviations:

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BHP

CHAIN OF CUSTODY

Environmental Technologies International, Inc.
Mauka Tower 737 Bishop Street, 22nd Floor
P.O. Box 3379 Honolulu, HI 96842
(808) 547-3600 Facsimile: (808) 547-3033

Project Name: Pond No. 1 Groundwater Monitoring
PROJECT NO: PI0200-001B
ET CLIENT:

SEND RESULTS TO		SEND INVOICE TO	
Name	Stephanie G. Sakurai	Name	Same
Company	Environmental Technologies Int'l	Company	
Address	733 Bishop Street	Address	
City, State, Zip	Honolulu, HI 96813	City, State, Zip	

Sample No.	~~Lab No.~~ preservative	No. Containers	Date	Time	Sample Type/Description	Analysis Required	Sampled By
MW-4	HNO_3	1-1L poly	2/22/94	1520	Groundwater	Fe, Mn, Na	SGS/JS
MW-4	None	1-1L poly	2/22/94	1520	Groundwater	TDS, Cl^-, SO_4	SGS/JS
MW-4	H_2SO_4	1-8oz A/G	2/22/94	1520	Groundwater	Phenols (9066)	SGS/JS

CUSTODY TRANSFERS #25867

	RELINQUISHED BY: (NAME, SIGNATURE)		DATE	TIME	RECEIVED BY: (NAME, SIGNATURE)		DATE	TIME	COMMENTS
1	Stephanie Sakurai	Stephanie Sakurai	2/22/94	1830	Jennifer Holmes	[illegible]	2/23	12:38	
2									
3									
4									

SHIPPING DETAILS

DELIVERED TO SHIPPER BY: Stephanie Sakurai DATE 2/22/94 TIME 1830
METHOD OF SHIPMENT: DHL AIRBILL #
RECEIVED FOR LAB: SIGNED DATE TIME
SAMPLE CONDITION UPON RECEIPT:

WHITE - CUSTODY SHEET YELLOW - LAB PINK - ET

QC Abbreviations (continued):

MS(D)	Matrix Spike (Duplicate) - This refers to a quality control sample. It may be a real sample or blank sample spiked with representative target analytes.
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TCLP	Toxicity Characteristic Leaching Procedure - According to EPA regulations, a waste is considered hazardous if the leachate from the TCLP extraction exceeds certain limits.
TTLC	Total Threshold Limit Concentration - According to California's hazardous waste regulations, a waste exceeding this concentration is considered a hazardous waste.
VOA	Volatile Organics Analysis - Represents a group of volatile organic solvents with a boiling range from below room temperature to approximately 150 C.
WET	Waste Extraction Test - See STLC.

BHP

CHAIN OF CUSTODY

Environmental Technologies International, Inc.
Mauka Tower 737 Bishop Street, 22nd Floor
P.O. Box 3379 Honolulu, HI 96842
(808) 547-3600 Facsimile: (808) 547-3033

Project Name: Pond No. 1 Groundwater Monitoring
PROJECT NO: PI0200-001B
ET CLIENT:

SEND RESULTS TO		SEND INVOICE TO	
	Name: Stephanie G. Sakurai		Name: Same
	Company: Environmental Technologies Int'l		Company:
	Address: 733 Bishop Street		Address:
	City, State, Zip: Honolulu, HI 96813		City, State, Zip:

Sample No.	~~Lab No.~~ preservative	No. Containers	Date	Time	Sample Type/Description	Analysis Required	Sampled By
MW-4	HNO_3	1-1L poly	2/22/94	1520	Groundwater	Fe, Mn, Na	SGS/JS
MW-4	None	1-1L poly	2/22/94	1520	Groundwater	TDS, Cl^-, SO_4	SGS/JS
MW-4	H_2SO_4	1-8 oz A/G	2/22/94	1520	Groundwater	Phenols (9066)	SGS/JS

CUSTODY TRANSFERS #25867

	RELINQUISHED BY: (NAME, SIGNATURE)		DATE	TIME	RECEIVED BY: (NAME, SIGNATURE)		DATE	TIME	COMMENTS
1	Stephanie Sakurai	Stephanie Sakurai	2/22/94	1830	Jennifer Holmes	Jennifer Holmes	2/23	12:38	
2									
3									
4									

SHIPPING DETAILS

DELIVERED TO SHIPPER BY: Stephanie Sakurai DATE 2/22/94 TIME 1830
METHOD OF SHIPMENT: DHL AIRBILL #
RECEIVED FOR LAB: SIGNED DATE TIME
SAMPLE CONDITION UPON RECEIPT:

WHITE - CUSTODY SHEET YELLOW - LAB PINK - ET

4. GROUNDWATER ELEVATION DATA

BHP PETROLEUM AMERICAS REFINING INC.
GROUNDWATER ELEVATION DATA

Well I.D. No.	Date [a]	Time [a]	Top of Stainless Steel Casing Elevation (ft,MSL) [b]	Top of Concrete Apron Elevation (ft,MSL) [c]	Ground Surface Elevation (ft,MSL) [c]	Depth to Oil (ft)	Depth to Water (ft)	Oil Thickness (ft)	Corrected Depth to Water (ft) [d]	Corrected Water Table Elevation (ft,MSL) [e]
MW-3	2/22/94	1:40pm	12.81	11.76	11.11	11.86	12.16	0.30	11.90	0.91
MW-4	2/22/94	2:50pm	13.29	12.15	11.75	12.26	12.67	0.41	12.31	0.98
MW-5	2/22/94	11:11am	13.58	11.85	11.05	12.69	12.89	0.20	12.71	0.87
MW-6	2/22/94	9:26am	13.12	11.58	11.28	12.09	12.15	0.06	12.10	1.02

(a) Date and time of oil and water level measurements

(b) Survey conducted 8/87

(c) Survey conducted 9/17/91

(d) Corrected depth to water = depth to water-(oil thickness x specific gravity)

Note: Specific gravities of oils were measured by the laboratory to be 0.87 for MW-3; 0.88 for MW-4; 0.88 for MW-5; and 0.87 for MW-6.

(e) Corrected water table elevation = top of casing elevation - corrected depth to water

RECORDS SEPARATOR PAGE

RECORDS SEPARATOR PAGE

RECORDS SEPARATOR PAGE

RECORDS SEPARATOR PAGE

RECORDS SEPARATOR PAGE

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RECORDS SEPARATOR PAGE

RECORDS SEPARATOR PAGE

4A

BHP Petroleum Americas Refining Inc.
91-325 Komohana Street
Kapolei, Hawaii 96707
Telephone **(808) 547-3900**
Fax (808) 547-3068

April 22, 1994

BHP Petroleum Americas

CERTIFIED MAIL P-101-726-840
RETURN RECEIPT REQUESTED

Mr. Mitch Kaplan
Arizona, Nevada, and Guam Section (H-3-2)
Hazardous Waste Management Division
U.S. ENVIRONMENTAL PROTECTION AGENCY
75 Hawthorne Street
San Francisco, California 94105

Dear Mr. Kaplan:

Revisions to Groundwater Monitoring Plan,
October 19, 1993
HID 056-786-395

This letter is in reply to EPA comments received by BHP Petroleum Americas Refining Inc. (BHPPAR) on March 25, 1994 regarding the Groundwater Monitoring Plan (GMP), which was submitted to EPA on October 19, 1993. In the March 25, 1994 letter, EPA requested that BHPPAR address the status of groundwater monitoring of the "C" water bearing zone of the Uppermost Aquifer which is beneath the Refinery. In addition, EPA requested that BHPPAR address ten (10) comments regarding the Sampling and Analysis Plan (SAP) and the Quality Assurance/Quality Control (QA/QC) portion of the GMP prior to EPA's final approval of the GMP. Each EPA comment and a brief response to each comment in the March 25, 1994 letter is presented below.

<u>Status of Groundwater Monitoring of the Uppermost Aquifer</u>

<u>EPA Comment in Cover Letter.</u> **One issue of concern to EPA remains the status of groundwater monitoring of the "C" water bearing zone of the uppermost aquifer. EPA's letters of December 28, 1993 (item no. 10) and January 20, 1994 (second paragraph) summarize our position on this issue. In your letter of February 18, 1994 you state that existing wells CW-1 through CW-4 will monitor the "C" zone. EPA's position remains that an expanded program of monitoring the "C" zone for contaminates, especially for LNAPLs (which have been documented as being present in the overlying "A" and "B" water bearing zones) is necessary to insure that such contamination would be immediately detected. The existing well system does not provide this coverage. This is of major concern due to the nature of the aquifer materials and the degree of hydraulic connection between the "A", "B"**

and "C" water bearing zones. The new cluster well locations also better establish upgradient and downgradient monitoring locations and provide "C" zone data not previously available from these locations.

Response. As discussed in our conference call with EPA on Monday April 18, 1994, the Uppermost Aquifer occurs from a depth of approximately 11 feet below the ground surface (BGS) to approximately 60 feet BGS. The Uppermost Aquifer is composed of one water-bearing coralline limestone unit with no separate or distinct water-bearing zones within it.

The terms "A zone", "B zone" and "C zone" have previously been used by BHPPAR to describe the intervals at which each groundwater monitoring well of the existing cluster wells (CW-1 through CW-4) are screened. However, these terms may have suggested that there are three (3) separate and distinct water-bearing zones within the Uppermost Aquifer. These zones were arbitrarily created in the Hydrogeologic Workplan, dated September 24, 1991 to assist in evaluating vertical hydraulic gradients and the vertical distribution of volatile and semi-volatile organic compound concentrations in the Uppermost Aquifer during the Hydrogeologic Characterization project.

Based on the April 18, 1994 conference call, it is BHPPAR's understanding that EPA is concerned about monitoring the lower vertical extent of the suspected dissolved phase benzene plume of the Uppermost Aquifer due to previously detected benzene concentrations in wells screened from 33 to 43 BGS. It should be noted that from all of the previous groundwater monitoring, conducted in June 1992 and July 1992 at cluster wells CW-1 through CW-4, indicated only one concentration of benzene in wells screened from 33 to 43 BGS above 5 μg/L.

On April 15, 1994 groundwater samples were collected from wells screened from 33 to 43 BGS of cluster wells CW-1 through CW-4 and the samples were submitted to Analytical Technologies, Inc. (ATI) for analysis of benzene using EPA Method 8240. The analytical results indicated that benzene concentrations detected within the four (4) wells ranged from <1 μg/l to 2 μg/l. These benzene concentrations are below the established maximum contaminant level (MCL) for benzene (5 μg/l) in drinking water. Please see Attachment A for ATI's laboratory report on the April 15, 1994 cluster well samples. Based on the current benzene concentrations present in wells screened from 33 to 43 BGS, it appears that the dissolved phase benzene plume does not extend below a maximum depth of approximately 33 feet BGS. Therefore, BHPPAR proposes that the GMP cluster wells will be comprised of two (2) separate groundwater monitoring wells. One well will be screened from 15 to 25 feet BGS and another will be screened from 33 to 43 feet BGS. These proposed groundwater monitoring wells should provide adequate data to monitor any downward migration, if such migration occurs, of the dissolved phase benzene plume or any additional Skinner List dissolved hydrocarbon plume in the Uppermost Aquifer.

Sampling and Analysis Plan (SAP) and Quality Assurance/Quality Control (QA/QC)

Please note that the following comments and responses pertain to documents and procedures that are compiled and conducted by independent environmental laboratories: West Coast Analytical Services (WCAS) and ATI. These two laboratories have significant experience with Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Recovery Compensation Liability Act (CERCLA) Projects.

EPA Comment 1. **[Section 3.4.5, Scope of Work, Decontamination Procedures]. It is recommended that the equipment decontamination procedure described in Section 3.4.5 be expanded to include a solvent rinse (e.g., hexane), when cross contamination from organic parameters is of concern, and an acid rinse (e.g., nitric acid) when cross contamination from inorganic parameters is of concern, for any non-dedicated sampling equipment.**

Response. This comment has previously been raised by the EPA and subsequently addressed and resolved through correspondence between EPA and BHPPAR. A brief description of this correspondence is summarized below.

On August 30, 1993, BHPPAR submitted a Sampling and Analysis Plan (SAP) to the EPA for the sampling of soil around and beneath Pond Nos. 2A and 2. In a letter dated September 16, 1993 regarding the SAP, EPA commented that nitric acid and hexane decontamination procedures be used. In a response letter dated October 15, 1993 to the EPA, BHPPAR requested that the nitric acid and hexane rinses be eliminated due to past decontamination experience at the Refinery, the absence of technical rationale to support the rinsing procedure, and the increased health and safety concerns related to handling nitric acid. In a letter dated November 3, 1993, EPA agreed that the hexane and nitric acid rinses were not necessary and approved the SAP. EPA's September 16, 1993 letter, BHPPAR's response letter to the EPA and the EPA's SAP approval letter are included as Attachment B.

EPA Comment 2. **[Section 3.4.6, Field Quality Assurance/Quality Control for Samples; Appendix F-1, Analytical Technologies, Inc.-laboratory Quality Assurance Manual; Appendix F-2, West Coast Analytical Services-Quality Assurance Manual]**

a. **Section 3.4.6 states that duplicate groundwater samples will be collected and analyzed by two separate laboratories, Analytical Technologies, Inc. (ATI) and West Coast Analytical Services (WCAS), for the parameters described in Section 3.7 (Laboratory Analysis of Groundwater and Free-Product Samples) as a check on field and laboratory procedures. To ensure that comparable data are generated, it is critical for these two laboratories to follow comparable analytical procedures and achieve similar analyte detection**

limits. The following dissimilarities between the laboratory procedures included in the laboratory quality assurance manuals (QAMs) were noted:

1. **The QAM for WCAS indicates that anions, including chloride, fluoride, nitrate, nitrite, and sulfate will be analyzed by ion chromatography; the method source is not referenced. The QAM for ATI lists methods corresponding to those specified in Table 5 (General Chemistry Analysis) of the GMP for the analysis of anions, including EPA method 340.2 (fluoride), a potentiometric method; EPA method 353.2 (nitrate and nitrite), a colorimetric method; and SW-846 method 9038 (sulfate), turbidimetric method. Additionally, the QAM for ATI lists EPA method 325.3 for the analysis of chloride, which is equivalent to the chloride method listed in Table 5 of the GMP, SW-846 method 9252; both are titrimetric methods.**

   Although the equivalent analyte detection limits can be achieved by following the analytical methods specified by ATI and WCAS, the instrumentation and, therefore, the analytical procedures differ. If the generation of comparable data by these two laboratories is critical for the purposed investigation, it is recommended that analytical methods involving the use of equivalent instrumentation be required.

Response. Groundwater samples submitted to WCAS for the analysis of anions (chloride, fluoride, nitrate, nitrite and sulfate) will be analyzed by EPA Method 300.0 utilizing ion chromatography.

Following discussions with ATI, the laboratory has changed the procedure for the analysis of chloride to EPA Method 9253. This change has been made in Table 5 of the GMP. Please see Attachment C for a revised Table 5.

The analytical data from the two (2) laboratories will be comparable to other methods through the use of required quality control (QC) checks. These checks include a comparison of the analytical data to several known standards and the use of matrix spike/matrix spike duplicates to determine accuracy. The use of different analytical methods following standard QC protocols should not cause disparate data. In any event, the general chemistry analysis data is only intended to provide general information regarding the geochemistry of the groundwater.

2. **The QAM for WCAS indicates that metals will be analyzed by inductively coupled argon plasma emission spectroscopy-mass spectrometry (ICP-MS); the method source is not referenced. The QAM for ATI lists methods corresponding to those specified in Table**

4 (Sample Summary Table, Quarterly Groundwater Samples) of the GMP for the analysis of metals, including SW-846 methods 7060 (arsenic), 7131 (cadmium), 7421 (lead), 7740 (selenium), which involve the use of graphite SW-846 method 7470 (mercury), which involves the use of cold vapor atomic absorption (CVAA) spectroscopy; and SW-846 method 6010 (for the remaining metals listed in Table 4), which involves the use of inductively coupled argon plasma emission spectroscopy (ICP).

The instrumentation, analytical procedures, and analyte detection limits differ for metals analysis by ICP-MS and the SW-846 methods cited. ICP-MS instrumentation is considerably more sensitive than GFAA, CVAA, or ICP instrumentation, and will facilitate achieving lower analyte detection limits. However, the cost of these analyses will be significantly greater.

Based on the information presented in Table 4, the analyte detection limits that can be achieved following SW-846 method 6010 and SW-846 7000 series methods appear to be sufficient for the proposed groundwater monitoring effort. It is recommended that these procedures be followed for both the primary and verification metals analyses.

Response. WCAS will utilize ICP-MS for metals analysis of the primary samples and will use EPA Method 200.8 for the analysis of duplicate samples. ICP-MS has been proven to be less prone to matrix interferences than GFAA or ICP. BHPPAR emphasizes that utilizing the required QC checks on different pieces of instrumentation will not produce erroneous data and that the data can be used for comparison purposes. Therefore, the data generated by ICP-MS should provide assistance in determining the effects of matrix interferences that may be experienced by the SW-846 6000 and 7000 series methods.

b. **Although the GMP includes provisions for the analysis of duplicate groundwater samples as a check on field and laboratory procedures, the evaluation of data generated from these analyses is not addressed. It is recommended that the discussion of duplicate analyses be expanded to include procedures for comparing duplicate data, acceptance criteria for duplicate result correlation, and corrective action measures that will be taken if duplicate analyses consistently fail to meet acceptance criteria.**

Response. Data collected from the analyses of duplicate samples will be handled statistically in the same manner as the data from the original samples. The analytical results from the duplicate samples will be validated by the same criteria (completeness, reporting of ND values, etc...) described in section 3.13 of the GMP and subjected to the same statistical methodology (confidence intervals and control charts) and graphic methodology (spatial distribution maps/histograms, isopleth maps, groundwater contour maps, trilinear diagrams and tabular summaries) as described in the GMP. If the analytical results for the duplicate samples do not meet the acceptance criteria for complete and accurate values, then BHPPAR will investigate possible reasons for deviation of the data from the acceptance criteria. The results of this investigation will be reported to the EPA and the causes mitigated.

A quantitative analysis will also be performed using the duplicate data. A calculation for relative percent difference (RPD) will be performed on the original and duplicate data obtained from the analytical laboratory if either of the original or duplicate data is above MCLs. The equation used to calculate the RPD is as follows:

$$RPD = \frac{| C_d - C_a |}{(1/2) \times | C_d + C_a |} \times 100$$

where C_d = Concentration reported in the duplicate sample
C_a = Concentration reported in the original sample

The results of the quantitative analysis will be tabulated and will be subjected to the following criteria:

RPD ≥0%-<25%	Duplicate data is valid
RPD ≥25%-<75%	Qualitatively the data is accurate Quantitatively the data is inaccurate
RPD ≥75%-≤100%	The data is neither qualitatively or quantitatively accurate

If the RPD is in the range of ≥25%-<75%, BHPPAR will notify the duplicate laboratory and the data from the analytical procedure will be re-evaluated. If the reason for the inaccurate quantitation is found to be laboratory error during analysis, the sample will be reanalyzed. If the error for the inaccurate quantitation is found to be committed during data evaluation by the laboratory, the mistake will be corrected and the new value will be input into the database.

If the RPD is in the range of ≥75%-≤100%, the duplicate data will be considered invalid. If the error for the inaccurate quantitation is found to be committed during data evaluation by the laboratory, the mistake will be corrected and the new value will be input into the database. If the reason for the inaccurate quantitation is found to be laboratory error during analysis, the sample will be reanalyzed by the duplicate laboratory. If the results again yield invalid results the duplicate data will not be used in any evaluation procedures.

EPA Comment 3. [Section 3.7, Laboratory Analysis of Groundwater and Free-Product Samples] It is recommended that the quality assurance/quality control (QA/QC) objectives for the gas chromatographic (GC) characterization analyses to be performed on free-product samples be provided in the plan. Section 3.7 states that these analyses will be performed by the analytical laboratory, Friedman & Bruya, however, a QAM for this laboratory was not included in the GMP with the QAMs in Appendix F for other laboratories that will be involved in the project. At a minimum, a laboratory standard operating procedures (SOP) for ASTM D2887 should be provided, that specifies required instrument calibration procedures, quality control (QC) sample analysis requirements, corrective action procedures, and laboratory documentation and reporting requirements.

Response. As described by Mr. James E. Bruya of Friedman & Bruya, the QA/QC objectives for the gas chromatographic (GC) characterization analyses (ASTM D-2887) to be performed on the free-product samples are as follows:

- Ensure that an adequate injection amount has been introduced into the GC by monitoring an internal standard;
- Ensure that high boiling compounds load onto the GC by comparing them with previous standards; and
- Ensure that retention times of the sample(s) match those of the standards by "running" a suitable standard.

The laboratory operating procedures for the GC analyses are the same as those procedures outlined in the standard test method for Boiling Range Distribution of Petroleum Fractions By Gas Chromatography (ASTM Designation: D 2887). Please see Attachment D for a copy of ASTM D 2887 procedures.

EPA Comment 4. [Section 3.8.3.1, Proposed Biodegradation Sampling and Analysis]

a. **It is recommended that the analytical methods that will be followed for the analysis of the water quality parameters ammonia and phosphorous be indicated in the GMP.**

Response. As indicated in Table 8 of the GMP, the analytical method for ammonia (NH_3) will be EPA Method 350.1 and the analytical method for reactive phosphorus (o-PO_4) will be EPA Method 365.2.

b. It is recommended that the "various other indicators of geochemistry" that will be analyzed as part of the second phase of biodegradation data collection be clarified.

Response. The term "various other indicators of geochemistry" refers to the remaining parameters on Table 8 that were not listed in the second bullet item of section 3.8.3.1 of the GMP. The unlisted parameters are total organic carbon (TOC), chemical oxygen demand (COD), biochemical oxygen demand (BOD), carbonates, alkalinity, hardness, total and soluble iron and total and soluble manganese. The paragraph has been edited to read as follows:

"• A second phase of data collection will require well sampling techniques similar to organic compound sampling for analytical chemistry characterization. The second phase of biodegradation data collection will analyze for water quality parameters such as the nitrogen species (e.g., ammonia (NH_3), nitrite (NO_2), nitrate (NO_3), sulfate (SO_4), phosphorus (o-PO_4)). See Table 8 for additional water quality parameters that will be analyzed during the second phase of biodegradation data collection."

EPA Comment 5. [Table 3, Sample Collection Table, Quarterly Groundwater Samples]

a. It is recommended that the groundwater preservation requirements listed in Table 3 for volatile organic compounds (VOCs) be revised to require the addition of sufficient hydrochloric acid to ensure that a pH less than 2 is achieved. This is considered to be preferable to simply adding 4 drops of concentrated hydrochloric acid to each sample vial. Although 4 drops of acid will generally be sufficient to lower the pH of groundwater samples, the actual quantity of acid required will depend on the size of the drops, the buffering capacity of the aquifer, and so forth. The pH of a representative test vial containing a sample from each aquifer should be checked prior to sample collection to determine the quantity of acid needed to achieve a pH less than 2.

Response. Prior to the collection of the GMP's first quarter groundwater samples, BHPPAR field personnel will measure the pH of the groundwater from each GMP cluster well screened from 15 to 25 feet BGS. The pH values obtained will be logged in a field log as described in the GMP. Concentrated hydrochloric acid (HCL) will be added to a series of 40 milliliter (ml) vials in multiples of 5-ml. For example, the first vial will contain 5-ml

of concentrated HCL, the second vial will contain 10-ml of HCL and the third vial will contain 15-ml of concentrated HCL, and so on. Groundwater will then be added to each of the vials and after sufficient time has passed to allow for thorough mixing, the pH of each of the vials will be measured in the field. The first vial in the series that has reached the desired pH (less than 2) will be noted in the field log book along with the required volume of concentrated HCL.

Following completion of this pH study, the laboratory(s) will be required to prepare preserved VOA vials with the appropriate volume of concentrated HCL (or equivalent quantity at a different concentration) in accordance with the results of the pH study. Each 40-ml vial used in the application of the GMP will be prepared with the same quantity of concentrated HCL.

b. **It is recommended that the sample preservation requirements for general chemistry analyses be clarified in Table 3. Although three preservation methods are listed, the associated analytical parameters are not specified.**

Response. Table 3 has been modified to include the preservative requirements for general chemistry analyses and is cross referenced to Table 5 for the preservation techniques of specific analytical parameters. Please see Attachment C and E for the revised Table 5 and 3, respectively.

EPA Comment 6. **[Table 4, Sample Summary Table, Quarterly Groundwater Samples; Appendix F-1, Analytical Technologies, Inc. - Laboratory Quality Assurance Manual; Appendix F-2, West Coast Analytical Services-Quality Assurance Manual]**

a. **The QAM for WCAS does not include target compound lists for SW-846 methods 8240 and 8270. As a result, it was not possible to verify that all of the volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) listed in Table 4 were included on the laboratory's target compound lists for these methods.**

Response. The target compound lists for Skinner List compounds for SW-846 methods 8260 (equivalent to EPA Method 8240) and 8270 have been supplied by WCAS to BHPPAR. All of the compounds listed in Table 4 are present in these lists. Please see Attachment F for WCAS's target compound list.

b. **Several of the target VOCs, including cyclohexane, 1,4-dioxane, and ethylene dibromide, and target SVOCs, including 7,12-dimethylbenz (a) anthracene, indene, quinoline, and benzenethiol cresols, that are listed in Table 4 of the GMP are not on the target compound lists for SW-846 methods 8240 and 8270 (Table 6) in the QAM for ATI. This discrepancy should be clarified.**

It is recommended that both laboratories be required to perform a method detection limit (MDL) study for the benzenethiol cresols. The applicability of SW-846 method 8270 for the analysis of these compounds is not well established and recovering them may be difficult. Requiring laboratories to perform a MDL study for the other nonstandard method 8240 and 8270 analytes would also be a good idea, although these analytes are chemically similar to other method analytes and analysis of them should be straightforward.

Response. ATI is not limited only to the target compound list for EPA Method 8240 provided in their QAM and all of the Skinner List compounds do not appear in the target compound lists for EPA Methods 8240 and 8270. BHPPAR has, in the past, submitted groundwater samples to ATI requesting analysis of target compounds identical to those listed in Table 4 of the GMP. The groundwater analytical results received from ATI and WCAS indicated that the detection limits reported by the laboratories are sufficient for purposes of the GMP. Therefore, BHPPAR does not believe that it is necessary for the laboratories to perform MDL studies for benzenethiol cresols.

EPA Comment 7. [Table 8, Biodegradation-Laboratory Groundwater Parameters; Appendix E, Summary of Analytical Laboratory Procedures]

a. **It is recommended that the required analyte detection limits for the methods listed in Table 8 be provided in the GMP. These detection limits should reflect needs of the biological environment characterization.**

Response. The analyte detection limits for the analytical methods listed in Table 8 have been included in a revised Table 8 presented as Attachment G. BHPPAR would like to emphasize that the analysis of groundwater for the parameters listed in Table 8 are for the purposes of groundwater modelling. Currently, BHPPAR has not established criteria for the determination of the particular detection limits for the parameter listed in Table 8. If further studies were performed, then the analyte detection limits would be provided in accordance with the studies desired results.

b. **The method reference for biochemical oxygen demand (BOD) in Table 8 appears to be incorrect. The listed method, EPA 320.1, is for the analysis of bromide. EPA method 405.1 is the correct reference in "Methods for Chemical Analysis of Water and Wastes" for BOD analysis.**

Response. This typographical error has been noted and the correct method for BOD has been included in Table 8. Please see Attachment G.

EPA Comment 8. [Table 9, Soil Characteristic Analytical Methods; Appendix F-1, Analytical Technologies, Inc.-Laboratory Quality Assurance Manual]

a. The methods for total organic carbon analysis listed in Table 9 of the GMP and in the QAM for ATI (SW-846 method 9060 and EPA method 415.1 and 415.2, respectively) are intended for the analysis of aqueous samples. If TOC analyses will be performed as part of the soil characterization, modifications will be necessary to adapt these methods to soil analysis. These method modifications should be addressed in the GMP.

Response. For the purposes of determining the total organic carbon (TOC) for solid materials and soils, ATI performs the Walkley Black method. A comparison of the Walkley Black method to the EPA 9060 method is included in Attachment H. Also included in Attachment H is a copy of the Walkley Black method as described in the document: "Methods of Soil Analysis".

b. The method listed in Table 9 for determining soil partitioning coefficients should be clarified. The listed "TCLP method" appears to be incorrect. Additionally, a laboratory procedure for this method should be included in the GMP.

Response. The description in Table 9 for the determination of the partitioning coefficient is incorrect. The correct analytical method is EPA Method 8240. The technique by which the sample will be prepared for analysis is similar to the Toxicity Characteristic Leachate Potential (TCLP) procedure. Please see Attachment I for a revised Table 9. A brief description of the soil partitioning coefficient procedure is presented below.

BHPPAR expects that the degree of partitioning would be dependent upon the ionic strength of the water, the concentration of hydrocarbons in the soil and possibly the concentration of aromatic compounds in the soil. Since benzene is likely to be present at low concentrations, Henry's Law should be a satisfactory model for the partitioning of benzene.

The most desirable way to run the partitioning coefficient experiment is to obtain a soil sample that is affected with an appreciable amount of benzene. The concentration of benzene in the samples would then be measured. The soil would then be subjected to an extraction similar to the zero-headspace TCLP extraction using groundwater from the Refinery. The concentration of benzene in the extract would then be measured to establish the partitioning ratio. Tumbling for varying lengths of time would be needed to establish

that equilibrium had been reached. Alternatively, the samples of soil and groundwater could be left together for a period of time with mild shaking occurring and then removing aliquots for analysis.

<u>EPA Comment 9.</u> **[Appendix E, Summary of Analytical Laboratory Procedures]**

a. **It is recommended that the 5 μg/L quantitation limit for the target volatile organic compound, 1,4-dioxane, be reevaluated. In comparison to the other target VOCs listed in Table 4 (Sample Summary Table, Quarterly Groundwater Samples), the purging efficiency of 1,4-dioxane in water samples is poor (i.e., the analyte preferentially remains in the aqueous phase rather than moving into the vapor phase). A quantitation limit of 25 μg/L is considered to be more reasonable for 1,4-dioxane following regular SW-846 method 8240 protocols for sample analysis.**

   Alternatively, a quantitation limit of 5 μg/L is reasonable for 1,4-dioxane provided that a larger sample volume is used for analysis. The standard SW-846 method 8240 procedures requires a 5 mL sample. If this procedure is modified to include a 25 mL sample volume, a 5 μg/L quantitation limit for 1,4-dioxane can be achieved.

<u>Response.</u> The detection limit for 1,4-dioxane has been re-evaluated and BHPPAR agrees that a higher limit is reasonable. Analytical results of groundwater samples previously submitted by BHPPAR to ATI and WCAS indicate that a detection limit of 200 μg/L is more realistic. Appendix E from the GMP has been revised to indicate this limit of detection for 1,4-dioxane. Please see Attachment J for revised Appendix E.

b. **It is recommended that the 5 μg/L quantitation limit for the target semivolatile organic compounds, 2,4-dinitrophenol and 4-nitrophenol, be reevaluated. A quantitation limit of 25 μg/L is considered to be more reasonable for these following SW-846 method 8270 protocols for sample analysis.**

<u>Response.</u> The detection limits for 2,4-dinitrophenol and 4-nitrophenol have been re-evaluated and BHPPAR agrees that a higher limit is reasonable. Analytical results of groundwater samples submitted to ATI and WCAS indicate that a detection limit of 50 μg/L is more realistic. Appendix E from the GMP has been revised to indicate these new limits of detection for 2,4-dinitrophenol and 4-nitrophenol. Please see Attachment J for the revised Appendix E.

c. **The estimated detection limits for metals listed in Appendix E are the minimum detection limits specified in The SW-846 methods (6010 and 7000 series). It is recommended that project specific detection limits be established that reflect the regulatory and investigatory needs of the groundwater monitoring effort. Although defaulting to the method established limits is acceptable, it should be noted that these published detection limits are determined experimentally under optimal analytical conditions. Actual method detection limits (MDLs) will vary from one MDL determination to the next and the detection limits for environmental samples will probably exceed those published in the SW-846 methods. It is recommended that analyte detection limits for the project be adjusted to be sufficiently below regulatory levels (a factor of 2 to 10 below) but above the minimum level of detection to allow for variations in MDL determinations.**

Response. The estimated detection limits proposed in Appendix E were re-evaluated to reflect the results of previous chemical analyses of groundwater samples collected from the Refinery. The new limits, although higher than those listed in SW-846, are still sufficient for the proposed groundwater monitoring effort. Please see Attachment J for the revised Appendix E.

d. **It is recommended that individual detection limits for each target metal that will be analyzed by following SW-846 method 6010 procedures be specified in Appendix E. This is preferable to specifying a range of detection limits for target metals.**

Response. Based on analytical results for groundwater samples previously submitted by BHPPAR to ATI, detection limits for each target metal have been specified in the revised Appendix E of the GMP. Please see Attachment J for the revised Appendix E.

e. **Table 5 (General Chemistry Analysis) indicates that groundwater samples will be analyzed for alkalinity following EPA method 310.1 procedures. However, Appendix E indicates that quantitation of carbonate and bicarbonate, in addition to alkalinity, is required. It is recommended that if determination of carbonate, bicarbonate, and alkalinity is necessary for the proposed groundwater monitoring effort, Standard Method 2320 procedures be followed for analysis rather than EPA method 310.1 procedures. Standard Method 2320 allows for quantitation of all three parameters; EPA method 310.1 allows for quantitation of alkalinity only.**

Response. Samples submitted to ATI for the analysis of carbonate, bicarbonate and alkalinity will be analyzed according to EPA Method 2320.

f. Detection limits for carbonate, bicarbonate, alkalinity, chloride, fluoride, nitrate-nitrite as nitrogen, sulfate, surfactants, and total dissolved solids (TDS) should be added to Appendix E.

Response. The detection limits for carbonate, bicarbonate, alkalinity, chloride, fluoride, nitrate-nitrite as nitrogen, sulfate, surfactants, and total dissolved solids (TDS) have been included in the revised Table 5. Please see Attachment C.

g. The reference to Table 6 under general minerals in Appendix E should be revised to Table 5.

The reference to Table 6 in Appendix E has been corrected and now reads Table 5. See Attachment J for the revised Appendix E.

EPA Comment 10. [Appendix F-1, Analytical Technologies, Inc.-Laboratory Quality Assurance Manual; Appendix F-2, West Coast Analytical Services-Quality Assurance Manual]

a. Method reporting limits were not provided in the quality assurance manual (QAMs) for either laboratory. As a result, it was not possible to verify whether the laboratories are capable of achieving the detection limits specified in the GMP.

Response. The method reporting limits for EPA Methods 8240, 8260 and 8270 have been furnished by ATI and WCAS to BHPPAR. The limits are included as Attachment F of this letter. These reporting limits are only estimates by the laboratory and are not necessarily those that will be achieved in BHPPAR's groundwater samples. Laboratory reports for groundwater samples submitted by BHPPAR to ATI and WCAS have yielded higher detection limits in the past.

b. It is recommended that the QAM for WCAS be amended to include instrument calibration procedures and acceptance criteria for all analytical methods which will be performed by this laboratory as part of the project.

Response. Instrument calibration procedures practiced by WCAS are included as Attachment K.

We appreciate your comments on our GMP and look forward to working with you on future hydrogeologic issues. Please contact Mr. Ken Vandergrift at (808) 547-3947 with any questions you or your staff may have with respect to the foregoing responses and to the revisions incorporated in the GMP.

Sincerely,

Frank D. Clouse

Frank D. Clouse
Refinery Manager

Attachments

cc: Mr. Rich Vaille, EPA w/ attachments
Ms. Paula Bisson, EPA w/ attachments
Ms. Nicole Moutoux, EPA w/ attachments
Ms. Steve Chang, HDOH w/ attachments

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AnalyticalTechnologies, Inc. Corporate Offices: 5550 Morehouse Drive San Diego, CA 92121 (619) 458-9141

ATI I.D.: 404202

April 19, 1994

ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
P.O. BOX 3379
HONOLULU, HI 96842

Project Name: CLUSTER
Project # : 207

Attention: TOM WALLIS

Analytical Technologies, Inc. has received the following sample(s):

Date Received	Quantity	Matrix
April 16, 1994	6	WATER

The sample(s) were analyzed with EPA methodology or equivalent methods as specified in the enclosed analytical schedule. The symbol for "less than" indicates a value below the reportable detection limit. If any flags appear next to the analytical data in this report, please see the attached list of flag definitions.

The results of these analyses and the quality control data are enclosed. Please note that the Sample Condition Upon Receipt Checklist is included at the end of this report.

Leslie Getman
LESLIE GETMAN
PROJECT MANAGER

M. E. Shigley
M. E. SHIGLEY
LABORATORY MANAGER

cc: ANTHONY SILVA
PARK ENVIRONMENTAL CORP.
5110 E. HUNTER
ANAHEIM, CA 92807

AnalyticalTechnologies,Inc.

SAMPLE CROSS REFERENCE

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : 207
Project Name: CLUSTER

Report Date: April 19, 1994
ATI I.D. : 404202

ATI #	Client Description	Matrix	Date Collected
1	CW-1B	WATER	15-APR-94
2	CW-1A	WATER	15-APR-94
3	CW-4B	WATER	15-APR-94
4	CW-3B	WATER	15-APR-94
5	CW-2B	WATER	15-APR-94
6	FB	WATER	15-APR-94

---TOTALS---

Matrix	# Samples
WATER	6

ATI STANDARD DISPOSAL PRACTICE

The sample(s) from this project will be disposed of in twenty-one (21) days from the date of this report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

AnalyticalTechnologies,Inc.

ANALYTICAL SCHEDULE

Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : 207
Project Name: CLUSTER

ATI I.D.: 404202

Analysis	Technique/Description
EPA 8240 (GC/MS FOR VOLATILE ORGANICS)	GC/MASS SPECTROMETER

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 404202
Project # : 207
Project Name: CLUSTER

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	CW-1B	WATER	15-APR-94	N/A	18-APR-94	1.00
2	CW-1A	WATER	15-APR-94	N/A	18-APR-94	1.00
3	CW-4B	WATER	15-APR-94	N/A	18-APR-94	1.00

Parameter	Units	1	2	3
CHLOROMETHANE	UG/L	<10	<10	<10
VINYL CHLORIDE	UG/L	<5	<5	<5
BROMOMETHANE	UG/L	<10	<10	<10
CHLOROETHANE	UG/L	<5	<5	<5
ACETONE	UG/L	<10	<10	<10
1,1-DICHLOROETHENE	UG/L	<1	<1	<1
METHYLENE CHLORIDE	UG/L	<5	<5	<5
CARBON DISULFIDE	UG/L	4	14	<2
TRANS-1,2-DICHLOROETHENE	UG/L	<1	<1	<1
1,1-DICHLOROETHANE	UG/L	<1	<1	<1
CIS-1,2-DICHLOROETHENE	UG/L	<1	<1	<1
CHLOROFORM	UG/L	<1	<1	<1
2-BUTANONE (MEK)	UG/L	<10	<10	<10
1,1,1-TRICHLOROETHANE	UG/L	<1	<1	<1
CARBON TETRACHLORIDE	UG/L	<1	<1	<1
1,2-DICHLOROETHANE	UG/L	<1	<1	<1
BENZENE	UG/L	2	13	<1
TRICHLOROETHENE	UG/L	<1	<1	<1
1,2-DICHLOROPROPANE	UG/L	<1	<1	<1
BROMODICHLOROMETHANE	UG/L	<1	<1	<1
4-METHYL-2-PENTANONE (MIBK)	UG/L	<10	<10	<10
CIS-1,3-DICHLOROPROPENE	UG/L	<1	<1	<1
TOLUENE	UG/L	6	3	<2
TRANS-1,3-DICHLOROPROPENE	UG/L	<1	<1	<1
2-HEXANONE (MBK)	UG/L	<10	<10	<10
1,1,2-TRICHLOROETHANE	UG/L	<1	<1	<1
TETRACHLOROETHENE	UG/L	<1	<1	<1
DIBROMOCHLOROMETHANE	UG/L	<1	<1	<1
CHLOROBENZENE	UG/L	<1	<1	<1
ETHYLBENZENE	UG/L	2	2	<1
XYLENES (TOTAL)	UG/L	9	4	<1
STYRENE	UG/L	<2	<2	<2
BROMOFORM	UG/L	<5	<5	<5
1,1,2,2-TETRACHLOROETHANE	UG/L	<1	<1	<1
DICHLORODIFLUOROMETHANE	UG/L	<10	<10	<10
TRICHLOROFLUOROMETHANE	UG/L	<5	<5	<5
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	UG/L	<5	<5	<5
1,2-DICHLOROBENZENE	UG/L	<5	<5	<5

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 404202
Project # : 207
Project Name: CLUSTER

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
1	CW-1B	WATER	15-APR-94	N/A	18-APR-94	1.00
2	CW-1A	WATER	15-APR-94	N/A	18-APR-94	1.00
3	CW-4B	WATER	15-APR-94	N/A	18-APR-94	1.00

Parameter	Units	1	2	3
1,3-DICHLOROBENZENE	UG/L	<5	<5	<5
1,4-DICHLOROBENZENE	UG/L	<5	<5	<5
SURROGATES				
1,2-DICHLOROETHANE-D4	%	95	92	90
TOLUENE-D8	%	98	99	97
BFB	%	94	100	95

AnalyticalTechnologies,Inc.

ADDITIONAL COMPOUNDS (SEMI-QUANTITATED)

Method : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : 207
Project Name: CLUSTER

ATI I.D.: 404202

Sample	Parameters	Units	Results
1	SUBSTITUTED BENZENE	UG/L	5
	SUBSTITUTED BENZENE	UG/L	7
2	UNKNOWN HYDROCARBON	UG/L	30
	SUBSTITUTED BENZENE	UG/L	10
	DIETHYL BENZENE ISOMER	UG/L	20
	SUBSTITUTED BENZENE	UG/L	30
	UNKNOWN HYDROCARBON	UG/L	200
3	UNKNOWN HYDROCARBON	UG/L	20
	UNKNOWN HYDROCARBON	UG/L	7

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 404202
Project # : 207
Project Name: CLUSTER

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	CW-3B	WATER	15-APR-94	N/A	18-APR-94	1.00
5	CW-2B	WATER	15-APR-94	N/A	18-APR-94	1.00
6	FB	WATER	15-APR-94	N/A	18-APR-94	1.00

Parameter	Units	4	5	6
CHLOROMETHANE	UG/L	<10	<10	<10
VINYL CHLORIDE	UG/L	<5	<5	<5
BROMOMETHANE	UG/L	<10	<10	<10
CHLOROETHANE	UG/L	<5	<5	<5
ACETONE	UG/L	<10	<10	<10
1,1-DICHLOROETHENE	UG/L	<1	<1	<1
METHYLENE CHLORIDE	UG/L	<5	<5	<5
CARBON DISULFIDE	UG/L	3	5	<2
TRANS-1,2-DICHLOROETHENE	UG/L	<1	<1	<1
1,1-DICHLOROETHANE	UG/L	<1	<1	<1
CIS-1,2-DICHLOROETHENE	UG/L	<1	<1	<1
CHLOROFORM	UG/L	<1	<1	<1
2-BUTANONE (MEK)	UG/L	<10	<10	<10
1,1,1-TRICHLOROETHANE	UG/L	<1	<1	<1
CARBON TETRACHLORIDE	UG/L	<1	<1	<1
1,2-DICHLOROETHANE	UG/L	<1	<1	<1
BENZENE	UG/L	<1	1	<1
TRICHLOROETHENE	UG/L	<1	<1	<1
1,2-DICHLOROPROPANE	UG/L	<1	<1	<1
BROMODICHLOROMETHANE	UG/L	<1	<1	<1
4-METHYL-2-PENTANONE (MIBK)	UG/L	<10	<10	<10
CIS-1,3-DICHLOROPROPENE	UG/L	<1	<1	<1
TOLUENE	UG/L	3	<2	<2
TRANS-1,3-DICHLOROPROPENE	UG/L	<1	<1	<1
2-HEXANONE (MBK)	UG/L	<10	<10	<10
1,1,2-TRICHLOROETHANE	UG/L	<1	<1	<1
TETRACHLOROETHENE	UG/L	<1	<1	<1
DIBROMOCHLOROMETHANE	UG/L	<1	<1	<1
CHLOROBENZENE	UG/L	<1	<1	<1
ETHYLBENZENE	UG/L	<1	2	<1
XYLENES (TOTAL)	UG/L	<1	2	<1
STYRENE	UG/L	<2	<2	<2
BROMOFORM	UG/L	<5	<5	<5
1,1,2,2-TETRACHLOROETHANE	UG/L	<1	<1	<1
DICHLORODIFLUOROMETHANE	UG/L	<10	<10	<10
TRICHLOROFLUOROMETHANE	UG/L	<5	<5	<5
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	UG/L	<5	<5	<5
1,2-DICHLOROBENZENE	UG/L	<5	<5	<5

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY RESULTS

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC. ATI I.D. : 404202
Project # : 207
Project Name: CLUSTER

Sample #	Client ID	Matrix	Date Sampled	Date Extracted	Date Analyzed	Dil. Factor
4	CW-3B	WATER	15-APR-94	N/A	18-APR-94	1.00
5	CW-2B	WATER	15-APR-94	N/A	18-APR-94	1.00
6	FB	WATER	15-APR-94	N/A	18-APR-94	1.00

Parameter	Units	4	5	6
1,3-DICHLOROBENZENE	UG/L	<5	<5	<5
1,4-DICHLOROBENZENE	UG/L	<5	<5	<5
SURROGATES				
1,2-DICHLOROETHANE-D4	%	89	93	92
TOLUENE-D8	%	104	101	99
BFB	%	94	91	92

AnalyticalTechnologies,Inc.

ADDITIONAL COMPOUNDS (SEMI-QUANTITATED)

Method : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : 207
Project Name: CLUSTER

ATI I.D.: 404202

Sample	Parameters	Units	Results
4	NONE DETECTED	N/A	N/A
5	NONE DETECTED	N/A	N/A
6	NONE DETECTED	N/A	N/A

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

REAGENT BLANK

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank I.D. : 29827
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : 207
Project Name: CLUSTER

ATI I.D. : 404202
Date Extracted: N/A
Date Analyzed : 18-APR-94
Dil. Factor : 1.00

Parameters	Units	Results
CHLOROMETHANE	UG/L	<10
VINYL CHLORIDE	UG/L	<5
BROMOMETHANE	UG/L	<10
CHLOROETHANE	UG/L	<5
ACETONE	UG/L	<10
1,1-DICHLOROETHENE	UG/L	<1
METHYLENE CHLORIDE	UG/L	<5
CARBON DISULFIDE	UG/L	<2
TRANS-1,2-DICHLOROETHENE	UG/L	<1
1,1-DICHLOROETHANE	UG/L	<1
CIS-1,2-DICHLOROETHENE	UG/L	<1
CHLOROFORM	UG/L	<1
2-BUTANONE (MEK)	UG/L	<10
1,1,1-TRICHLOROETHANE	UG/L	<1
CARBON TETRACHLORIDE	UG/L	<1
1,2-DICHLOROETHANE	UG/L	<1
BENZENE	UG/L	<1
TRICHLOROETHENE	UG/L	<1
1,2-DICHLOROPROPANE	UG/L	<1
BROMODICHLOROMETHANE	UG/L	<1
4-METHYL-2-PENTANONE (MIBK)	UG/L	<10
CIS-1,3-DICHLOROPROPENE	UG/L	<1
TOLUENE	UG/L	<2
TRANS-1,3-DICHLOROPROPENE	UG/L	<1
2-HEXANONE (MBK)	UG/L	<10
1,1,2-TRICHLOROETHANE	UG/L	<1
TETRACHLOROETHENE	UG/L	<1
DIBROMOCHLOROMETHANE	UG/L	<1
CHLOROBENZENE	UG/L	<1
ETHYLBENZENE	UG/L	<1
XYLENES (TOTAL)	UG/L	<1
STYRENE	UG/L	<2
BROMOFORM	UG/L	<5
1,1,2,2-TETRACHLOROETHANE	UG/L	<1
DICHLORODIFLUOROMETHANE	UG/L	<10
TRICHLOROFLUOROMETHANE	UG/L	<5
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	UG/L	<5
1,2-DICHLOROBENZENE	UG/L	<5
1,3-DICHLOROBENZENE	UG/L	<5
1,4-DICHLOROBENZENE	UG/L	<5
SURROGATES		
1,2-DICHLOROETHANE-D4	%	89
TOLUENE-D8	%	99
BFB	%	91

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

REAGENT BLANK
ADDITIONAL COMPOUNDS (SEMI-QUANTITATED)

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank I.D. : 29827 ATI I.D. : 404202
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : 207
Project Name: CLUSTER

Parameters	Units	Results
NONE DETECTED	N/A	N/A

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

MSMSD

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
MSMSD # : 61658
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.

Project # : 207
Project Name: CLUSTER

ATI I.D. : 404202
Date Extracted: N/A
Date Analyzed : 18-APR-94
Sample Matrix : WATER
REF I.D. : 404202-05

Parameters	Units	Sample Result	Conc Spike	Spiked Sample	% Rec	Dup Spike	Dup % Rec	RPD
1,1-DICHLOROETHENE	UG/L	<1	50	49	98	50	100	2
BENZENE	UG/L	1	50	57	112	54	106	5
TRICHLOROETHENE	UG/L	<1	50	59	118	55	110	7
TOLUENE	UG/L	<2	50	54	108	52	104	4
CHLOROBENZENE	UG/L	<1	50	56	112	53	106	6

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample Result - Duplicate Spike Result)*100/Average Result

AnalyticalTechnologies,Inc.

GAS CHROMATOGRAPHY/MASS SPECTROSCOPY - QUALITY CONTROL

BLANK SPIKE

Test : EPA 8240 (GC/MS FOR VOLATILE ORGANICS)
Blank Spike #: 45804
Client : ENVIRONMENTAL TECHNOLOGIES INT'L, INC.
Project # : 207
Project Name : CLUSTER

ATI I.D. : 404202
Date Extracted: N/A
Date Analyzed : 18-APR-94
Sample Matrix : WATER

Parameters	Units	Blank Result	Spiked Sample	Spike Conc.	% Rec
1,1-DICHLOROETHENE	UG/L	<1	48	50	96
BENZENE	UG/L	<1	52	50	104
TRICHLOROETHENE	UG/L	<1	51	50	102
TOLUENE	UG/L	<2	50	50	100
CHLOROBENZENE	UG/L	<1	49	50	98

% Recovery = (Spike Sample Result - Sample Result)*100/Spike Concentration
RPD (Relative % Difference) = (Spiked Sample - Blank Result)*100/Average Result

ACCESSION #: 404202

INITIALS: IJ

SAMPLE CONDITION UPON RECEIPT CHECKLIST (FOR RE-ACCESSIONS, COMPLETE #7 THRU #9)			
1	Does this project require special handling according to NEESA Levels C, D, AFOEHL or CLP protocols? If yes, complete a) thru c) a) Cooler temperature _____ b) pH sample aliquoted: yes / no / n/a c) LOT #'s: _____	YES	NO
2	Are custody seals present on cooler?	YES	NO
	If yes, are seals intact? N/A	YES	NO
3	Are custody seals present on sample containers?	YES	NO
	If yes, are seals intact? N/A	YES	NO
4	Is there a Chain-Of-Custody (COC)*?	YES	NO
5	Is the COC* complete? Relinquished: yes/no Requested analysis: yes/no	YES	NO
6	Is the COC* in agreement with the samples received? # Samples: yes/no Sample ID's: yes/no Date sampled: yes/no Matrix: yes/no # containers: yes/no	YES	NO
7	Are the samples preserved correctly?	YES	NO
8	Is there enough sample for all the requested analyses?	YES	NO
9	Are all samples within holding times for the requested analyses?	YES	NO
10	Cooler temperature: #335 = 2.0°C		
11	Were all sample containers received intact (ie. not broken, leaking, etc.)?	YES	NO
12	Are samples requiring no headspace, headspace free? N/A	YES	NO
13	Are VOA 1st stickers required?	YES	NO
14	Are there special comments on the Chain of Custody which require client contact?	YES	N/A
15	If yes, was ATI Project Manager notified?	YES	NO

Describe "no" items: _____

Was client contacted? yes / no

If yes, Date: _____ Name of Person contacted: _____

Describe actions taken or client instructions: _____

*Or other representative documents, letters, and/or shipping memos

AnalyticalTechnologies, Inc.
5550 MOREHOUSE DRIVE
SAN DIEGO, CA 92121-1709
(619) 458-9141

Chain of Custody

DATE 4-15-94 PAGE 1 OF 1

PROJECT MANAGER: Tom Wallis
COMPANY: ETI
ADDRESS: P.O. Box 3379 Honolulu, HI 96842

BILL TO: Same as Above
COMPANY:
ADDRESS:

OFD + JWIN — SAMPLERS: (Signature)
(808) 547-3855 — PHONE NUMBER

Recommended Quantity and Preservative (Provide triple volume on QC Samples)

SAMPLE ID	SAMPLE DATE	TIME	MATRIX	LAB ID	Petroleum Hydrocarbons 418.1 (1L (H_2SO_4)/100g)	Oil and Grease 413.2 (1L (H_2SO_4)/100g)	Gasoline (MOD 8015/DOHS) (4 oz (HCl)/50g)	Diesel (MOD 8015/DOHS) (4 oz (HCl)/50g)	Gasoline/BTXE (MOD 8015/8020) Maximum Contamination Level of Gasoline: 2ppm (water), 50ppm (Soil) (2X40ml (HCl)/50g)	MOD 8015 (Unknown) (4 oz (HCl)/50g)	BTXE (8020) (2X40ml (HCl)/50g)	Chlorinated Hydrocarbons (8010) (2X40ml (HCl)/50g)	Aromatic Hydrocarbons (8020) (2X40ml (HCl)/50g)	Chlorinated/Aromatic Hydrocarbons (8010/8020) (2X40ml (HCl)/50g)	Organic Pb (500ml/50g)	Pesticides/PCB (8080) (1L/50g)	Base/NEU/Acid Cmpds GC/MS (8270) (1L/100g)	Volatile Cmpds GC/MS (8240) (2X40ml (HCl)/100g)	Polynuclear Aromatic (8310) (1L/100g)	CCR Metals (500ml/100g)	Priority Pollutant Metals (500ml/100g)	Number of Containers
CW-1B	4-15-94	12:41	H_2O	01														X					2
CW-1A	4-15-94	1:40	H_2O	02														X					2
CW-4B	4-15-94	3:56	H_2O	03														X					2
CW-3B	4-15-94	5:25	H_2O	04														X					2
CW-2B	4-15-94	6:26	H_2O	05														X					2
FB	4-15-94	6:33	H_2O	06														X					2

PROJECT INFORMATION		SAMPLE RECEIPT	
PROJECT NUMBER:	207	TOTAL NUMBER OF CONTAINERS	6
PROJECT NAME:	Cluster	CHAIN OF CUSTODY SEALS Y/N/NA	N
PURCHASE ORDER NUMBER:		SEALS INTACT? Y/N/NA	NA
VIA:	DHL	RECEIVED GOOD COND./COLD	Y/Y
TAT: ☒24HR ☐48HRS ☐72HRS ☐1WK ☐2WK		LAB NUMBER	404202

SAMPLE DISPOSAL INSTRUCTIONS

☐ ATI Disposal @ $5.00 each ☐ Return ☐ Pickup

Comments:

2°C

Cooler #335

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature: Dan DeSario Time: 7:50	Signature: Time:	Signature: Time:
Printed Name: DAN DESARIO Date: 4-15-94	Printed Name: Date:	Printed Name: Date:
Company: ETI	Company:	Company:
RECEIVED BY: 1.	**RECEIVED BY: 2.**	**RECEIVED BY: (LAB) 3.**
Signature: Time:	Signature: Time:	Signature: Time: 11:30
Printed Name: Date:	Printed Name: Date:	Printed Name: Lisa Tucker Date: 4-16-94
Company:	Company:	Analytical Technologies, Inc.

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4/18/94

4/18/94

conf call

Dennis Denouden, Anthony Si[illegible], John O[illegible]

- to discuss 3/24 letter regarding monitoring of C zone
- matl required vertical + ~~[illegible]~~ horizontal gradient of upper zone
  10-60' below gs labeled them A, B, C - they designated
  them - hydraulic interconnection b/w all 3 zones
- sampled wells 2 years ago - showed 4-10 ug/l of benzene in B zone
- they feel they have very [illegible] of benzene [illegible]
- want to refer to [illegible] as upper + lower ~~[illegible]~~ portions rather than
  3 distinct zones
- want to put in 2 wells at 20' + 35' bgs (cluster wells)
  - if hits [illegible]
  - monitor 20' + 55'
- looking [illegible] LNAPL activity [illegible] DNAPL [illegible]
- revise GMP - 2 wells [illegible] upper 25' [illegible] (middle) 10' screen
  [illegible] 35' or 55' screen - based on
  data from sampling last week

Attachment A

ATI's Analytical Results for Sampling Conducted on April 15, 1994

ATI Sample #	Sample Location	Well Screened Interval (bgs)
1	CW-1B	33 to 43
2	CW-1A	15 to 25
3	CW-4B	33 to 43
4	CW-3B	33 to 43
5	CW-2B	33 to 43
6	Field Blank	Does not apply

bgs = below ground surface

RECORDS SEPARATOR PAGE

RECORDS SEPARATOR PAGE

RECORDS SEPARATOR PAGE

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RECORDS SEPARATOR PAGE

RECORDS SEPARATOR PAGE

ICF KAISER
ENVIRONMENT & ENERGY GROUP

ICF Kaiser Engineers, Inc.
160 Spear Street, Suite 1380
San Francisco, CA 94105-1535
415/882-3000 Fax 415/882-3199

MEMORANDUM

TO: Mitch Kaplan, Environmental Scientist
Permits Section (H-3-2)

THROUGH: Hedy Ficklin, Acting Chief
Quality Assurance Management Section (QAMS) (P-3-2)

FROM: Lisa Hanusiak, Senior Investigation Coordinator
Environmental Services Assistance Team (ESAT)

DATE: March 16, 1994

SUBJECT: BHP Petroleum Americas Refining, Inc. Groundwater Monitoring Plan, Kapolei, Hawaii (EPA QAMS Document Control Number RCRA045594HJF1)

The subject document, prepared by Delta Environmental Consultants, Inc. and dated October 19, 1993, was reviewed. The review included all sections of the Groundwater Monitoring Plan (GMP) with the exception of Appendix H, which contained the site health and safety plan. The following documents were used for reference during review of the subject document: "RCRA Groundwater Monitoring Technical Enforcement Guidance Document (TEGD)," (Document Control Number OSWER-9950.1, September 1986), Code of Federal Regulations (CFR) Section 40 Part 265, Subpart F, Groundwater Monitoring, "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations," (Document Control Number EPA QA/R-5, draft January 29, 1992), "Guidelines and Specifications for Preparing Quality Assurance Program Plans," (Document Control Number QAMS-004/80, September 20, 1980).

Overall, the groundwater monitoring plan sufficiently covers the field activities that will be implemented during the proposed groundwater monitoring effort. However, several issues related to sample analyses that will be performed as part of this effort require clarification. It is recommended that the following comments be addressed before the groundwater monitoring plan is implemented.

These comments have been reviewed and approved by the EPA Task Monitor for the ESAT Contract, whose signature appears above.

Concerns

1. [Section 3.4.5, Scope of Work, Decontamination Procedures] It is recommended that the equipment decontamination procedure described in Section 3.4.5 be expanded to include a solvent rinse (e.g., hexane), when cross contamination from organic parameters is of concern, and an

acid rinse (e.g., nitric acid) when cross contamination from inorganic parameters is of concern, for any non-dedicated sampling equipment.

2. [Section 3.4.6, Field Quality Assurance/Quality Control for Samples; Appendix F-1, Analytical Technologies, Inc.-Laboratory Quality Assurance Manual; Appendix F-2, West Coast Analytical Services-Quality Assurance Manual]

   a. Section 3.4.6 states that duplicate groundwater samples will be collected and analyzed by two separate laboratories, Analytical Technologies, Inc. (ATI) and West Coast Analytical Services (WCAS), for the parameters described in Section 3.7 (Laboratory Analysis of Groundwater and Free-Product Samples) as a check on field and laboratory procedures. To ensure that comparable data are generated, it is critical for these two laboratories to follow comparable analytical procedures and achieve similar analyte detection limits. The following dissimilarities between the laboratory procedures included in the laboratory quality assurance manuals (QAMs) were noted:

      1. The QAM for WCAS indicates that anions, including chloride, fluoride, nitrate, nitrite, and sulfate, will be analyzed by ion chromatography; the method source is not referenced. The QAM for ATI lists methods corresponding to those specified in Table 5 (General Chemistry Analysis) of the GMP for the analysis of anions, including EPA method 340.2 (fluoride), a potentiometric method; EPA method 353.2 (nitrate and nitrite), a colorimetric method; and SW-846 method 9038 (sulfate), turbidimetric method. Additionally, the QAM for ATI lists EPA method 325.3 for the analysis of chloride, which is equivalent to the chloride method listed in Table 5 of the GMP, SW-846 method 9252; both are titrimetric methods.

         Although the equivalent analyte detection limits can be achieved by following the analytical methods specified by ATI and WCAS, the instrumentation and, therefore, the analytical procedures differ. If the generation of comparable data by these two laboratories is critical for the proposed investigation, it is recommended that analytical methods involving the use of equivalent instrumentation be required.

      2. The QAM for WCAS indicates that metals will be analyzed by inductively coupled argon plasma emission spectroscopy-mass spectrometry (ICP-MS); the method source is not referenced. The QAM for ATI lists methods corresponding to those specified in Table 4 (Sample Summary Table, Quarterly Groundwater Samples) of the GMP for the analysis of metals, including SW-846 methods 7060 (arsenic), 7131 (cadmium), 7421 (lead), 7740 (selenium), which involve the use of graphite

furnace atomic absorption (GFAA) spectroscopy; SW-846 method 7470 (mercury), which involves the use of cold vapor atomic absorption (CVAA) spectroscopy; and SW-846 method 6010 (for the remaining metals listed in Table 4), which involves the use of inductively coupled argon plasma emission spectroscopy (ICP).

The instrumentation, analytical procedures, and analyte detection limits differ for metals analysis by ICP-MS and the SW-846 methods cited. ICP-MS instrumentation is considerably more sensitive than GFAA, CVAA, or ICP instrumentation, and will facilitate achieving lower analyte detection limits. However, the cost of these analyses will be significantly greater.

Based on the information presented in Table 4, the analyte detection limits that can be achieved following SW-846 method 6010 and SW-846 7000 series methods appear to be sufficient for the proposed groundwater monitoring effort. It is recommended that these procedures be followed for both the primary and verification metals analyses.

b. Although the GMP includes provisions for the analysis of duplicate groundwater samples as a check on field and laboratory procedures, the evaluation of data generated from these analyses is not addressed. It is recommended that the discussion of duplicate analyses be expanded to include procedures for comparing duplicate data, acceptance criteria for duplicate result correlation, and corrective action measures that will be taken if duplicate analyses consistently fail to meet acceptance criteria.

3. [Section 3.7, Laboratory Analysis of Groundwater and Free-Product Samples] It is recommended that the quality assurance/quality control (QA/QC) objectives for the gas chromatographic (GC) characterization analyses to be performed on free-product samples be provided in the plan. Section 3.7 states that these analyses will be performed by the analytical laboratory, Friedman & Bruya, however, a QAM for this laboratory was not included in the GMP with the QAMs in Appendix F for other laboratories that will be involved in the project. At a minimum, a laboratory standard operating procedure (SOP) for ASTM D2887 should be provided, that specifies required instrument calibration procedures, quality control (QC) sample analysis requirements, corrective action procedures, and laboratory documentation and reporting requirements.

4. [Section 3.8.3.1, Proposed Biodegradation Sampling and Analysis]

a. It is recommended that the analytical methods that will be followed for the analysis of the water quality parameters ammonia and phosphorus be indicated in the GMP.

b. It is recommended that the "various other indicators of geochemistry" that will be analyzed as part of the second phase of biodegradation data collection be clarified.

5. [Table 3, Sample Collection Table, Quarterly Groundwater Samples]

a. It is recommended that the groundwater preservation requirements listed in Table 3 for volatile organic compounds (VOCs) be revised to require the addition of sufficient hydrochloric acid to ensure that a pH less than 2 is achieved. This is considered to be preferable to simply adding 4 drops of concentrated hydrochloric acid to each sample vial. Although 4 drops of acid will generally be sufficient to lower the pH of groundwater samples, the actual quantity of acid required will depend on the size of the drops, the buffering capacity of the aquifer, and so forth. The pH of a representative test vial containing a sample from each aquifer should be checked prior to sample collection to determine the quantity of acid needed to achieve a pH less than 2.

b. It is recommended that the sample preservation requirements for general chemistry analyses be clarified in Table 3. Although three preservation methods are listed, the associated analytical parameters are not specified.

6. [Table 4, Sample Summary Table, Quarterly Groundwater Samples; Appendix F-1, Analytical Technologies, Inc.-Laboratory Quality Assurance Manual; Appendix F-2, West Coast Analytical Services-Quality Assurance Manual]

a. The QAM for WCAS does not include target compound lists for SW-846 methods 8240 and 8270. As a result, it was not possible to verify that all of the volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) listed in Table 4 were included on the laboratory's target compound lists for these methods.

b. Several of the target VOCs, including cyclohexane, 1,4-dioxane, and ethylene dibromide, and target SVOCs, including 7,12-dimethylbenz(a)anthracene, indene, quinoline, and benzenethiol cresols, that are listed in Table 4 of the GMP are not on the target compound lists for SW-846 methods 8240 and 8270 (Table 6) in the QAM for ATI. This discrepancy should be clarified.

It is recommended that both laboratories be required to perform a method detection limit (MDL) study for the benzenethiol cresols. The applicability of SW-846 method 8270 for the analysis of these compounds is not well established and recovering them may be difficult. Requiring the laboratories to perform a MDL study for the other nonstandard method 8240 and 8270 analytes would also be a good idea, although these analytes are chemically similar to

other method analytes and analysis of them should be straightforward.

7. [Table 8, Biodegradation-Laboratory Groundwater Parameters; Appendix E, Summary of Analytical Laboratory Procedures]

   a. It is recommended that the required analyte detection limits for the methods listed in Table 8 be provided in the GMP. These detection limits should reflect needs of the biological environment characterization.

   b. The method reference for biochemical oxygen demand (BOD) in Table 8 appears to be incorrect. The listed method, EPA 320.1, is for the analysis of bromide. EPA method 405.1 is the correct reference in "Methods for Chemical Analysis of Water and Wastes" for BOD analysis.

8. [Table 9, Soil Characteristic Analytical Methods; Appendix F-1, Analytical Technologies, Inc.-Laboratory Quality Assurance Manual]

   a. The methods for total organic carbon analysis listed in Table 9 of the GMP and in the QAM for ATI (SW-846 method 9060 and EPA methods 415.1 and 415.2, respectively) are intended for the analysis of aqueous samples. If TOC analyses will be performed as part of the soil characterization, modifications will be necessary to adapt these methods to soil analysis. These method modifications should be addressed in the GMP.

   b. The method listed in Table 9 for determining soil partitioning coefficients should be clarified. The listed "TCLP method" appears to be incorrect. Additionally, a laboratory procedure for this method should be included in the GMP.

9. [Appendix E, Summary of Analytical Laboratory Procedures]

   a. It is recommended that the 5 μg/L quantitation limit for the target volatile organic compound, 1,4-dioxane, be reevaluated. In comparison to the other target VOCs listed in Table 4 (Sample Summary Table, Quarterly Groundwater Samples), the purging efficiency of 1,4-dioxane in water samples is poor (i.e., the analyte preferentially remains in the aqueous phase rather than moving into the vapor phase). A quantitation limit of 25 μg/L is considered to be more reasonable for 1,4-dioxane following regular SW-846 method 8240 protocols for sample analysis.

      Alternatively, a quantitation limit of 5 μg/L is reasonable for 1,4-dioxane provided that a larger sample volume is used for analysis. The standard SW-846 method 8240 procedures requires a 5 mL sample. If this procedure is modified to include a 25 mL

sample volume, a 5 μg/L quantitation limit for 1,4-dioxane can be achieved.

b. It is recommended that the 5 μg/L quantitation limit for the target semivolatile organic compounds, 2,4-dinitrophenol and 4-nitrophenol, be reevaluated. A quantitation limit of 25 μg/L is considered to be more reasonable for these following SW-846 method 8270 protocols for sample analysis.

c. The estimated detection limits for metals listed in Appendix E are the minimum detection limits specified in the SW-846 methods (6010 and 7000 series). It is recommended that project specific detection limits be established that reflect the regulatory and investigatory needs of the groundwater monitoring effort. Although defaulting to the method established limits is acceptable, it should be noted that these published detection limits are determined experimentally under optimal analytical conditions. Actual method detection limits (MDLs) will vary from one MDL determination to the next and the detection limits for environmental samples will probably exceed those published in the SW-846 methods. It is recommended that analyte detection limits for the project be adjusted to be sufficiently below regulatory levels (a factor of 2 to 10 below) but above the minimum level of detection to allow for variations in MDL determinations.

d. It is recommended that individual detection limits for each target metal that will be analyzed by following SW-846 method 6010 procedures be specified in Appendix E. This is preferable to specifying a range of detection limits for target metals.

e. Table 5 (General Chemistry Analysis) indicates that groundwater samples will be analyzed for alkalinity following EPA method 310.1 procedures. However, Appendix E indicates that quantitation of carbonate and bicarbonate, in addition to alkalinity, is required. It is recommended that if determination of carbonate, bicarbonate, and alkalinity is necessary for the proposed groundwater monitoring effort, Standard Method 2320 procedures be followed for analysis rather than EPA method 310.1 procedures. Standard Method 2320 allows for quantitation of all three parameters; EPA method 310.1 allows for quantitation of alkalinity only.

f. Detection limits for carbonate, bicarbonate, alkalinity, chloride, fluoride, nitrate-nitrite as nitrogen, sulfate, surfactants, and total dissolved solids (TDS) should be added to Appendix E.

g. The reference to Table 6 under general minerals in Appendix E should be revised to Table 5.

Mr. Mitch Kaplan
March 16, 1994

10. [Appendix F-1, Analytical Technologies, Inc.-Laboratory Quality Assurance Manual; Appendix F-2, West Coast Analytical Services-Quality Assurance Manual]

    a. Method reporting limits were not provided in the quality assurance manual (QAMs) for either laboratory. As a result, it was not possible to verify whether the laboratories are capable of achieving the detection limits specified in the GMP.

    c. It is recommended that the QAM for WCAS be amended to include instrument calibration procedures and acceptance criteria for all analytical methods which will be performed by this laboratory as part of the project.

The document will be retained by ESAT for future reference unless requested by EPA. If you have any questions concerning this review, please contact Lisa Hanusiak, ICF Technology, Inc., at (415) 882-3063, or Hedy Ficklin, EPA Region 9, Quality Assurance Management Section, at (415) 744-1497.

cc: Hedy Ficklin, QAMS Task Manager, (P-3-2)

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BHP Petroleum Americas Refining Inc.
91-325 Komohana Street
Kapolei, Hawaii 96707
Telephone **(808) 547-3900**
Fax (808) 547-3068

rec'd 2/23
discussed w/ mitch -
we will have response
in 30 days - sent
sch plan to EPA for review

February 18, 1994

BHP Petroleum Americas

CERTIFIED MAIL P-872-486-790
RETURN RECEIPT REQUESTED

Mr. Mitch Kaplan
Arizona, Nevada, and Pacific Islands Section (H-3-2)
Hazardous Waste Management Division
U.S. Environmental Protection Agency
75 Hawthorne Street
San Francisco, California 94105

Dear Mr. Kaplan:

Revisions to Groundwater Monitoring Plan,
October 19, 1993
HID 056-786-395

This letter is in reply to EPA comments received by BHP Petroleum Americas Refining Inc. (BHPPAR) on December 28, 1993 and January 20, 1994, regarding the Groundwater Monitoring Plan (GMP), which was submitted to EPA on October 19, 1993. In the December 28, 1993 letter, EPA requested that BHPPAR address ten (10) comments regarding the GMP prior to EPA approval. The January 20, 1994 letter further clarified the ten (10) original comments and stated that EPA would not require a response to the first comment. A brief response to the EPA comments listed in both the December 28, 1993 letter and the January 20, 1994 letter is provided below.

The following ten (10) comments were made in EPA's December 28, 1993 letter:

> **1) BHPPAR's Hydrogeologic Report, submitted to EPA on September 24, 1991, was reviewed by EPA in 1992. The tasks that came out of this review have been addressed in the current GWM plan, except for the following. Tasks 6 and 7 of the BHP's plan address pump tests and pump test analyses. There is no indication that additional pump tests are to be conducted nor that the concerns expressed regarding the previous pump tests have been addressed in the current GWM plan.**

Based on discussions with Mr. Mitch Kaplan of the EPA and the January 20, 1994 letter, this comment was addressed in the Hydrogeologic Characterization, dated January 7, 1993 and does not require further response from BHPPAR.

2) Page 5, section 2.3, second paragraph, line 4: I believe the reference here should be to aquitard 1, not aquifer 1. The terms aquitard and aquiclude are used interchangeably in the text. Is a distinction between these two terms intended here or not? If not, then only one term should be used. The term aquitard is preferred.

The sentence in section 2.3 requires further clarification. It is actually referring to the depositional environment of the limestone formation composing Aquifer 1 rather than the reader's inference that it is a description of Aquitard 1.

A distinction between the two terms aquitard and aquiclude is not intended in this section. The two terms are not intended to be used interchangeably. BHPPAR prefers the term aquitard as well and will use this term rather than aquiclude when describing the confining sediments beneath the refinery and the Ewa Plain of Oahu, Hawaii.

3) Page 6, section 2.3.1.2: Did the hydrogeologic characterization include pump tests to support this conclusion for a containment confining layer? Were water quality analyses used? Please explain the basis used for defining the confining layer.

Pumping test data obtained during the implementation of the Hydrogeologic Characterization and vertical hydraulic conductivity data obtained from sediments of the Uppermost Aquitard were used to support the conclusion for the presence of a confining layer - the Uppermost Aquitard. In addition, groundwater analytical data were used to support this conclusion. Based on a review of the groundwater analytical data, Skinner List compounds such as benzene were not detected above the laboratory's method detection limit or the regulatory threshold values in cluster wells completed in the C-zone. These C-zone cluster wells were screened approximately 50 to 60 feet below the ground surface (bgs) and lie directly above the Uppermost Aquitard which is located approximately 57 to 60 feet bgs. Please refer to pages 30 and 31 of the Hydrogeologic Characterization for additional information which describes in detail the methodologies used to determine the presence of the Uppermost Aquitard and the potential for hydraulic interconnection between saturated zones.

4) Page 9, section 3.2 (Groundwater Monitoring Well Install.): Precautions are described when drilling wells in which free product is encountered in order to prevent its migration from the uppermost water bearing zone to underlying water bearing zones. What precautions will be made to prevent hazardous wastes or hazardous waste constituents in wells that do not exhibit free product from migrating from the shallow to deeper water bearing zones when wells are drilled and screened in the B zone only? The same drilling procedures proposed for use when the presence of floating product is suspected should be used for wells in which hazardous wastes or hazardous waste constituents dissolved in the groundwater are suspected.

In discussions on the appropriate procedures for constructing wells in the B-zone, it is important to recognize that the A, B, and C zones are vertical intervals of the same Uppermost Aquifer and that they are therefore hydraulically interconnected. The distribution of the dissolved constituents in the Uppermost Aquifer is a function of dispersion from a source in a porous media. The very short-term drilling activities for B-zone well construction will not cross-contaminate zones of the Uppermost Aquifer that have not already been contaminated by dispersion over the long term. The Special Drilling Instructions referred to on page 9 of the GMP will be employed during the installation of B-zone groundwater monitoring wells where there is a risk that the drilling operations may cause petroleum-based material on the water table to impact the B-zone.

5) Page 10, section 3.2.1 (Lithologic Logging), first paragraph: Notations of moisture content and depth to water first encountered should be noted on the logs.

Field observations of moisture content along with the depth at which groundwater was first encountered during drilling will be recorded on the lithologic logs.

6) Page 13, 14, section 3.4.2 (Well Purging) and Page 16, section 3.4.4.1 (Free Product Sampling Procedures): Concerning the sampling of wells containing free product, a device such as a stilling tube is recommended in these situations (EPA-RCRA GWM Technical guidance 11/92).

BHPPAR has in the past employed the stilling tube to sample groundwater from wells containing free product. However, this sampling methodology was not successful. Groundwater samples collected shortly after inserting the stilling tube into the well contained significant quantities of free product (visually observed globules of free product). Based on these observations, EPA and the State of Hawaii Department of Health recommended that BHPPAR implement another type of groundwater sampling methodology - dedicated bladder pumps. BHPPAR has found that the most effective groundwater sample collection methodology in wells containing free product is by using dedicated bladder pumps as follows:

- Step 1 — Remove the free product from the well with the use of vacuum truck equipped with a clean PVC "stinger" and a clean disposable polyethylene bailer.
- Step 2 — Install the dedicated positive displacement pneumatic bladder pump into the well immediately following the free product removal.

- Step 3 — Immediately begin to purge the well through the use of the newly installed bladder pump.

In most cases, the free product recharge rate into the well casing has been quite slow and has allowed for ample time to install the dedicated pumps.

7) Page 15, section 3.4.3 (Groundwater Sampling), first paragraph: Will a sampling event occur at approximately high tide and the other sampling event at approximately low tide? Second paragraph: How were the percentages (20%, 90%) arrived at? This paragraph is unclear in terms of sampling outcomes. Sampling scenarios I and II were described in the GWM plan. But there is a third possible scenario that has not been addressed by BHP that falls between the two given scenarios. This paragraph should be rewritten to account for the third sampling scenario. The three scenarios, as we see them, are described below:

BHP's Scenario I: If there is a change of > 20% between a particular constituent concentration at high vs low tide occurring in > 90% of samples taken, then BHP will do tide based sampling during the other 3 quarters;

BHP's Scenario II: If there is a change of < 20% between a particular constituent concentration at high vs low tide occurring in less than 90% of samples taken, then BHP will not do tide based sampling for other 3 quarters.

EPA's potential Scenario III: If there is a change of > 20% between a particular constituent concentration taken at high vs. low tide in < 90% of samples taken, what will BHP do?

Sampling events in the first quarter will occur at approximately high tide and at approximately low tide. These daily tidal cycles will be estimated using information obtained from the local weather service as reported in the local newspapers.

The percentages were derived from standard statistical methodologies for evaluating analytical data. This methodology applies the concept of having a 90 percent confidence that the analytical results from a set of groundwater samples provide statistically significant evidence that the mean concentration of a sample set is influenced by the tides. Changes in compound/chemical concentrations would have to be evident in over 90 percent of the groundwater samples to provide statistically significant evidence for dilution created by tidal influences. In addition, normal variability in laboratory analyses due to the analytical procedure can create sample result changes up to 20 percent of the true compound/chemical concentration. Thus, changes of 20 percent or greater would be required to indicate influences on the sample results due to tides.

95% is normal [illegible]

If Scenario III were to take place, then BHPPAR would not conduct tide-based sampling due to the lack of statistically significant evidence (i.e., not having a 90 percent confidence level) that the sample set's results are affected by the tides.

9) Page 18, section 3.4.7 (Equipment Calibration and Maintenance Plan): Will backups of the portable measuring devices for field parameters be available on-site? If not, what would be the turnaround time for replacement and what provisions are in the sampling procedures in the event of equipment failure? The GWM plan should be modified to include this additional information.

Backups or equivalent pieces of equipment of the portable measuring devices listed in the GMP for the measurement of field parameters will be available at the refinery during sampling events.

10) GWM is proposed for the A and B water bearing zones only. Please explain why the C zone is not included for GWM. Previous GWM has included the C zone.

As indicated in your January 20, 1994 letter, BHPPAR will monitor on a quarterly basis the C zone of the existing cluster wells CW-1 through CW-4. This monitoring will provide data necessary in demonstrating that this zone is not affected by constituents of the light nonaqueous phase liquids (LNAPL) such as benzene and toluene, which have been previously detected in only the A and B zones of the Uppermost Aquifer beneath the Refinery.

The following three (3) comments were made in your January 20, 1994 letter and specifically pertain to the Hydrogeologic Characterization, dated January 7, 1993.

1) Page 38, section 5.2.1 (top of page): The concentrations given here for Naphthalene do not agree with the concentrations given for Naphthalene for well CW-2 (upper well) in Table 16. Please explain this discrepancy.

The naphthalene concentration of 102 ug/L reported on page 38 is incorrect. This reported concentration is a typographic error and the correct concentration is 120 ug/L as listed on Table 16.

2) Page 45, section 6.0. second bullet: Please explain the following: A conclusion is made that there is no apparent hydraulic interconnection between the uppermost water-bearing zone, "A zone", and the lower water-bearing zone "B and C zones". Apparently contradicting this is a second conclusion that there is an upward displacement of groundwater indicating hydraulic interconnection as a result of use of the injection wells.

The foregoing comment requires clarification on two points. First, the conclusion that there is "no apparent hydraulic interconnection between the uppermost water-bearing zone, 'A zone,' and the lower water-bearing zones 'B and C zones'" is not correct. The second bullet on page 45 of the Hydrogeologic Characterization is repeated and clarified below.

> "The data and field observations indicate that the aquitard is laterally continuous, and that there is no apparent hydraulic interconnection between the Uppermost Aquifer [zones A, B, and C] and deeper aquifers [those below zone C and the Uppermost Aquitard]."

Second, the assertion regarding the upward displacement of water from refinery injection has not been confirmed by additional water level measurements. This conclusion is based on a limited set of data collected from four sets of cluster wells. The potentiometric gradients are very small at the BHPPAR facility and even slight variations of water level measurements due to normal pressure transducer drift could account for the apparent upward displacement of groundwater. The influence of the injection wells on the Uppermost Aquifer should be based on additional water level measurements as proposed in the GMP. The nine sets of cluster wells that will be utilized by the GMP will provide more extensive data.

> **3) Page 9, section 2.1.2, third paragraph: What is the status of the injection wells nos. 1 and 2? Specifically have these wells been plugged and abandoned? Did these wells inject wastes into what is termed "aquifer 2".**

* These two injection wells are currently in the process of being properly abandoned under State of Hawaii Underground Injection Control program guidelines and have not been in use for the last ten (10) years. BHPPAR should receive the abandonment permits from the State of Hawaii Department of Health within sixty (60) days of EPA's receipt of this response letter. These two injection wells did not inject wastewater into "Aquifer 2". These wells were completed in "Aquifer 1" and were used in the past to inject wastewater into "Aquifer 1".

We appreciate your comments on our GMP and look forward to working with you on future hydrogeologic issues. Please contact Mr. Ken Vandergrift at (808) 547-3947 with any questions you or your staff may have while reviewing these responses and revisions to the GMP.

Sincerely,

Frank R. LaPointe

Frank R. LaPointe
Refinery Manager

cc: Mr. Rich Vaille, EPA
Ms. Paula Bisson, EPA
Ms. Gracelda Simmons, HDOH

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from BHP

Park
Environmental

January 14, 1994

Mr. Richard Vaille
U.S. ENVIRONMENTAL PROTECTION AGENCY **1233-J1**
Hazardous Waste Management Division
75 Hawthorne Street
San Francisco, CA 94105

REFERENCE: Generalized Hydrogeologic Cross-Section and Corresponding Letter

Dear Mr. Vaille:

Enclosed is a copy of the Generalized Hydrogeologic Cross-Section of the Ewa Plain, Oahu, Hawaii, and the corresponding letter dated January 12, 1994, that describes the cross-section, for your files. The cross-section and corresponding letter were submitted to Ms. Nicole Moutoux of the U.S EPA on January 13, 1994.

If you have any questions or comments regarding this cross-section, please contact me at (714) 777-1001.

Sincerely,

PARK ENVIRONMENTAL CORPORATION

Anthony Silva

Anthony Silva, R.G.
Principal Hydrogeologist

AS:kj

Enclosures

5100 E. Hunter Ave. Anaheim, CA 92807 TEL:714-777-1001 800-727-7275 FAX: 714-777-1262

Park
Environmental

January 12, 1994

Ms. Nicole Moutoux
Arizona, Nevada, Pacific Islands Section (H-2-2)
Hazardous Waste Management Division
U. S. ENVIRONMENTAL PROTECTION AGENCY **1233-J1**
75 Hawthorne Street
San Francisco, CA 94105-3901

REFERENCE: Generalized Hydrogeologic Cross-Section of the Ewa Plain, Oahu, Hawaii as Requested by EPA

Dear Ms. Moutoux:

At the request of BHP Petroleum Americas Refinery, Inc. (BHPPAR) (formerly known as Hawaiian Independent Refinery, Inc. [HIRI]), **Park Environmental Corporation (Park)** has prepared this letter and enclosed generalized hydrogeologic cross-section which describes the nature and types of sediments and aquifers beneath the Ewa Plain and BHPPAR's refinery located at 91-325 Komohana Street, Ewa Beach, Oahu, Hawaii (the "Refinery"). This cross-section was requested by Ms. Latha Rajagopalan in a recent meeting with BHPPAR.

The enclosed cross-section (A-A') of the Ewa Plain, Oahu, Hawaii represents a compilation and interpretation of information regarding the hydrogeology of the Ewa Plain. This information was obtained from the following sources: reports from various environmental consulting firms (e.g., Dames & Moore), State of Hawaii governmental agencies and the United States Geological Survey (USGS). References for this information are listed at the end of this letter. A brief description of the hydrogeology illustrated in the cross-section and our understanding of groundwater extraction at the desalination plant is presented in this letter.

Generalized Ewa Plain Cross-Section Hydrogeology

The generalized cross-section illustrates lithologic sediments and geologic formations through the use of geologic symbols. Five (5) separate geological symbols are used to graphically represent the following lithology in the cross-section: reef limestone, silty coral gravel (limestone), silty material (aquitard material), alluvium and volcanic. The lithology is grouped into two (2) main series: the Caprock series which consists of aquifers and aquitards, and the Waianae volcanic series which consists of three (3) separate groundwater zones including the fresh water lens or the "Basal Lens/Aquifer". These symbols and their representative lithology

B:1233J1.LTR

5100 E. Hunter Ave. Anaheim, CA 92807 TEL:714-777-1001 800-727-7275 FAX: 714-777-1262

are shown on the cross-section's legend.

Three separate types of groundwater (fresh, brackish and saline groundwater), differentiated by their total dissolved solids (TDS) content, are illustrated on the cross-section through the use of blue and green colors. Light blue color represents fresh water, medium blue color represents brackish water and green color represents saline water. The different colors and their respective groundwater types can also be found in the cross-section's legend.

In general, coastal plain deposits of the Caprock series consisting of reef limestone interbedded with silt layers can be found on the left-hand section (south) of the cross-section. This section is further characterized by the presence of saline groundwater (green color). Volcanic deposits of the Waianae volcanic series can be found on the right-hand section (north) of the cross-section with three distinctive types of groundwater: fresh, brackish and saline. Fresh groundwater within the Waianae volcanic series has been described as a lens of relatively fresh water or the Basal Lens/Aquifer flowing over a body of relatively static saline water. The thickness of the Basal Lens/Aquifer appears to vary with hydraulic head in accordance with the Ghyben Herzberg principal and is influenced by precipitation within the Waianae Range and groundwater extraction for drinking water. A transition zone (brackish water) separating the relatively fresh water from more brackish and saline water lies beneath the Basal Lens/Aquifer.

The coastal plain deposits and the volcanic sediments are separated by a gently sloping (3° from the horizontal) "erosional layer" consisting of silty material. This erosional layer acts as a relatively impermeable boundary restricting significant groundwater flow between the coastal plain deposits and the volcanic sediments. Groundwater in the volcanic sediments occur in confined or artesian conditions due to the confining erosional layer. If intermixing of groundwater from the Caprock series and the Waianae volcanic series were to occur, then it would result from upward flow of groundwater from the confined aquifers of the Waianae volcanic series into the Caprock series. Regional groundwater flow in the Caprock is towards the ocean or in a southerly direction in the cross-section A-A' (Dames & Moore 1986, State of Hawaii, 1989). A more detailed description of the hydrogeology of the Ewa Plain is presented below.

Detailed Ewa Plain Cross-Section Hydrogeology

Field work and literature research completed by Dames & Moore in 1974 and 1986, and by HLA in 1987, indicate that the Refinery was underlain by a "wedge" (often referred to by the Department of Land and Natural Resources [DLNR] and the USGS as "Caprock") of sedimentary strata composed of reef and lagoonal sediments, including coralline limestone and calcareous mudstone, and terrestrial sediments (Dames & Moore, 1974; Dames & Moore, 1986; Harding Lawson, 1987; State of Hawaii, 1989).

The Caprock overlies a basaltic basement and the upper 300 feet consists of three (3) aquifers separated by at least two (2) terrestrial silt aquitards (Dames & Moore, 1974). The uppermost portion of the Caprock (i.e., limestone strata) is termed Aquifer 1 by the DLNR and is described

as a fossil reef. Aquifer 1 is underlain by a terrestrial silt unit (often referred to by the DLNR and the USGS as Aquitard 1 which occurs approximately 110 to 140 feet below ground surface (bgs). The next lower limestone strata is termed Aquifer 2 by the DLNR and the following confining layer is termed Aquitard 2. Further differentiation of the remainder of the Caprock between Aquitard 2 and the volcanic basement is not made and is generally referred to as Aquifer 3 (State of Hawaii, 1989). The lower aquitards appear to consist of brown terrestrial and alluvial sediments (Dames & Moore, 1986). The lowest strata in the Caprock is composed of muddy sediments (the "erosional layer") directly overlying the basaltic basement.

Based on the Dames & Moore 1974 and 1986 reports, a brown silt layer (an additional aquitard later termed the "Uppermost Aquitard" by BHPPAR) believed to be of alluvial origin is located within Aquifer 1 at approximately 65 feet below the ground surface and is approximately 5 to 10 feet thick. Dames & Moore believed that this silt layer was laterally continuous beneath the Refinery (Dames & Moore, 1974 and Dames & Moore, 1986). Please see Dames & Moore, 1974, Dames & Moore, 1986 and Harding Lawson, 1987 for additional hydrogeologic information. Further description of the Uppermost Aquifer and the Uppermost Aquitard is presented in the following section.

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Sincerely,

PARK ENVIRONMENTAL CORPORATION

Anthony Silva

Anthony Silva, R.G.
Principal Hydrogeologist

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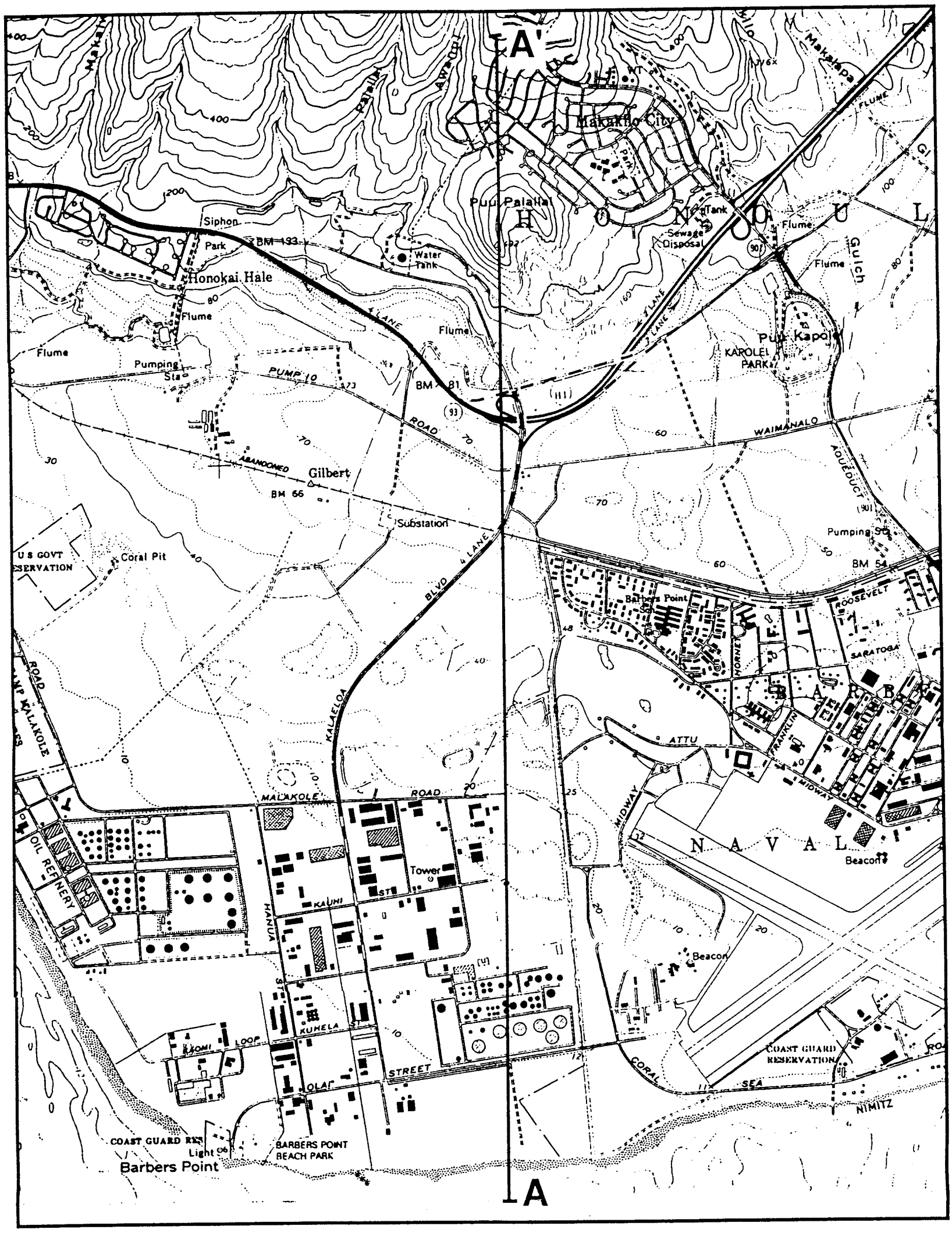

REFERENCE 1983 UNITED STATES GEOLOGICAL SURVEY: EWA QUADRANGLE

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SITE VICINITY MAP
SHOWING CROSS-SECTION A-A'
EWA PLAIN
OAHU, HAWA

Park Environmental

GENERALIZED HYDROGEOLOGIC CROSS-SECTION OF THE EWA PLAIN OAHU, HAWAII

HORIZONTAL SCALE 1"=2,000'
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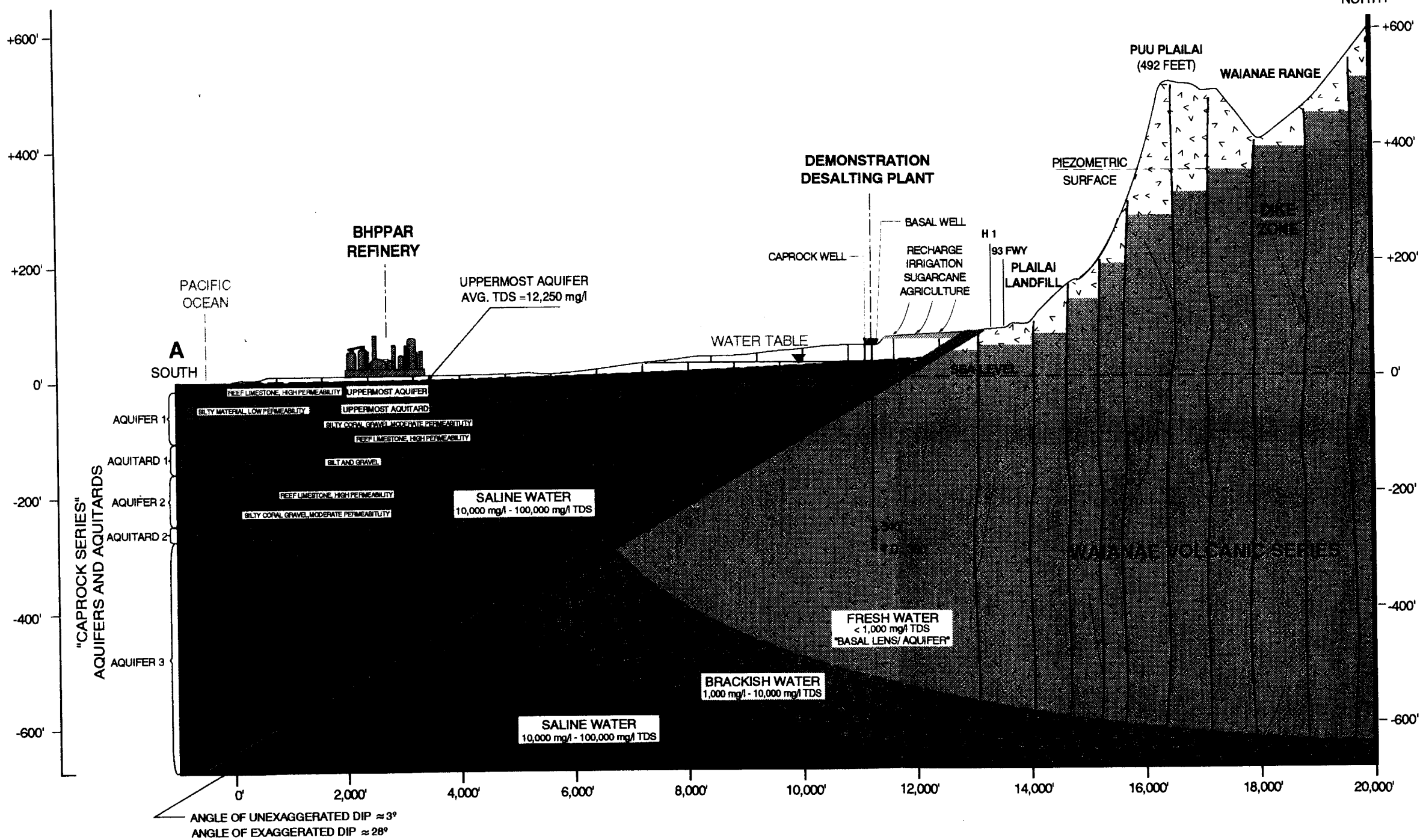

LEGEND

BHPPAR - BHP PETROLEUM AMERICAS REFINING INC.

mg/l - MILLIGRAM PER LITER

TDS - TOTAL DISSOLVED SOLIDS

T.D. - TOTAL DEPTH

LITHOLOGY

- REEF LIMESTONE
- SILTY CORAL GRAVEL
- SILTY MATERIAL
- ALLUVIUM
- VOLCANIC

GROUNDWATER

- SALINE WATER 10,000 mg/l - 100,000 mg/l TDS
- BRACKISH WATER 1,000 mg/l - 10,000 mg/l TDS
- FRESH WATER < 1,000 mg/l TDS

CONTACT — — — ? ? DASHED WHERE APPROXIMATELY LOCATED ; QUERIED WHERE UNCERTAIN

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Park
Environmental

January 12, 1994

Ms. Nicole Moutoux
Arizona, Nevada, Pacific Islands Section (H-2-2)
Hazardous Waste Management Division
U. S. ENVIRONMENTAL PROTECTION AGENCY **1233-J1**
75 Hawthorne Street
San Francisco, CA 94105-3901

REFERENCE: Generalized Hydrogeologic Cross-Section of the Ewa Plain, Oahu, Hawaii as Requested by EPA

Dear Ms. Moutoux:

At the request of BHP Petroleum Americas Refinery, Inc. (BHPPAR) (formerly known as Hawaiian Independent Refinery, Inc. [HIRI]), **Park Environmental Corporation (Park)** has prepared this letter and enclosed generalized hydrogeologic cross-section which describes the nature and types of sediments and aquifers beneath the Ewa Plain and BHPPAR's refinery located at 91-325 Komohana Street, Ewa Beach, Oahu, Hawaii (the "Refinery"). This cross-section was requested by Ms. Latha Rajagopalan in a recent meeting with BHPPAR.

The enclosed cross-section (A-A') of the Ewa Plain, Oahu, Hawaii represents a compilation and interpretation of information regarding the hydrogeology of the Ewa Plain. This information was obtained from the following sources: reports from various environmental consulting firms (e.g., Dames & Moore), State of Hawaii governmental agencies and the United States Geological Survey (USGS). References for this information are listed at the end of this letter. A brief description of the hydrogeology illustrated in the cross-section and our understanding of groundwater extraction at the desalination plant is presented in this letter.

Generalized Ewa Plain Cross-Section Hydrogeology

The generalized cross-section illustrates lithologic sediments and geologic formations through the use of geologic symbols. Five (5) separate geological symbols are used to graphically represent the following lithology in the cross-section: reef limestone, silty coral gravel (limestone), silty material (aquitard material), alluvium and volcanic. The lithology is grouped into two (2) main series: the Caprock series which consists of aquifers and aquitards, and the Waianae volcanic series which consists of three (3) separate groundwater zones including the fresh water lens or the "Basal Lens/Aquifer". These symbols and their representative lithology

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5100 E. Hunter Ave. Anaheim, CA 92807 TEL:714-777-1001 800-727-7275 FAX: 714-777-1262

are shown on the cross-section's legend.

Three separate types of groundwater (fresh, brackish and saline groundwater), differentiated by their total dissolved solids (TDS) content, are illustrated on the cross-section through the use of blue and green colors. Light blue color represents fresh water, medium blue color represents brackish water and green color represents saline water. The different colors and their respective groundwater types can also be found in the cross-section's legend.

In general, coastal plain deposits of the Caprock series consisting of reef limestone interbedded with silt layers can be found on the left-hand section (south) of the cross-section. This section is further characterized by the presence of saline groundwater (green color). Volcanic deposits of the Waianae volcanic series can be found on the right-hand section (north) of the cross-section with three distinctive types of groundwater: fresh, brackish and saline. Fresh groundwater within the Waianae volcanic series has been described as a lens of relatively fresh water or the Basal Lens/Aquifer flowing over a body of relatively static saline water. The thickness of the Basal Lens/Aquifer appears to vary with hydraulic head in accordance with the Ghyben Herzberg principal and is influenced by precipitation within the Waianae Range and groundwater extraction for drinking water. A transition zone (brackish water) separating the relatively fresh water from more brackish and saline water lies beneath the Basal Lens/Aquifer.

The coastal plain deposits and the volcanic sediments are separated by a gently sloping (3° from the horizontal) "erosional layer" consisting of silty material. This erosional layer acts as a relatively impermeable boundary restricting significant groundwater flow between the coastal plain deposits and the volcanic sediments. Groundwater in the volcanic sediments occur in confined or artesian conditions due to the confining erosional layer. If intermixing of groundwater from the Caprock series and the Waianae volcanic series were to occur, then it would result from upward flow of groundwater from the confined aquifers of the Waianae volcanic series into the Caprock series. Regional groundwater flow in the Caprock is towards the ocean or in a southerly direction in the cross-section A-A' (Dames & Moore 1986, State of Hawaii, 1989). A more detailed description of the hydrogeology of the Ewa Plain is presented below.

Detailed Ewa Plain Cross-Section Hydrogeology

Field work and literature research completed by Dames & Moore in 1974 and 1986, and by HLA in 1987, indicate that the Refinery was underlain by a "wedge" (often referred to by the Department of Land and Natural Resources [DLNR] and the USGS as "Caprock") of sedimentary strata composed of reef and lagoonal sediments, including coralline limestone and calcareous mudstone, and terrestrial sediments (Dames & Moore, 1974; Dames & Moore, 1986; Harding Lawson, 1987; State of Hawaii, 1989).

The Caprock overlies a basaltic basement and the upper 300 feet consists of three (3) aquifers separated by at least two (2) terrestrial silt aquitards (Dames & Moore, 1974). The uppermost portion of the Caprock (i.e., limestone strata) is termed Aquifer 1 by the DLNR and is described

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Sincerely,

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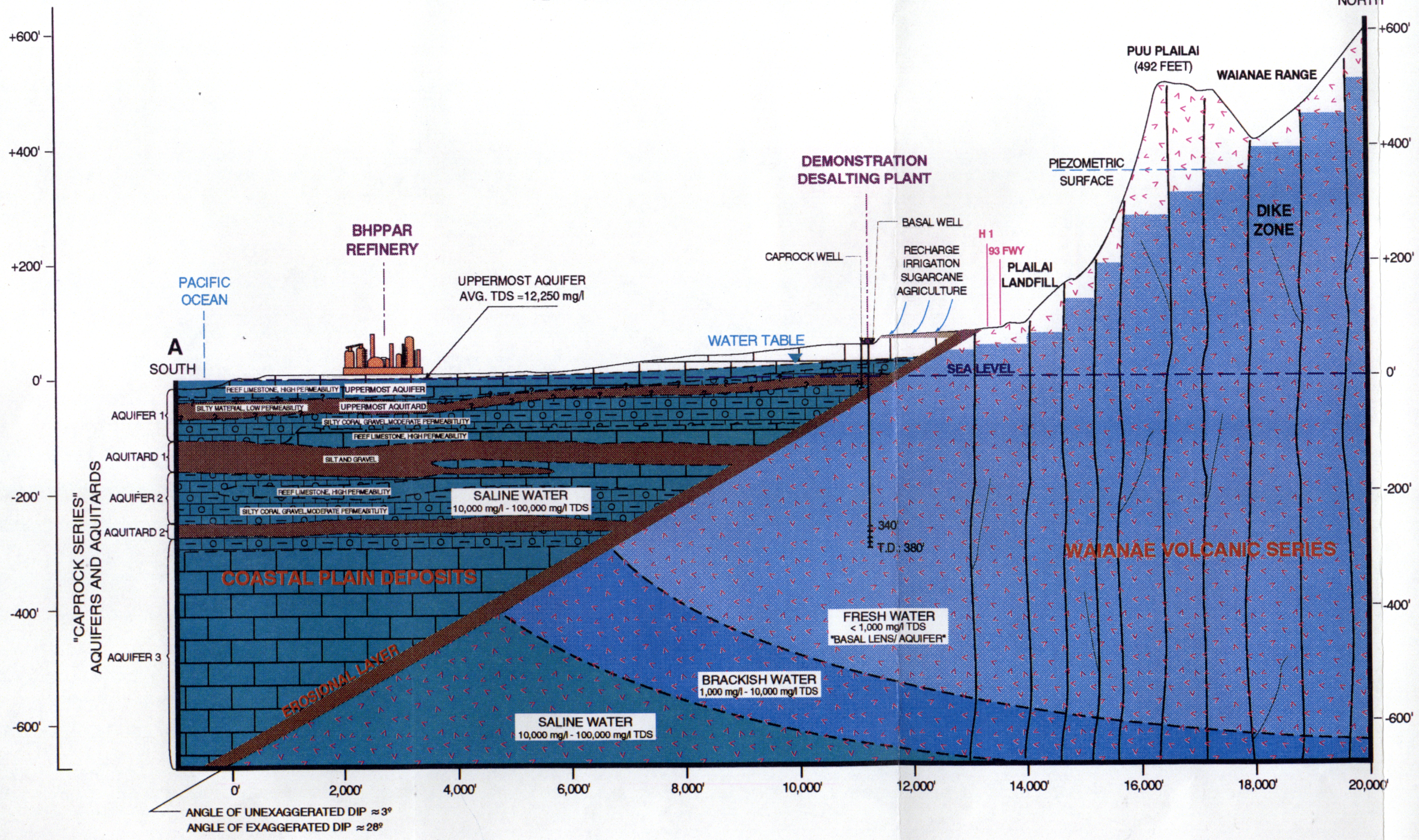

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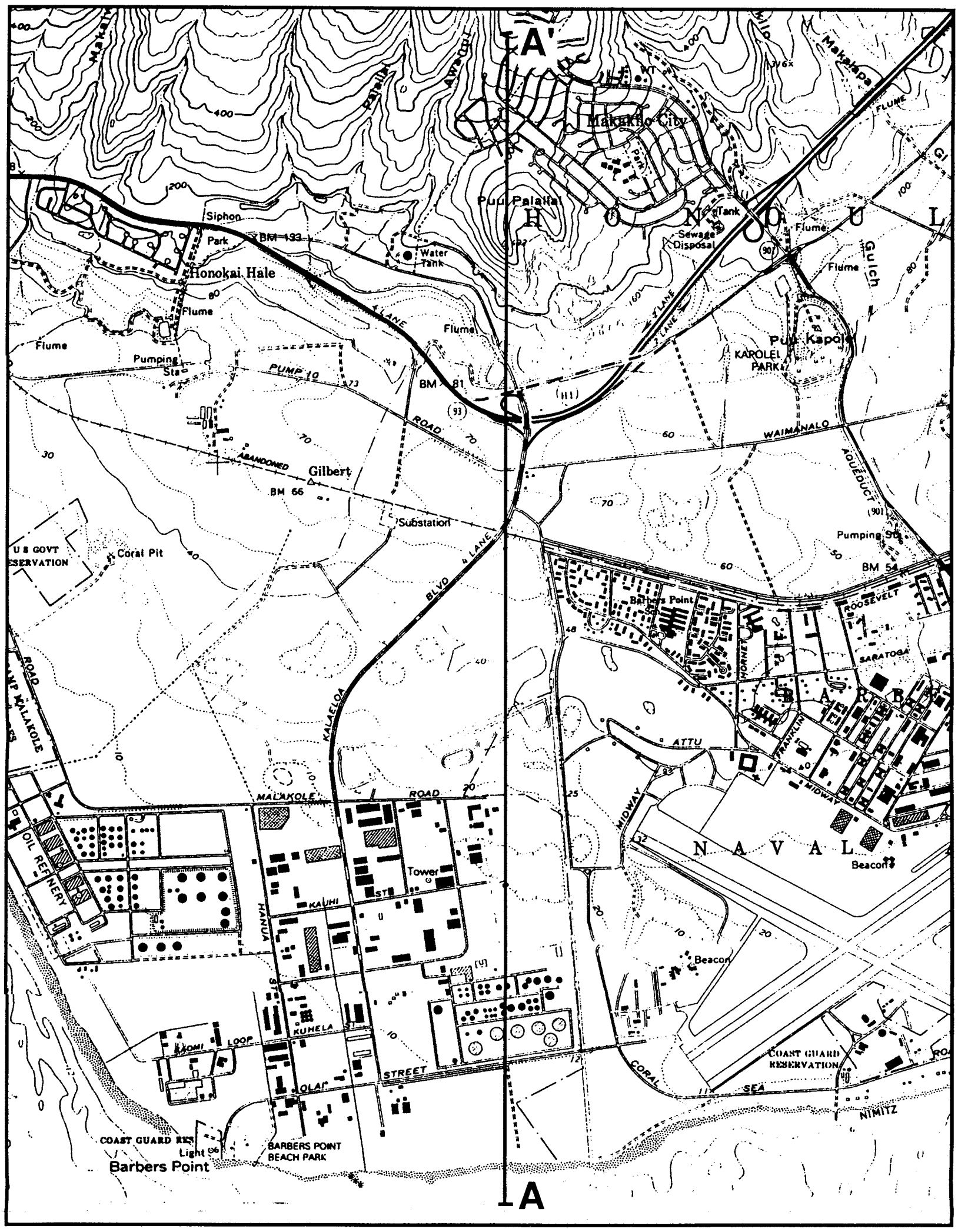

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SITE VICINITY MAP
SHOWING CROSS-SECTION A-A'
EWA PLAIN
OAHU, HAWA

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GROUNDWATER MONITORING PLAN

BHP PETROLEUM AMERICAS REFINING INC.

HID 056 786 395

91-325 KOMOHANA STREET

KAPOLEI, HAWAII 96707

DELTA NO. 45-93-033

Prepared by:

Delta Environmental Consultants, Inc.
27141 Aliso Creek Road, Suite 270
Aliso Viejo, California 92656
(714) 362-3077

October 19, 1993

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1.0 INTRODUCTION

This Groundwater Monitoring Plan (GMP) describes the scope of work and methods of implementation for groundwater monitoring at BHP Petroleum Americas Refining Inc. (BHPPAR, the "Refinery"), formerly Hawaiian Independent Refinery, Inc. or HIRI. The Refinery is located at 91-325 Komohana Street, Kapolei, Hawaii, in the Campbell Industrial Park (Figure 1).

The GMP is submitted by BHPPAR to the U.S. Environmental Protection Agency (EPA) as required by Paragraph 17(b)(i) of the Consent Agreement and Final Order (CA/FO), EPA Docket No. RCRA 09-91-0007. As required by the CA/FO, field activities and analytical results will be summarized in a final report which will be submitted to the EPA in accordance with the schedule of implementation included herein as Table 1.

1.1 Objective

The objective of this GMP is to provide the EPA and personnel conducting the GMP with a written document that describes the scope of work, procedures and techniques that will provide data necessary to meet the requirements specified in the CA/FO, 40 CFR 265.93(d) (3-4) and to conduct groundwater monitoring for groundwater monitoring wells MW-3, MW-4, MW-5 and MW-6 and cluster wells CW-1, CW-2, CW-3 and CW-4. According to 40 CFR 265.93(d)(3) the GMP for the Refinery must specify:

- The number, location, and depth of groundwater monitoring wells installed under the GMP to further characterize the groundwater flow system in the vicinity of Pond Nos. 1, 2A and 2.
- Sampling and analytical methods for Skinner List constituents identified at the Refinery.
- Evaluation procedures, including any use of previously gathered groundwater quality information.
- A schedule of implementation.

Under 40 CFR 265.93(d)(4) and the CA/FO the GMP must, at a minimum, determine:

- The rate and extent of migration of Skinner List constituents that may have been released from Pond Nos. 1, 2A or 2 into the groundwater at the Refinery.
- The concentration of Skinner List constituents in the groundwater at the Refinery.

The data collected will be evaluated and a determination will be made regarding the rate of migration and concentration of Skinner List constituents in the groundwater at the Refinery as soon as technically feasible. This evaluation and determination will be provided to EPA in a report which will be submitted in accordance with the schedule of implementation (Table 1). As stated in 40 CFR 265.93 (d)(6), if the results of the first determination indicate no significant concentrations of Skinner List constituents in the groundwater resulting from releases from Pond Nos. 1, 2A or 2, then BHPPAR will reinstate the quarterly indicator evaluation program for Pond Nos. 1, 2A and 2. The EPA will be notified as required in 40 CFR 265.93 (d)(5) prior to the reinstatement of an indicator evaluation program. Based on an evaluation of GMP data, if the GMP does not provide the information necessary to determine: 1) the rate and extent of migration of Skinner List constituents, which may have been released from Pond Nos. 1, 2A or 2; and 2) whether a release had occurred from Pond Nos. 1, 2A or 2, then additional work will be conducted conducted to provide this information.

This GMP supersedes the "Revised Sampling and Analysis Plan Ground-Water Quality Assessment Monitoring at Pond No. 1", dated August 28, 1991. The previous plan describes the procedures for conducting groundwater monitoring for groundwater monitoring wells MW-3, MW-4, MW-5 and MW-6. This GMP will be the reference document for collecting groundwater samples from groundwater monitoring wells MW-3 through MW-6, cluster wells CW-1 through CW-4 and proposed cluster wells CW-5 through CW-9 (Figures 2 and 3). Cluster wells CW-1 through CW-4 are each comprised of three (3) groundwater monitoring wells. Each groundwater monitoring well is screened at different zones (A, B and C) within the uppermost aquifer. For the purpose of this GMP, only zones A and B will be sampled during groundwater monitoring.

1.2 Overview of Scope of Work

The scope of work includes: the installation of additional groundwater monitoring wells at the Refinery that will be used to assist in determining the rate of migration and the vertical and horizontal extent of Skinner List constituents, which may be detected in groundwater of the uppermost aquifer, emanating from Pond Nos. 1, 2A or 2; groundwater sample collection and analysis; sample handling and shipment; assessment of certain aquifer characteristics necessary for groundwater modeling; water level measurement; immiscible liquid (free-product) evaluation; computer transport modeling; and data evaluation. In addition, this GMP describes quality control procedures that will be implemented during all phases of the scope of work. The purpose of these quality control procedures is to assess the accuracy and validity of the sample analytical

results and computer modeling results. This plan also includes a Health and Safety Plan (HSP) which addresses potential hazards associated with planned field activities outlined in this GMP. A scope of work task summary is included as Table 2.

2.0 BACKGROUND

This section describes the Refinery's history, processes employed and hydrogeologic setting, and briefly summarizes previous investigations conducted at the Refinery.

2.1 Refinery Description

The Refinery is located approximately 22 miles west of downtown Honolulu and approximately 2,000 feet north of the mean tide level of the Pacific Ocean. The Refinery occupies approximately 150 acres in an area of relatively little topographic relief at an elevation of approximately 11 feet above mean sea level. BHPPAR has operated the petroleum refinery since 1972. A refinery site plan is included as Figure 2.

2.1.1 Processing Units and Refined Products

Crude oil processing facilities at the Refinery consist of a crude oil distillation unit, a vacuum distillation unit, a catalytic reformer unit, a distillate hydrocracker, a hydrogen generation unit, a visbreaker, a cogeneration unit, sulfur recovery units, a light ends recovery unit and an asphalt plant. The Refinery produces a variety of petroleum products, including various grades of gasoline, naphtha-based jet aviation fuel, kerosene-based jet aviation fuel, diesel fuel, a variety of distillate and residual fuel oils, asphalt and a petroleum-based feed stock for use in synthetic natural gas production.

2.1.2 Surface Impoundments

Four (4) surface impoundments (Pond Nos. 1, 2A, 2 and 3) are located near the southwestern corner of the Refinery, as shown on Figure 2. Pond No. 1 was formerly used to manage wastewater and is currently in the closure process. Pond Nos. 2 and 3 are presently used to manage non-hazardous wastewater. Tanks 902 and 902A receive refinery process wastewater which is discharged into Pond No. 2. Pond No. 3 receives only discharge from Pond No. 2. Pond No. 2A formerly received effluent from Tank 902, but this pond is no longer in use.

Wastewater from Pond No. 3 is injected into two (2) underground injection control wells located south of the impoundments as shown in Figure 3. These wells have permits from the State of Hawaii Department of Health (HDOH), Environmental Management Division, Safe Drinking Water Branch.

2.2 Refinery History

The existing groundwater monitoring well network adjacent to the ponds consists of four (4) monitoring wells (MW-3, MW-4, MW-5 and MW-6) installed by Harding Lawson Associates (HLA) in 1987 to monitor groundwater in the vicinity of Pond No. 1, two (2) monitoring wells (MW-7 and MW-8) installed by Levine•Fricke in 1991 to monitor groundwater in the vicinity of Pond Nos. 2A and 2 and four (4) cluster wells (CW-1, CW-2, CW-3 and CW-4) installed by Levine•Fricke to monitor groundwater in the vicinity of Pond Nos. 1, 2A and 2. Locations of the six (6) monitoring wells and the four (4) cluster wells are shown in Figures 2 and 3, respectively. Each of the six (6) groundwater monitoring wells was installed to a depth approximately 20 feet below ground surface (BGS) and screened between 10 and 20 feet BGS. Each of the four (4) cluster wells is comprised of three groundwater monitoring wells. The cluster wells were installed to depths of 25, 43 and 60 feet BGS. The bottom ten (10) feet of each cluster well was screened. Water level measurements collected from these wells have ranged from approximately 11 to 12 feet BGS. Water levels in the wells fluctuate in response to tidal influences.

2.3 Hydrogeologic Setting

Field work and literature research completed by Dames & Moore in 1974 and 1986, and by HLA in 1987, indicate that the Refinery was underlain by a "wedge" (often referred to by the Department of Land and Natural Resources [DLNR] and the United States Geological Survey [USGS] as "Caprock") of sedimentary strata composed of reef and lagoonal sediments, including coralline limestone and calcareous mudstone, and terrestrial sediments (Dames & Moore, 1974; Dames & Moore, 1986; Harding Lawson, 1987; State of Hawaii, 1989).

The Caprock overlies a basaltic basement and the upper 300 feet consists of three (3) aquifers separated by at least two (2) terrestrial silt aquitards (Dames & Moore, 1974). The uppermost portion of the Caprock (i.e., limestone strata) is termed Aquifer 1 by the DLNR and is described as a relatively clean fossil reef. Aquifer 1 is underlain by a terrestrial silt unit (often referred to by the DLNR and the USGS as Aquiclude 1) which occurs approximately 110 to 140 feet BGS. The next lower limestone strata is termed Aquifer 2 by the DLNR and the following confining layer is termed Aquiclude 2. Further differentiation of the

remainder of the Caprock between Aquiclude 2 and the volcanic basement is not made (State of Hawaii, 1989). However, the lower aquifers are generally thinner, with silt contents generally increasing inland. The lower aquitards appear to consist of brown terrestrial and alluvial sediments (Dames & Moore, 1986). The lowest strata in the Caprock is composed of muddy sediments directly overlying the basaltic basement. The wedge is called Caprock because the basal formations of the wedge exhibit poor permeability characteristics and inhibit upward seepage from the lower confined volcanic aquifers (State of Hawaii, 1989).

The limestone formation forming the Caprock (Aquifer 1) is argillaceous to some degree (especially toward the inland boundary). This limestone was believed to be moderately permeable, and the silt layer forming the underlying confining layer (i.e., Aquitard 1) below Aquifer 1 is believed to exhibit a lower permeability than the limestone formation immediately above it (Dames & Moore, 1986). Aquifer 1 is predominantly a lagoonal deposit containing evidence of a thin ash strata and thin discontinuous lenses of mud. Neither strata was believed to behave as an aquiclude. The transition from Aquifer 1 to Aquitard 1 is believed to be abrupt (State of Hawaii, 1989).

Based on the Dames & Moore 1974 and 1986 reports, a brown silt layer (an additional aquitard) believed to be of alluvial origin is located approximately 65 feet below the ground surface and is approximately 5 to 10 feet thick. Dames and Moore believed that this silt layer acted as an additional aquitard, was laterally continuous beneath the Refinery and was probably the lower boundary for movement of potential refinery contaminants (Dames & Moore, 1974 and Dames & Moore, 1986). Please see Dames & Moore, 1974, Dames & Moore, 1986 and Harding Lawson, 1987 for additional hydrogeologic information.

2.3.1 Site Hydrogeology

The uppermost aquifer and the uppermost aquitard were defined in Levine•Fricke's "*Hydrogeologic Characterization*", dated January 7, 1993. The uppermost aquifer was originally identified by Dames & Moore in 1986.

2.3.1.1 Uppermost Aquifer

The uppermost aquifer was defined (pursuant to 40 CFR, Section 146.3) as the fossil reef from a depth of 11 feet BGS to a depth of approximately 60 feet BGS. The water-bearing zone consists of coralline limestone with discontinuous lenses of siltstone, sandy silt and silty sands, as described in Section 4.2. The limestone is stated to be very porous, with voids measuring up to several inches. Based on the drilling

conditions and lithology encountered in the exploratory borings drilled during the Levine•Fricke hydrogeologic characterization, groundwater flow in the uppermost aquifer appears to be representative of porous media flow, as opposed to typical conduit (mature karst-type) flow.

2.3.1.2 Uppermost Aquitard

Less permeable terrestrial sediments (an aquitard) consisting of sandstone and silty sand underlie the uppermost aquifer. This strata was encountered at each cluster well location at depths ranging from 57 to 60 feet BGS and extending to the bottom of the boreholes. Dames & Moore also encountered a relatively low permeability silt layer (an aquitard) near CW-3 at a depth of approximately 65 feet BGS. Dames & Moore concluded that this lower permeability layer was probably the lower boundary for movement of potential refinery contaminants (Dames & Moore, 1986). Exploration by Levine•Fricke did not fully penetrate the sandstone/silty sand formation encountered at a depth of 57 to 60 feet BGS. The Hydrogeologic Characterization indicated that the sandstone/siltstone formation (aquitard) is the lower boundary for downward migration of potential Refinery contaminants near the surface impoundments.

2.3.2 Previous Subsurface Investigations

Previous subsurface investigations were performed at the Refinery by Dames & Moore in 1974 and 1986, by HLA in 1987 and by Levine•Fricke in 1991 and 1993. These investigations are summarized below.

2.3.2.1 Dames & Moore Hydrogeologic Characterization

In 1974, the Refinery retained Dames & Moore to evaluate alternatives for wastewater disposal. The work included conducting a hydrogeologic investigation to compare groundwater injection and ocean outfall discharge scenarios.

In 1986, the Refinery retained Dames & Moore to perform a more comprehensive hydrogeologic study to provide data useful in designing and implementing a groundwater monitoring well network. The results of this study were presented to the Refinery in Dames & Moore's June 1986 report.

2.3.2.2 Shallow Groundwater Monitoring Well Network

In 1987, HLA installed a network of four (4) monitoring wells (MW-3, MW-4, MW-5 and MW-6) to monitor shallow groundwater conditions adjacent to Pond No. 1. The locations of these four (4) monitoring wells are shown in Figures 2 and 3. The monitoring wells were installed to depths of approximately 20 feet BGS,

and were screened from approximately 10 to 20 feet BGS. Water level measurements indicate groundwater in the wells ranges from approximately 11 to 12 feet BGS.

2.3.2.3 Previous Groundwater Monitoring

Groundwater monitoring was performed by HLA for wells MW-3, MW-4, MW-5 and MW-6 during four (4) different periods prior to November 1987, and at semi-annual intervals from November 1987 through May 1989. Quarterly groundwater monitoring was performed for these wells by HLA between May 1989 and May 1991, and by Levine•Fricke between August 1991 and May 1993. Currently, the Refinery is conducting the quarterly groundwater monitoring. A summary of the 1991 and 1992 quarterly groundwater monitoring data for Pond No. 1 is presented in the Refinery's Annual Groundwater Monitoring Reports (HIRI, 1991 and 1992).

2.3.2.4 Levine•Fricke Hydrogeologic Characterization

In 1992, the Refinery retained Levine•Fricke to conduct a hydrogeologic characterization at the Refinery. The objectives of the hydrogeologic characterization were to assess: 1) the vertical flow direction and gradient; 2) the horizontal flow direction and gradient; 3) the hydraulic conductivity, storativity, and effective porosity of the uppermost aquifer; 4) the hydraulic conductivity and total porosity of the uppermost aquitard; 5) the potential for hydraulic interconnection between saturated zones; 6) the influence of the tides and the injection wells on groundwater flow directions; and 7) the vertical and lateral distribution of Skinner List constituents in groundwater near the surface impoundments.

The hydrogeologic characterization was completed in accordance with applicable EPA guidance documents and approved Work Plans. Results of the study were described in Levine•Fricke's report entitled "*Hydrogeologic Characterization*", dated January 7, 1993 and approved by the EPA in a letter dated August 6, 1993.

3.0 SCOPE OF WORK

This section describes the scope of work and procedures for conducting the GMP. Items described in this section include installation of groundwater monitoring wells, sampling of groundwater, analysis of groundwater samples, preservation and handling of groundwater samples, implementation of a free-product evaluation program, assessment of certain aquifer characteristics necessary for groundwater modeling,

establishment of a water level monitoring program, an equipment Quality Assurance/Quality Control (QA/QC) program, selection and development of a computer database containing all pertinent GMP data, development of a groundwater flow and transport model and the methods used to interpret groundwater data.

3.1 Limited Geophysical Survey

Prior to drilling the borings, the locations of underground utilities will be assessed through the use of electrical line locator and pipe locator instruments. Underground utilities that are identified will be marked with survey paint and/or flagging. Final boring placement will be dependent on the locations of underground utilities.

3.2 Groundwater Monitoring Well Installation

BHPPAR will install five (5) on site groundwater monitoring well clusters (CW-5 through CW-9) in the uppermost aquifer underlying the Refinery. The well clusters will be located as shown in Figure 3. The locations of the well clusters was determined by the five following objectives: 1) to provide data points to develop potentiometric surfaces for each of the two (2) arbitrary vertical zones (zones A and B) of the uppermost aquifer; 2) to allow adequate spatial distribution between the clusters to be representative of the area of interest (i.e., Pond Nos. 1, 2A and 2); 3) to provide water quality data for groundwater upgradient and downgradient of Pond Nos. 1, 2A and 2; 4) to divide the uppermost aquifer into arbitrary vertical intervals, with a separate monitoring well in each interval, that will allow the evaluation of vertical gradients; and 5) to aid in the estimation of the rate and extent of migration of possible Skinner List constituents in the groundwater which may have been released from Pond Nos. 1, 2A or 2.

Based on the analytical data reported in the "*Hydrogeologic Characterization*", the investigation of the uppermost aquifer will be confined to two (2) vertical groundwater zones, A and B. The third zone (zone C) assessed in the "*Hydrogeologic Characterization*" did not indicate the presence of Skinner List constituents and therefore is not considered in this GMP. Each well cluster will consist of two (2) groundwater monitoring wells as shown in Figure 4. The wells within each cluster will be screened at depths selected to assess the vertical gradient. Each cluster will have an alphanumeric identification (e.g., CW-5A and CW-5B) which describes the depth of the well in that particular cluster. For example, cluster well CW-5A will be installed to approximately 25 feet BGS and screened within interval A at a depth of approximately 15 to 25 feet BGS (Figure 5). The second well in each cluster (CW-5B) will be installed to approximately 43 feet

BGS and will be screened within interval B at a depth of approximately 33 to 43 feet BGS. Necessary monitoring well permits and utility clearances will be obtained by BHPPAR prior to drilling and installing each of the wells. All applicable health and safety standards as described in Appendix H will be implemented during the groundwater monitoring well installation.

Groundwater monitoring wells will be installed by drilling the boreholes with a Watson 2000 Bucket Auger drilling rig (or equivalent drilling equipment). The drilling rig will be equipped with 12-inch outer diameter (O.D.) core barrels. The core barrels are 5 feet long and each borehole will be cored in 5-foot intervals until completion. In the event that free-product is encountered during the installation of groundwater monitoring wells, special drilling procedures will be incorporated. (See Appendix A for these special drilling procedures.)

Drilling equipment will be steam cleaned prior to use at each groundwater monitoring well location. Sampling equipment will be cleaned with a laboratory-grade detergent and double-rinsed with distilled water between sampling events. All down hole drilling equipment and well casings will be steam cleaned prior to initiation of each well installation.

The groundwater monitoring wells will be constructed of 4-inch diameter flush-threaded-joint polyvinyl chloride (PVC) casing with factory-slotted well screen. Based on the consolidated limestone of the formation well casing, slot size will be 0.020-inch factory-slotted screen. The shallow wells will be designed to allow sampling of the upper shallow groundwater zone without allowing direct surface water runoff or vertical migration through the well annulus. An illustration of a typical monitoring well is presented as Figure 6. Additionally, monitoring well construction information will be included on well construction logs. A sample well construction log is included in Appendix B.

After the well has been installed in the boring, the well annulus opposite the slotted casing will be backfilled with No. 8-12 sized sand pack. The sand will extend to a height of approximately two (2) feet above the screened interval. A sodium bentonite seal approximately three (3) feet thick will then be placed above the sand pack. Well development (Section 3.2.3) will occur during and after the installation of the sand pack. The remaining borehole annulus will be filled with cement/bentonite grout, and the top of the well will be completed with a locking cap and monument well box to protect the integrity of the well. When dedicated pumps are added to the wells, the well head equipment will be secured to the well head and locked.

Waste soils and wastewater produced from drilling, well development and groundwater sampling activities will be placed within storage bins and/or 55-gallon Department of Transportation (DOT)-approved drums and stored at the Refinery pending proper disposal. Waste soil and wastewater management are further discussed in Section 3.10 of this document.

3.2.1 Lithologic Logging

The field geologist will describe the recovered coral cores visually in the field and these descriptions will be recorded on a well construction log. The description will be based on coral cores and drill cuttings circulated to the surface. All well construction log, sample intervals (depth intervals) and percent sample recovery will be recorded on the boring log. All rock designations, descriptions and strata changes will also be recorded.

Once the core barrel has collected its sample, the core barrel will be removed from the borehole and disassembled on the ground surface by the field geologist. The recovered core will be placed in the core box with the upper (surface) end of the core at the upper-left corner of the core box. The core will continue to be boxed with appropriate markings and spacer blocks. Spacer blocks will be used to properly mark noticeable gaps in the recovered core which may indicate voids in the coral formation. The field geologist will photograph each core with a scale and describe the recovered core in accordance with the procedure described below.

Coral cores generated during the installation of groundwater monitoring wells will be classified by geologic classification, weathering characteristics, discontinuity classification, color, grain size and hardness. Geologic classification identifies the sample by the geologic name and local name (if any). Geologic classification for sedimentary rocks (coral) would include: group, grain size, composition and name (e.g., fossiliferous limestone). Subordinate constituents in the sample such as seams or bands of a different type of material (e.g., calcareous sandstone, clay, sandy limestone and dolomitic limestone) will also be recorded on the well construction log. Weathering classification is described as fresh, slightly weathered, moderately weathered, highly weathered, completely weathered and residual coral. Discontinuity classification describes spacing of fractures, joints and voids as wide, medium, close and very close. The width of the fracture opening or the cavity and its filling (sand, clay, breccia, etc.) will be recorded. The Rock Color Chart by the Geological Society of America will be used to describe the sample's basic colors. Grain size for sedimentary rocks will include the following descriptions: coarse-grained, medium-grained, fine-grained, and very fine-grained.

Hardness will include the following descriptions: extremely hard, very hard, hard, soft and very soft. Subsurface structures, including fractures, cavities and visual observations of staining, will also be described on the boring log. This lithologic logging will assist in further characterizing the uppermost aquifer.

3.2.2 Coral Sample Collection

Coral samples will be collected for the assessment of aquifer characteristics as described in Section 3.8 and Table 9 of this document. Samples will be collected from the borings following ASTM designation: D 2113-83; Standard Practice for Diamond Core Drilling For Site Investigation. The samples will be placed in wide mouth plastic or glass containers, labeled and immediately placed in a chilled cooler for delivery to the analytical laboratory. Each sample container submitted to the laboratory for analysis will have a label affixed to identify the Refinery's project number, sample date, analyses requested, time of sample collection and sampler's initials. Strict chain-of-custody protocol will be followed throughout the sample handling process.

3.2.3 Well Development

Prior to well development, static water level measurements will be collected from each well. The groundwater monitoring wells will be developed by surging, swabbing, and pumping to remove fine sediment from the formation around the wells to enhance hydraulic communication of the well with the surrounding formation. Visual observations concerning the quantity and clarity of the groundwater drawn from the well will be recorded during this process. Turbidity measurements will be collected using a turbidity meter calibrated to the nephelometric turbidity unit (NTU) system, or equivalent turbidity unit system, and recorded on the appropriate groundwater sampling data sheets and in the field log book. The final turbidity measurement will be recorded in the field log book and on the well construction log. The rate at which groundwater is removed from the well during development will be recorded in the field log book and well development sheets.

3.2.4 Monitoring Well Security, Inspection and Maintenance

The monument well box for each groundwater monitoring well included in this GMP will be secured with a lock to prevent tampering. The groundwater monitoring wells (including well box, casing and dedicated pump) will be inspected on a monthly basis by field personnel for signs of tampering or damage. All well security, inspection and maintenance information will be recorded in a field log book on a monthly basis. If field personnel notice signs of tampering or damage, then descriptions of the tampering or damage will be made in the field log book and the damage will be repaired.

3.3 Well Location Survey

Following installation of the cluster wells, the horizontal and vertical coordinates of each groundwater monitoring well will be established by a licensed surveyor. The following sections describe the necessary standards for elevation reference points associated with the construction of groundwater monitoring wells.

3.3.1 Establishment of Elevation Reference Points

Each well will have a permanent, easily identifiable reference point established with respect to mean sea level (MSL). The reference points will be established in relation to a National Geodetic Vertical Datum (NGVD) bench mark. If necessary, a temporary bench mark will be established at the Refinery and referenced to an established NGVD bench mark to facilitate future surveying events. Each well will have the following reference point elevations established:

- Ground surface elevation at the bench mark or temporary bench mark (± 0.01 feet) with respect to MSL.
- Surveyor's pin elevation or distinguishable marking on the concrete apron located around the groundwater monitoring well (± 0.01 feet).
- Top of the groundwater monitoring well casing elevation (± 0.01 feet) with locking cap removed.
- Top of protective steel casing (if present) elevation (± 0.01 feet) with locking cap removed.

All reference points will be marked on the north side of the groundwater monitoring wells. Groundwater elevation measurements will be taken from the reference point located and marked at the top of the well casing with locking cap removed.

All monitoring wells will have established horizontal coordinates and will be referenced to Hawaii Zone 3 State Plane Coordinate System based on the 1983 NGVD datum. The monitoring wells will also be referenced to the Refinery's local coordinate system. All applicable health and safety standards, as described in Appendix H, will be implemented during the well location survey.

3.4 Well Purging and Sample Collection

This section describes the procedures to be followed when collecting groundwater samples for chemical analysis, decontamination of sampling equipment procedures and laboratory QA/QC procedures.

3.4.1 Static Water Level Measurements

The locking and protective caps will be removed from each monitoring well and the air above the wellhead will be monitored for organic vapors. The concentration of organic vapors will be measured using a combustible gas meter (CGM) calibrated to isobutylene. If the concentration of organic vapors above the wellhead is greater than 10% of the lower explosion limit (LEL) for naphtha (10,000 parts per million [ppm]), then field personnel will monitor the area until the concentrations fall below 10% of the LEL. Not until the concentration of organic vapors around the wellhead falls to acceptable levels will permission be given by the Site Safety Officer (SSO) for work to begin on the well.

Prior to purging each well, the depth to the top of free-product (if any), the depth to groundwater and the total depth of the well will be measured from the established reference point using an ORS oil-water interface meter or an equivalent interface measuring probe. The measuring devices will have the capability of measuring to the nearest 0.01 foot. Prior to beginning well purging, samples of the free-product will be collected in accordance with Section 3.4.4 of this GMP.

Before introducing any measuring device into each groundwater monitoring well, the device will be decontaminated according to procedures outlined in Section 3.4.5. The measurements, the date and time of measurement will be recorded in the bound field log book. (See Section 3.6.6.)

Groundwater elevations obtained from wells containing free-product floating on the water table will be numerically adjusted by multiplying the measured thickness of the free-product by the specific gravity of the free-product within each well and then subtracting the result from the measured depth to groundwater, thereby creating an adjusted value for the depth to groundwater. This adjusted depth to groundwater will then be subtracted from the well elevation to obtain the adjusted groundwater elevation. (See Section 3.4.4 for free-product sample collection.)

3.4.2 Well Purging

Prior to collecting groundwater samples, a volume of groundwater equal to at least the volume of groundwater contained in the borehole will be withdrawn from the well using a dedicated positive displacement pneumatic bladder sampling pump or an equivalent piece of equipment. Plastic sheeting will be placed around each groundwater monitoring well. The groundwater will be withdrawn at a rate no greater than the maximum rate achieved during the development process (recorded in field log book and on

the well development sheets). The intake portion of the pump will be located at a level sufficient to draw fresh formation groundwater through the entire submerged portion of the well casing. The purged groundwater will be collected and placed in 55-gallon DOT-approved drums and stored at the Refinery pending proper disposal.

The rate and volume of groundwater purged from each well will be measured by timing the filling of a container graduated in increments of a known volume. Using a borehole diameter of 12 inches and a casing diameter of 4 inches, there is approximately 5.22 gallons of fluid in each linear foot of the borehole (not including the fluid in the well casing) and approximately 0.65 gallons of fluid in each linear foot of the well casing. The minimum volume of groundwater to be purged from the well is calculated by multiplying the height of the water column (total depth of the well minus the depth to water in the well) times 5.22 times the porosity (n) of the sand pack and adding the product of the height of the water column times 0.65. (The porosity of the sand pack may be obtained from the manufacturer.)

$$\textit{minimum purge volume} = (\textit{Water Column} \times 5.22 \times n) + (\textit{Water Column} \times 0.65)$$

Prior to well purging and sampling each day, a pH meter will be calibrated using standard solutions, as specified by the manufacturer of the particular pH meter. The pH, temperature and electrical conductivity of the discharged groundwater will be measured and this data will be recorded on groundwater sampling data sheets and in a field log book at least three (3) times during the purging process. These water quality parameters will be allowed to reach relative stabilization (consecutive values within 10% of each other) before groundwater samples are collected.

Well purging depends on the specific yield characteristics of the well. The recharge rate of groundwater monitoring wells is expected to be high and is expected to be capable of yielding more than one borehole volume of water as recommended in the RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD), September, 1986. Remeasuring for pH, temperature and specific conductance after sampling each well as a check on the stability of the water sampled is generally applicable for low-yield wells. Measurement of these parameters after completion of sampling will be collected only if a low-yield well is encountered. A low yield well is one from which field personnel are unable to purge one (1) borehole volume of groundwater.

3.4.3 Groundwater Sampling

Groundwater samples will be collected on a quarterly basis (four [4] times a year) approximately coincident with the four (4) major seasonal events: Autumnal equinox, Vernal equinox, Winter solstice and Summer solstice. For the first quarterly sampling event, sample sets will be collected at each monitoring well twice in the same 24-hour period to account for the possible dilutionary effects of tidal influences. Groundwater samples collected at low tide will have an "L" suffix and groundwater samples collected at high tide will have an "H" suffix. Groundwater samples will be collected from groundwater monitoring wells MW-3 through MW-6, cluster wells CW-1 through CW-4 (zones A and B only) and proposed cluster wells CW-5 through CW-9.

If the first quarter sampling results indicate a change of 20% or greater for 90% of the analytical parameters, then two sample sets well be collected for the remaining three (3) quarterly sampling events. If the first quarter sampling results indicate a change between the two (2) sampling sets of less than 20% for 90% of the analytical parameters, then the remaining three (3) quarterly sampling events will be limited to only one (1) sample set.

3.4.3.1 Groundwater Sample Collection

After completion of well purging activities, groundwater samples will be collected from each well using the dedicated, positive displacement bladder pumps. Prior to sample collection, the pumping rate will be reduced for collection of samples to be analyzed for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). Once the groundwater samples have been collected for chemical analysis of VOCs and SVOCs, the pumping rate may be increased to expedite the sample collection process. The samples will be collected in the following order:

- VOCs
- SVOCs
- Total metals
- Dissolved metals
- General chemistry
- Turbidity
- Phase II parameters for biodegradation (where applicable)

High tide and low tide information will be obtained from the local daily weather service (i.e., newspaper). At no time will the pumping rate used during sample obtained exceed the pumping rate achieved during the well purging process.

Two (2) groundwater samples will be collected in appropriate containers, as specified by EPA's approved analytical methods for Principal Appendix VIII Constituents in Petroleum Refining Wastes ("Skinner List"). Table 3 outlines the chemical analyses to be performed to detect compounds listed on the Skinner List and the types of containers and preservatives required for each chemical analysis.

Two (2) separate groundwater samples will be collected for metals analysis. One (1) sample will be collected in an appropriate sample container for total metals analysis. The other sample (collected for dissolved metals analysis) will be filtered and preserved in the field. Field personnel will use in-line filtering devices for preparation of dissolved metals samples.

The sample containers will be sealed, labeled and placed in a chilled cooler for delivery to the analytical laboratory. Strict chain-of-custody protocol will be followed throughout the sample handling process. (See Section 3.6 for sample preservation and handling.)

3.4.4 Free-Product Sample Collection

If free-product is found floating on the groundwater table in a monitoring well, then the liquid will be sampled at least once a year. Free-product will be analyzed for three (3) possible parameters: specific gravity, flashpoint and gas chromatographic (GC) characterization. Depending upon the quantity of product in each groundwater monitoring well, samples will be collected for one (1) or more of the aforementioned analyses. If there is not enough free-product in a monitoring well for any of the analyses, then that well will be noted in the field log book.

3.4.4.1 Free-Product Sampling Procedure

The free-product will be recovered from the monitoring well using a polyethylene bailer. When filled, the bailer will be emptied into a plastic or glass beaker. If groundwater is collected along with the free-product, the water will be poured from the bailer into a 55-gallon DOT-approved drum following collection of the free-product sample(s).

Free-product will be analyzed for specific gravity and flashpoint by BHPPAR's on-site laboratory. The GC characteristic analysis will be submitted to an off-site laboratory (Friedman and Bruya of Seattle, Washington).

To obtain a free-product sample for GC characterization, the free-product sample will be transferred from the bailer into a glass or plastic beaker. A laboratory-provided capillary tube will be positioned into the beaker at approximately 25 degrees from the horizontal. When the capillary tube is three-quarters full (accomplished by upward movement [capillarity] of the product into the tube), some water will be drawn into the tube to from a "water plug". A PVC stopper will be placed on the end of the capillary tube containing the water plug. The other end of the tube will be sealed by filling another PVC stopper with water and placing the stopper onto this end of the tube. The aforementioned process will be repeated to collect an additional product sample in a separate capillary tube. A sample label will be placed on the two (2) capillary tubes and both tubes will be placed in a stainless steel container. Teflon caps will be placed on both ends of the stainless steel container to seal it and the container will be inserted into a shipping envelope, along with a chain-of-custody form. These product samples will be shipped to the analytical laboratory for characterization using a GC.

Sample containers will be sealed, labeled, placed in a chilled cooler and transported via motor vehicle and airplane to a laboratory for chemical analysis. Analytical procedures with associated sample containers are included in Table 3.

3.4.5 Decontamination Procedures

All equipment inserted into the wells will be decontaminated by washing with a solution of non-phosphate detergent and double-rinsing with distilled water. Equipment that will require decontamination includes: water level indicators, oil-water interface probes, polyethylene bailers and pressure transducers. Decontamination procedures will not be necessary for disposable sampling equipment. However, disposable sampling equipment will be placed on clean plastic sheeting prior to and during sampling activities. Sampling equipment will not lie on any uncovered (without plastic) ground surface. Decontamination procedures are not required for purging and sampling equipment, since each well is to be equipped with dedicated positive displacement bladder pumps which will remain in their respective wells after installation.

Sample collectors will wear a clean pair of disposable gloves at each well location. Protective clothing and equipment will be replaced if their protective function is compromised through holes or tears. At the end of each work day, disposable gloves, coveralls, and other disposable clothing or equipment worn by field personnel will be placed into a suitable disposal container located at the Refinery pending proper disposal.

3.4.6 Field Quality Assurance/Quality Control for Samples

For a QA/QC check of field sampling procedures, one (1) field blank sample will be submitted to the analytical laboratory with each "batch" of groundwater samples collected each sampling day (a batch will not exceed 20 samples). The field blank will be collected in the middle or near the end of each sampling day. In addition, one (1) trip blank sample will be submitted with each "batch" of groundwater samples. No equipment blanks will be collected, since the groundwater sampling equipment used will be dedicated to each well, eliminating the possibility of cross-contamination due to equipment transfer from well to well.

The field blank sample will be a sample of distilled water transported to the field in its original container and then transferred into a sample bottle in a manner similar to that in which the groundwater sample bottles are filled. The trip blank sample will be a sample of distilled water transported to the field in a set of sample bottles prepared by the analytical laboratory. The trip blank sample will accompany all the sample bottles from the laboratory into the field and back to the laboratory again as a check against sample contamination originating from the laboratory sample transport, shipping and from site conditions. The field and trip blank samples will be handled, labeled and shipped exactly as though they were groundwater samples.

Duplicate groundwater samples will also be collected (approximately 10% of the total number of groundwater samples collected from each quarterly sampling event) and submitted to a separate laboratory, which is currently anticipated to be West Coast Analytical Service (WCAS) of Santa Fe Springs, California for the chemical analyses described in Section 3.7 as a check on field and laboratory procedures. This duplicate groundwater sample preparation will be an additional check of the QA/QC procedures which are part of each laboratory's standard program.

3.4.7 Equipment Calibration and Maintenance Plan

Equipment to be used in accordance with this GMP will be subject to standard calibration and performance checks. A maintenance leader will be appointed to ensure that calibration and performance checks are

periodically conducted and that all malfunctioning equipment is repaired or replaced. Brief summaries of periodic maintenance and/or calibration of the equipment will be noted by the maintenance leader in a field equipment log book. Each instrument will be operated according to the manufacturer's instructions. The procedures for these performance checks are as follows.

Water Level Indicator and Oil-Water Interface Meter - Each day prior to use the water level indicator(s) and oil-water interface meter(s) will be visually inspected for tears or abrasions that may affect the performance of the measurements. Connections between the measuring tape and the sounding device will be inspected for disconnections and frays. The batteries will be tested using the instrument's self-testing feature. Any equipment showing signs of malfunction or disrepair will be repaired or replaced with a properly functioning instrument. The instruments will be tested using water at ground surface near the wells.

Bladder Pumps - If a bladder pump appears not to be functioning correctly, then the bladder pump will be temporarily removed from service, disassembled and the working parts will be inspected for wear. Any disintegrating "O" rings or parts that appear to be incorrectly worn or unusually brittle will be replaced. Field personnel that notice questionable performance from any pump will note the problem in the log book and notify the maintenance leader. There is no calibration necessary for this equipment.

Air Compressor - Air compressors used in the operation of the bladder pumps will be inspected for wearing parts in accordance with the manufacturer's recommended schedule. The manufacturer's information will be consulted for proper inspection procedures. Field personnel that notice questionable performance from any pump will note the problem in the log book and notify the maintenance leader. There is no calibration necessary for this equipment.

Combustible Gas Meter (CGM) - CGMs used in the groundwater sample collection process will be inspected and calibrated prior to use in accordance with the manufacturer's calibration procedures. Each CGM will be calibrated to an isobutylene standard, with a calibration gas of a concentration within the range of the anticipated background conditions it is expected to monitor. Field personnel that notice any performance problems with a CGM will make note in the field log book and inform the maintenance leader.

Photo Ionization or Flame Ionization Detectors - PIDs and/or FIDs used in accordance with this GMP will be inspected and calibrated each day of use in accordance with the manufacturer's calibration procedures.

Each PID or FID will be calibrated to an isobutylene standard, with a calibration gas of a concentration within the range of the anticipated background conditions it is expected to monitor. Field personnel that notice any performance problems with the PIDs and/or FIDs will make note in the field log book and inform the maintenance leader.

Turbidity Meter - Turbidity meters used in accordance with this GMP will be inspected and calibrated each day of use in a manner consistent with the manufacturer's recommended calibration procedures. Field personnel that notice any performance problems with the turbidity meters will make note in the field log book and inform the maintenance leader. Any equipment showing signs of malfunction or disrepair will be repaired or replaced with a properly functioning instrument.

Electrical Conductivity, pH and Temperature (Triple) Meter - Triple meters used in the sample collection process will be inspected and calibrated prior to use in accordance with the manufacturer's calibration procedures. Each Triple meter will be calibrated using the manufacturer's standard calibration solutions. Field personnel that notice any performance problems with the triple meter will make note in the field log book and inform the maintenance leader. Any triple meters showing signs of malfunction and/or disrepair will be repaired or replaced with a properly functioning instrument.

3.5 Free-Product Evaluation

This section describes the procedures that will be used to conduct an evaluation of free-product that may be present in groundwater monitoring wells. Free-product data will be acquired from historical free-product thickness measurements and analytical results, as well as from measurements that will be collected in accordance with this GMP. Data for the free-product evaluation will be collected during groundwater sampling events which are indicated on the schedule of implementation. (See Table 1.)

3.5.1 Background/Historical Free-Product Data

Any data collected prior to the implementation of this GMP pertaining to the thickness of free-product in the vicinity of Pond Nos. 1, 2A and 2 and data collected in accordance with this GMP will be compiled and entered into an EPA-approved database which will be developed during execution of GMP activities.

3.5.2 Free-Product Measurement

Prior to collecting the free-product thickness (FPT) measurements, the oil-water interface probe will be decontaminated as described in Section 3.4.5. To collect the FPT measurements an oil-water interface probe will be grounded to the well box and the measuring tape associated with the interface probe will be lowered into the well. Upon encountering the free-product, the interface probe will sound with an intermittent tone. Upon encountering groundwater, the interface probe will sound with a continuous tone. The free-product thickness is the distance that the interface probe was lowered during the intermittent tone. All measurements (taken to the nearest 0.01 foot) and the date and time of measurement will be recorded in a bound field log book. (See Section 3.6.6.) FPT measurements will be transferred from the field log book to the EPA-approved database.

3.5.3 Evaluation of Free-Product Analytical Results

The results of the free-product analysis for GC characterization, specific gravity and flashpoint will be entered into the EPA-approved database. The analytical results of the GC characterization will be used to aid in determining possible sources of the free-product. The results of the specific gravity analysis will be used in the calculation of the adjusted water levels discussed in Section 3.4.1. The results of the flashpoint will assist in classifying the free-product for transportation from the Refinery to an off site laboratory and in disposal of the free-product.

3.6 Sample Preservation and Handling

This section describes the procedures to be followed when preparing samples for shipment to the analytical laboratory for chemical analysis.

3.6.1 Sample Containers and Preservation

Samples will be collected and placed in containers supplied by an EPA-approved vendor. Containers will meet all EPA Contract Laboratory Program (CLP) container requirements appropriate for the analyses to be performed. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition, July, 1992 (SW-846) will be used and referenced for proper collection, preservation, shipping and labeling procedures. Shipping containers for the samples will be insulated and cooled to maintain a chilled environment until delivery to the analytical laboratory. (See Table 3 for sample preservation, container type and container volumes.)

3.6.2 Sample Labels

Each sample will be labeled immediately after collection and before field personnel collect additional samples. Labels will be backed with adhesive and will be covered with clear plastic tape before sample containers are stored in the delivery container. Labels will have, at a minimum, the following information written on them with waterproof ink:

- Sample identification number
- Project number
- Initials of sample collector
- Date and time of collection
- Analyses requested

Sample identification numbers and corresponding sample locations will be recorded on sampling data sheets and in the bound field log book. An example of a sample label is included as Appendix C.

3.6.3 Security Seals

After sampling activities have been completed for the day, the chilled cooler containing the samples will be closed with security seals that cannot be removed without damage and that will reveal any tampering en route to the analytical laboratory. Seals will be paper backed with adhesive. The seals will be signed and dated by the sample collector and attached across the lid of the cooler. Individual sample containers inside the sample cooler will not be sealed with security seals.

3.6.4 Chain-of-Custody Record

To establish documentation of sample possession, a chain-of-custody form filled out by the sample collector will accompany each shipping container. The chain-of-custody form will include the following information:

- Project Number
- Sample identification
- Signature of sample collector
- Date and time of collection
- Sample type (e.g., soil, coral or groundwater)
- Number of sample containers

- Parameters requested for analysis
- Signature(s) of persons involved in the chain of possession
- Inclusive dates of possession
- Preservative (if any)

Each person accepting possession of the samples will add appropriate information to the form. The form will be enclosed in a plastic bag and placed inside the shipping container when shipped. An example of the chain-of-custody form is presented on Appendix D.

3.6.5 Sample Shipment

The samples will be delivered via motor vehicle to the overnight shipper in time for next day delivery. The samples will be shipped via Federal Express (airplane transportation) or an equivalent carrier to the following address:

Analytical Technologies, Inc.
5550 Morehouse Drive
San Diego, California 92121
Attention: Sample Control

Samples that contain acidic preservative will be placed in appropriately-sized "Safe Transport Kits". These Kits are sturdy metal cans containing vermiculite as an absorbent. The cans will be sealed with a lid and placed inside the transportation cooler. The remaining samples in glass sample containers will be placed in appropriately-sized "Safe Transport Sleeves". These sleeves are lightweight and flexible, made of polyurethane foam material and designed to hold sample containers. The sleeves can withstand cold temperature and are ideal for use in coolers. The chain-of-custody(s) will be placed in a resealable plastic bag and placed inside the cooler with the respective samples.

Federal Express and similar carriers do not record custody of shipments through the signature of chain-of-custody documents. The security seals of the shipping container(s) will serve as documentation of sample integrity during the shipment and the receiving laboratory will be instructed to document the condition of the seal upon receipt of each shipment.

3.6.6 Field Log Book

The field log book will be a bound, hard-cover, water-resistant notebook. Information recorded in the field log book will include the following:

- Field personnel on site
- Decontamination activities prior to sampling and between samples
- Identification of sampling locations and corresponding sample numbers
- Physical properties of samples (e.g., color, odor)
- Measured properties of the groundwater (e.g., pH, electrical conductivity, temperature turbidity)
- Sample collection procedures/equipment
- Date and time of start and completion of field activities
- Sample collection sequence
- Types of sample containers used and sample identification numbers
- Preservative(s) used
- Quantity of 55-gallon drums generated during groundwater sampling activities and the contents of those drums
- Analysis requested
- Field data method(s) and equipment
- Sample destination and transporter
- Special packaging procedures
- Field observations of sampling event
- Name and signature of collector
- Climatic conditions, including air temperature
- Date and time of sample shipment from the facility
- Level of personal protection employed
- Any variation in standard procedures or equipment malfunction

3.7 Laboratory Analysis of Groundwater and Free-Product Samples

The primary analytical laboratory currently selected for groundwater samples is Analytical Technologies, Inc. (ATI). The QA/QC analytical laboratory currently selected for groundwater samples is West Coast Analytical Services (WCAS). ATI and WCAS have rigid and comprehensive QA/QC programs which are

detailed in their quality assurance manuals. Copies of both laboratory's quality assurance manuals are included in Appendix F. Laboratory procedures such as flashpoint and specific gravity will be performed at the Refinery. If there is a change in either of the analytical laboratories, the EPA will be notified prior to such change. The analytical laboratory currently selected for free-product samples is Friedman & Bruya, Inc.

3.7.1 Groundwater Sample Analysis

Groundwater samples will be analyzed for VOCs according to EPA Method 8240 and for SVOCs according to EPA Method 8270. Additionally, groundwater samples will be analyzed for antimony, barium, beryllium, cobalt, chromium, nickel and vanadium according to EPA Method 6010, arsenic according to EPA Method 7060, cadmium according to EPA Method 7131, lead according to EPA Method 7421, mercury according to EPA Method 7470 and selenium according to EPA Method 7740. The complete list of VOC, SVOC and metals parameters, EPA methods and preparation methods is included as Table 4. Brief descriptions of the VOC, SVOC and metal analytical procedures are included in Appendix E.

Additional laboratory procedures will include general chemistry analyses of the groundwater samples. General chemistry analyses will include measurements of total dissolved solids, alkalinity, fluoride, nitrate-nitrite as nitrogen, surfactants, sulfate, pH, electrical conductivity and chloride.

3.7.2 Free-Product Sample Analysis

Free-product samples collected for chemical analyses will be analyzed by ASTM 2887 (GC characterization), specific gravity according to Standard Method SM•213E and flashpoint according to EPA Method 1010. A summary of the parameters for general chemistry analysis and the associated EPA Methods and techniques are listed in Table 5. A summary of the free-product analyses are listed in Table 6.

3.8 Aquifer Characteristics Assessment

Data obtained in the assessment of certain aquifer characteristics will be used as input parameters for groundwater modeling activities. The following section discusses the aquifer characteristics and the methods that will be used to obtain values for these characteristics.

3.8.1 Background Aquifer Characteristic Data

Data collected prior to the implementation of this GMP pertaining to relevant aquifer characteristics and groundwater quality throughout the Refinery and any data collected in accordance with this GMP will be compiled and entered into the EPA-approved database to be developed as part of GMP activities. These data will be used as input parameters for contaminant transport modeling.

3.8.2 Effective Porosity

Total porosity is defined as the volume of total pore space divided by the total volume of the media. Effective porosity is the measure of the percent of the pore space which is interconnected (i.e., the pore space where water flow occurs). Effective porosity is defined by the volume of the interconnected pores divided by the total volume of the soil/coral sample. The effective porosity can be determined by interpreting the results of laboratory tracer tests conducted on approximately four (4) coral cores in the laboratory or estimated from values cited in the literature. A laboratory tracer test involves tagging the water with a nonreactive compound, such as bromide, and measuring the strength and speed at which it passes through a soil column, otherwise known as breakthrough. The breakthrough data are used to back calculate the effective porosity.

3.8.3 Biodegradation Sampling and Analysis

Biodegradation data will be collected to provide site-specific assessment of environmental conditions that influence passive biodegradation in the subsurface soil and groundwater. Various oxidation-reduction (redox) reactions occur in the subsurface depending on conditions that exist in the subsurface environment. The redox conditions dictate the most appropriate biodegradation electron acceptor that is utilized by indigenous microbes. The most common electron acceptor is oxygen, and aerobic biodegradation generally is the most complete and fastest rate of natural biodegradation known for many organic contaminants. Other electron acceptors, such as nitrate (NO^-_3), iron (Fe^{3+}), manganese (Mn^{3+}), and sulfate (SO_4^{2-}), can also be used for microbial metabolism when oxygen redox conditions are not adequate. By determining the availability of the subsurface electron acceptors and essential macro-nutrients for each biological process, passive biodegradation, or natural bioremediation, processes will be better characterized for the ability to naturally attenuate various organic contaminants. In addition, an understanding of the subsurface environment related to biodegradation processes will assist in developing a groundwater contaminant transport model. The natural bioremediation process is described below:

- **Natural Biodegradation**

  The basic concept behind natural biodegradation or passive bioremediation is to allow naturally occurring microbes to degrade organic contaminants that have been released into the subsurface and at the same time minimize risks to public health and the environment. To assess natural biodegradation in the groundwater at the Refinery, a site-specific assessment of the factors that influence the biodegradation capacity of the aquifer or soil and the potential human and environmental risks will be required. Ongoing research has shown that an aquifer's assimilative capacity depends on the metabolic capabilities of the native microbes, the aquifer hydrogeology and geochemistry, and the contaminants involved. The GMP will collect this type of data for the Refinery.

3.8.3.1 Proposed Biodegradation Sampling and Analysis

The data used to assess environmental conditions related to natural biodegradation is proposed to be collected by two (2) different methods, as follows:

- Initial site screening and database development will be accomplished by field data collection using portable field test kits and meters. Parameters collected by these means will include dissolved oxygen (DO), soluble (Fe^{2+}) and total (Fe^{3+}) iron, pH, conductivity, and temperature.

- A second phase of data collection will require well sampling techniques similar to organic compound sampling for analytical chemistry characterization. The second phase of biodegradation data collection will analyze for water quality parameters such as nitrogen species (ammonia (NH_3), nitrite (NO_2), nitrate (NO_3), sulfate (SO_4), phosphorus (o-PO_4) and various other indicators of geochemistry.

3.8.3.2 Phase I Site Screening

During the GMP, several rounds of groundwater samples will be collected from monitoring wells for analysis of organic chemical compounds to assist in mapping the extent of Skinner List constituents in the subsurface. During this task, supplemental data will be collected by using portable test kits and meters for certain groundwater parameters that have importance in assessing biodegradation related to the chemical compounds

of interest. Specifically, the additional data collection is for DO, (Fe^{2+}), (Fe^{3+}), temperature, conductivity, and pH. The importance of each parameter specific to biodegradation is listed in Table 7.

The data from the biological environment characterization will allow interpretation of factors that control the rate and extent of in-situ organic chemical biodegradation. Observations and notes for each specific well will accompany the data produced by the test kits measurements to ensure accurate data interpretation.

3.8.3.3 Phase II Groundwater Sampling

The second phase of groundwater sampling and analysis will attempt to characterize the in-situ groundwater environment as it relates to organic chemical biodegradation. Standard testing parameters analyzed in this phase are listed on Table 8. When sampling for dissolved iron and manganese metals, groundwater samples will be filtered by in-line filtration devices.

Data analysis and interpretation of the Phase II groundwater sampling results will be completed to assess the biodegradation capacity of natural biodegradation for site-specific contaminants. Data evaluation of these test results will lead to an understanding of the natural biodegradation processes at the Refinery, as well as the limiting factors for biodegradation in the subsurface environment.

3.8.4 Dispersion Characteristics

Aquifer dispersivities will be estimated based on published dispersivities determined in hydrogeologic systems that are similar to those found at the Refinery. The aquifer soil/water distribution or partitioning coefficient (K_d) will be estimated based on the product of the fraction of organic carbon (F_{oc}) and the organic carbon partitioning coefficient (K_{oc}). As in the vadose-zone, the product of K_{oc} and F_{oc} will be used to estimate K_d for the groundwater zone. Laboratory measurements of soil partitioning coefficients may also be used. Laboratory techniques to aid in determining the above characteristics are summarized in Table 9.

3.9 Water Level Measurements

This section describes the procedures, measuring equipment, data collection, calibration procedures and data evaluation procedures that will be used in the water level measurement program.

3.9.1 Water Level Measurement Program

Groundwater level measurements in the cluster wells installed during this GMP will be performed on a seasonal basis. A time series analysis of the groundwater flow system will be conducted by installing pressure transducers in the newly installed cluster wells and selected existing monitoring wells and measuring water level fluctuations, tidal conditions and atmospheric conditions for periods lasting approximately one month in each of the summer and winter seasons (a total of two (2) months). One (1) pressure transducer, rated at five (5) pounds per square inch (psi), will be installed in each of the newly installed cluster wells and selected existing groundwater monitoring wells. A five (5) psi transducer will provide water level measurements accurate to the nearest one-hundredth (0.01) foot. A data logger will be housed in the center of each well cluster. In locations where it is feasible, the transducers from two (2) well clusters will be connected to one (1) data logger. Simultaneous groundwater level measurements will be collected from each well on an hourly basis for two (2) separate one-month periods.

The purpose of collecting continuous water level measurements is to further assess the influence of the tides on groundwater flow and gradients, to monitor changes in regional and localized groundwater flow during times of the year with different amounts of rainfall, and to collect information to accurately determine the mean groundwater levels. The uppermost aquifer has been divided into two (2) arbitrary layers in order to deduce this information. Based on groundwater surface elevation measurements at the different locations within each layer, an equipotentiometric surface map will be made at different times within seasonal and tidal cycles. Interpretations of these maps in each of the two (2) layers will provide a three-dimensional understanding of groundwater flow changes with time.

Atmospheric conditions will be monitored on an hourly basis by establishing a weather station at the Refinery. Such a weather station will be capable of monitoring, at a minimum, barometric pressure, temperature, rainfall and pan evaporation.

Hourly ocean, stage data collected from nearby tide measuring stations will be used to compare the results obtained from the water level measurement activities. Data obtained from the pressure transducer system will provide a base-line gradient against which groundwater flow and gradient variations can be compared.

3.9.2 Transducer Correction Procedure

During the seasonal time series analysis, the transducers will need to be adjusted for drift, which is typically encountered during extended periods of use. Drift that occurs in the field will be quantified by comparing the water level measurement obtained by the transducer with a simultaneous water level measurement obtained with a hand-held water level indicator. The manufacturer's instructions will be followed when correcting the transducer drift. This manual drift correction procedure will be conducted on a weekly basis. BHPPAR will consult with the manufacturer of the transducers on these drift correction procedures.

3.9.3 Data Evaluation

Data recorded by the data loggers will be downloaded into the EPA-approved database developed for this GMP. The water level data, along with each monitoring well's survey data, will be used to calculate groundwater elevations in each well. Groundwater elevation data will be used to evaluate the rate and direction of regional groundwater flow through the use of groundwater contour maps and rose diagrams.

3.10 Waste Management

Waste soils, formation materials and wastewater produced from drilling, well development and sampling activities will be placed in storage bins, tanks, drum or other suitable containers and stored on site pending proper disposal.

Based on information currently available to BHPPAR regarding the composition of generated wastewater, BHPPAR anticipates disposal of the wastewater through its existing and new wastewater treatment system. Additional soil/formation material sampling and chemical analysis may be required to characterize (profile) the waste soils prior to disposal.

3.11 Computer Database

A computer database will be developed, as part of these GMP activities, that will be able to archive, manage and manipulate information developed during execution of the GMP. Such information includes, but is not limited to the following: groundwater level observations; groundwater quality information; free-product data; waste management information; and hydrologic/hydrogeologic information. Once information has been assembled in the database, the data can be subjected to mathematical and statistical operations which can further enhance understanding of the groundwater flow system.

BHPPAR will select a database based on the abilities and features described below. Once BHPPAR has selected a database, the selection of database and the final data format will be submitted to the EPA for approval. After receiving approval from the EPA, BHPPAR will integrate the database into the Refinery's data management system.

3.11.1 Database Structure

A data management system will be developed to provide storage, analysis, reporting and display of data collected during the GMP. A data management plan will be developed and submitted to the EPA for review and approval. The data management plan will include the following:

- Guidelines for data acquisition
- Data security
- Data reporting and display
- Data transfer
- Recommended software

After review and approval of the data management plan, data collected during the GMP will be entered into the database.

3.11.1.1 Data Types

Data which will be collected during execution of the GMP will include, but not be limited to the following:

- Monitoring well construction details
- Water quality data
- Free product data
- Water level data
- Contaminant concentrations

3.11.1.2 Digital Data Entry

The results and observations obtained during execution of project tasks will be entered into the database management system. Data entry will be verified by utilizing double entry techniques, comparison with data

entry forms, posting of appropriate data on base maps and statistical evaluation of data for determination of "outlying" values.

3.11.1.3 Database Design

A relational database management system and associated technical application package will be used to store and manipulate data collected during the project. Information collected will be identified with a unique combination of site or sample designation and the date and time the information was obtained. Sequential sample numbers will be assigned to each sample. That sample number will be cross-referenced with the laboratory sample information that is carried in the database. Site designations will be tied to the Hawaii Zone 3 State Plane Coordinate System and local "Refinery" coordinates using a global positioning system (GPS), or other approved surveying techniques.

3.11.1.4 Digital Data

A primary or dedicated hardware platform will be maintained with the project database residing on it. The machine will be locked using the manufacturer's hard drive lock provided with the machine. Any data input, release or transfer will be made by request in writing to the database manager. Such requests will be filed appropriately. The data manager will perform incremental backups of project files. The data manager will also keep a log of all personnel having access to the database system.

3.11.2 Data Analysis and Display

Data reports and information generated during the project will include the project name, date, originator and number of total pages. Generated documents will bear a draft notation until final review indicates that the documents are approved as final. A standard sign-off will be included at the bottom corner of the document which will indicate the individuals who have reviewed and approved the documents.

3.11.2.1 Graphic Formats

The final graphic formats will be approved by BHPPAR. Each graphic will contain the following minimum information.

- Date
- Prepared by
- Revision No.

- Revision Date
- Project No.
- Title

Maps will contain a bar scale, north arrow and legend. Graphics will be labeled as draft until approved as final.

3.11.2.2 Digital Data Exchange Format

Transfer of groundwater quality data to the EPA will be accomplished using 3.5" - 1.4 Mb magnetic diskettes formatted using MS-DOS Version 4.0 or higher.

3.12 Groundwater Flow and Transport Modeling

To facilitate evaluation of the rate and extent of dissolved phase "Skinner List" constituents that may be migrating within the groundwater flow system beneath the Refinery, a groundwater transport model will be constructed as part of this GMP. Prior to actually building the computer model, a conceptual model will be developed and submitted for the EPA's review and approval. Such conceptual modeling will be accomplished by utilizing a standard modeling process and will be summarized in a brief letter submitted to the EPA prior to commencement of the groundwater flow and transport modeling. Once the EPA approves the conceptual model and recommended modeling software, BHPPAR will begin integrating the model into the GMP activities. Such a model will be calibrated until simulated conditions correlate favorably with select observed field conditions. At such time, the model will be considered calibrated. A detailed description of the modeling process is included in Appendix G.

3.13 Data Validation

In order to ensure that data integrity is maintained throughout the implementation of this GMP, data validation will be an integral part of QA/QC procedures.

3.13.1 Groundwater Analytical Data

Upon receipt of analytical data on standard laboratory report format and computer diskette, pertinent information will be transferred to the database system. Such information will include chemical information, well number, sample collection data, sample analysis data, method detection limits, analytical results and units of measurement. In order to minimize the probability for entering incorrect data into the database

system, a quality assurance program will be implemented, including double entry and statistical checks for outlying values. Data input into the Refinery's database system will be referenced with the laboratories' analytical reports. Final results on the laboratory analytical reports will be assumed correct.

3.13.1.1 Completeness Check

The Refinery will perform a check for data completeness during the review of the analytical data. Completeness of data is a measure of the number of analytical data points which meet all of the acceptance criteria required by the specific methods used relative to the total number of data points generated. Completeness for all organic analyses will be generally 90% or greater and completeness for all inorganic analyses will be 95% or greater. If the completeness of data, in any area, is found to be less than the above set completeness requirements, then the reasons for the incompleteness will be investigated. Based on the results of the investigation, measures will be implemented to avoid continued incomplete data reporting. The laboratory standards for completeness, accuracy and precision are included in the QA/QC manuals included as Appendix F.

3.13.1.2 Reporting of Not Detectable (ND) Values

In the event that the laboratory reports an analytical result for a given parameter as below the limit of detection, the data will be analyzed and a judgement will be made as to the validity of the not detectable (ND) value. Possible reasons for the ND value include the absence of contaminants, the presence of contaminants at concentrations below the limit of detection, or the interference of a chemical matrix of the groundwater with the analytical technique. When data sets consist of a mixture of values that are ND and actual concentration measurements, the ND values may be considered at half of their limit of detection. In other words, if a result is reported ND with a limit of detection of 5.0 μg/l, then the value of 2.5 μg/l will be used for statistical analysis. In this event, the analytical results will be analyzed to check for changes in the reported limits of detection. If inconsistencies are noted in the detection limits, such as increasing detection limits over time and ND results, the Refinery will investigate the reasons for the increasing limit and implement corrective procedures.

3.13.1.3 Outliers

In the event that an analytical result from the laboratory is significantly different from previous and subsequent analytical results, BHPPAR will investigate and document the possible reasons for the discrepancy, such as an unnatural occurrence or an error in transcription of data values or decimal points.

Documentation and validation of the cause of the outliers will accompany any request to the EPA to correct or delete outlier data values.

3.13.2 Groundwater Elevation Data

Periodically, water level measurements collected by pressure transducers will be compared with water level measurements collected using a hand-held water level indicator. If necessary, the pressure transducers will be manually adjusted to match the values measured with the water level indicator. The transducers will be adjusted as described in Section 3.9.2.

3.14 Data Evaluation

Statistical and graphic evaluation methods along with groundwater computer modeling will be employed to determine: 1) the rate and extent of migration of selected Skinner List constituents that may have been released from Pond Nos. 1, 2A or 2 into the groundwater at the Refinery; and 2) whether a release of Skinner List constituents has occurred from Pond Nos. 1, 2A or 2. Such a determination will require the evaluation of hydrogeologic, geochemical and climatic factors along with other environmental parameters. The evaluation of these factors during a statistical analysis and graphic evaluation will also be necessary to determine the boundaries of the Skinner List Constituents' dissolved phase plumes and whether a result is actually indicative of a statistically significant release from Pond Nos. 1, 2A or 2. The statistical and graphic methods are briefly described in this section; however, the groundwater flow and transport computer modeling has been previously described in Section 3.12 of this GMP.

3.14.1 Statistical Methods

Statistical methods, as outlined in Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance, will be employed to evaluate the groundwater analytical data collected from the existing groundwater monitoring wells, MW-3, MW-4, MW-5 and MW-6, the existing cluster wells, CW-1 through CW-4 and the proposed cluster wells CW-5 through CW-9. Selection of the appropriate statistical methods will be based on the theoretical properties of the methods, available data, the Refinery's hydrogeology and the fate and transport characteristics of certain Skinner List constituents. However, based on a review of the current groundwater analytical data, the following types of statistical methods will be employed:

1. Confidence Intervals - A fixed standard comparison of well concentration data to an alternate concentration limit (ACL), the HDOH Water Quality Standards for Protection of Marine Life, using confidence intervals.

2. Control Charts - An intra-well comparison that plots each well's concentration data on a time scale. The time scale is evaluated for trends or sudden changes in the concentration levels - a time series analysis.

3.14.2 Graphic Methods

Graphic methods will be employed to evaluate the groundwater analytical data collected from the existing groundwater monitoring wells, MW-3, MW-4, MW-5 and MW-6, the existing cluster wells, CW-1 through CW-4 and the proposed cluster wells CW-5 through CW-9.

1. Spatial Distribution Maps/Histograms - The plotting of select Skinner List constituent concentration values for each well and other groundwater data as a series of comparative "footprint or fingerprint" histograms on a Refinery site plan. These data histograms will be used to evaluate variations in Skinner List constituent concentrations from well to well, to track certain Skinner List constituent's plumes and to compare the relative proportions of these constituents from well to well. The plotted histograms are also evaluated along with groundwater flow data for trends or sudden changes in the spatial distribution of the concentration levels and changes in the relative proportions of the constituents.

2. Isopleth Maps - The technique of mapping Skinner List constituent concentration values by drawing lines of equal concentration. The applicability of this technique is dependent on the following:

    - Homogeneity of groundwater composition with depth.

    - Gradient of the constituent concentration between wells.

3. Groundwater Contour Maps -The technique of mapping groundwater elevations and vertical flow potential by drawing lines of equal hydraulic elevation and vertical flow potential.

4. Trilinear Diagrams - The technique of plotting certain groups of ions or compounds within triangles (usually two triangles bracketing a diamond shaped plotting field) that represent the composition percentages of a particular group of ions or compounds. These trilinear diagrams provide a useful tool in groundwater analysis interpretation by allowing the evaluation of certain relationships which may exist among individual samples.

5. Tabular Summaries - Skinner List constituent concentrations and other groundwater analytical data collected from the groundwater monitoring wells will be tabulated and compared, in tabular form, to actual or predicted leachate data from possible sources of Skinner List constituents such as Pond Nos. 1, 2A and 2.

3.15 Report Preparation

Following receipt of the laboratory analytical results, the activities associated with the GMP will be summarized in a Groundwater Monitoring Report. This report will include detailed descriptions of the methodologies used to collect data, evaluations and interpretations of the data, and the technical rationale for the conclusions reached. A summary of the geologic and hydrogeologic conditions in the general site vicinity will be included in the report. The report will:

- Describe the location and construction of the groundwater monitoring well network installed by this GMP.
- Discuss analytical results of groundwater sampling.
- Present the results of groundwater transport modeling.
- State whether or not Skinner List constituents have been released from Pond Nos. 1, 2 or 2A and have entered the groundwater at the Refinery.

The report will be submitted by BHPPAR to the EPA in accordance with the schedule of implementation included as Table 1.

4.0 HEALTH AND SAFETY

A copy of the HSP, which describes the hazards associated with the field activities to install groundwater monitoring wells and collect groundwater samples at the Refinery is included in Appendix H. The field activities include the drilling of soil borings, the construction of groundwater monitoring wells and the collection of groundwater samples from various locations throughout the Refinery. All procedures to complete the aforementioned tasks are described in this GMP.

h:\users\projects.93\93-033\reports\gmpfnl.a17

5.0 REFERENCES

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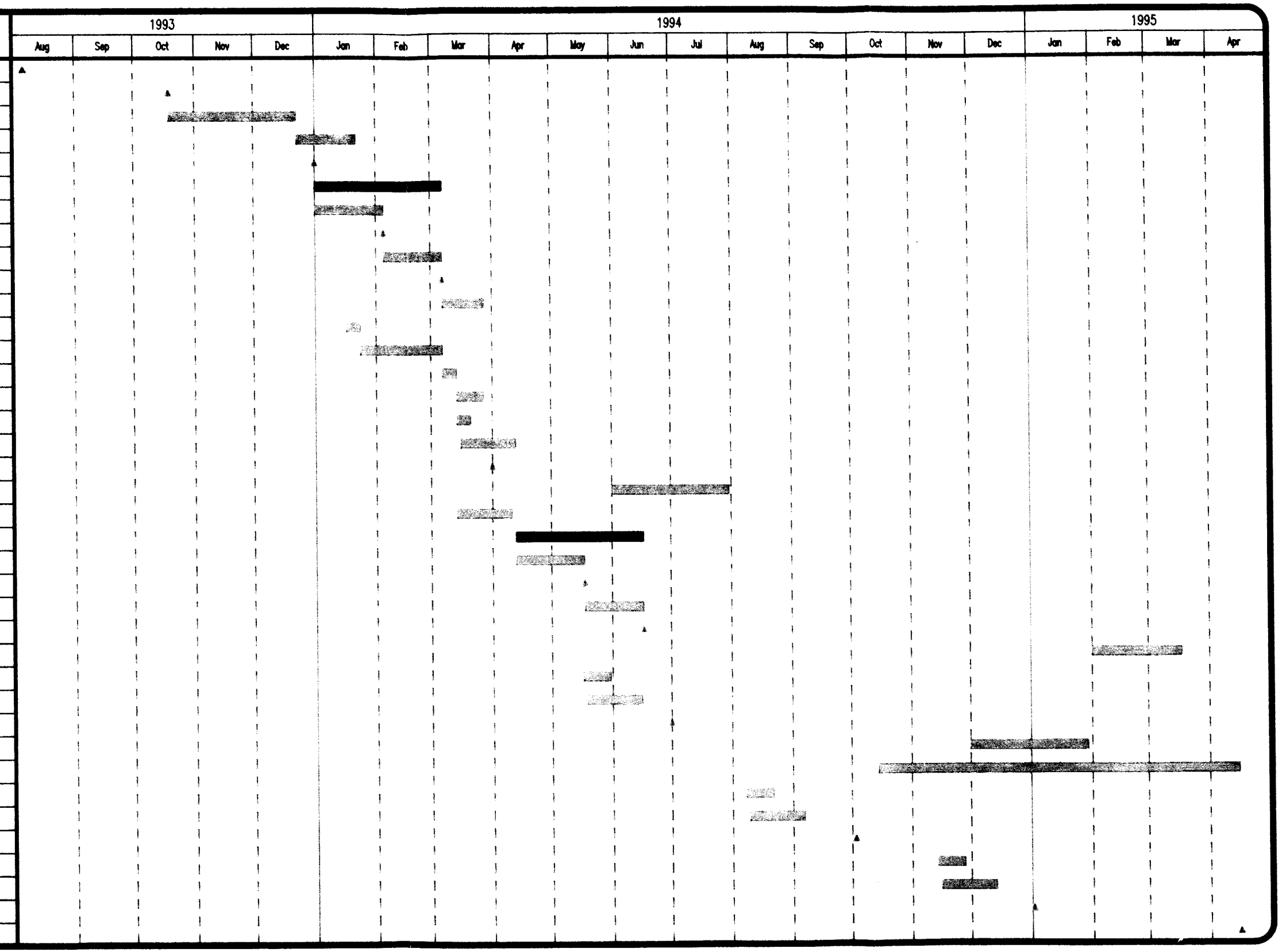
TABLES

Table 1
Schedule of Implementation

Task Name	CPM Start	Duratn (Days)
Receipt of Hydro. Char. Letter	6-Aug-93	0
1-Submit GMP to EPA	19-Oct-93	0
EPA reviews GMP	19-Oct-93	65
Thirty Day Start-Up Period	23-Dec-93	30
Submit 1993 4th Quarter Report	1-Jan-94	0
2-Develop Database	1-Jan-94	65
Evaluation of Data Bases	1-Jan-94	35
Submit Database to EPA	5-Feb-94	0
EPA Reviews Database	5-Feb-94	30
EPA Approves Database	7-Mar-94	0
3-Setup Database	7-Mar-94	21
4-Conduct Geophysical Survey	17-Jan-94	7
5-Install Monitoring Wells	24-Jan-94	42
6-Conduct Well Location Survey	7-Mar-94	7
7-Conduct 1st Quarter Sampling	14-Mar-94	14
8-Conduct Free Product Eval.	14-Mar-94	7
9-Conduct Laboratory Analysis	16-Mar-94	28
Submit 1994 1st Quarter Report	1-Apr-94	0
10-Conduct 1st Wtr. Lvl. Meas.	1-Jun-94	60
11-Assess Aquifer Char.	14-Mar-94	28
12-Initiate Transport Modeling	13-Apr-94	65
Conduct Trans Model Evaluation	13-Apr-94	35
Submit Model for EPA Review	18-May-94	0
EPA Reviews Model	18-May-94	30
EPA Approves Model	17-Jun-94	0
13-Conduct Transport Modeling	1-Feb-95	45
7-Conduct 2nd Quarter Sampling	17-May-94	14
9-Conduct Laboratory Ananlysis	19-May-94	28
Submit 1994 2nd Quarter Report	1-Jul-94	0
10-Conduct 2nd Water Lvl. Mea	1-Dec-94	60
14-Prepare Final Report	15-Oct-94	183
7-Conduct 3rd Quarter Sampling	8-Aug-94	14
9-Conduct Laboratory Analysis	10-Aug-94	28
Submit 1994 3rd Quarter Report	3-Oct-94	0
7-Conduct 4th Quarter Sampling	14-Nov-94	14
9-Conduct Laboratory Analysis	16-Nov-94	28
Submit 1994 4th Quarter Report	2-Jan-95	0
15-Submit Final Report to EPA	16-Apr-95	0



PROJECT NO. 45-93-033	DRAWN BY M. ENTERLINE	Delta Environmental Consultants, Inc.
FILE NO. 3-033-08	PREPARED BY J. AMATO	
DATE 17 OCT 93 / REV.	REVIEWED BY	

TABLE 2

TASK SUMMARY
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII
DELTA NO. 45-93-033

TASK 1	Submit GMP to EPA
TASK 2	Develop Database for Submittal to the EPA
TASK 3	Setup Database
TASK 4	Conduct Geophysical Survey
TASK 5	Install and Develop Groundwater Monitoring Wells
TASK 6	Conduct Well Location Survey
TASK 7	Conduct Quarterly Groundwater Sampling
TASK 8	Conduct Free-Product Evaluation
TASK 9	Conduct Laboratory Analysis
TASK 10	Conduct Water Level Measurements
TASK 11	Assess Aquifer Characteristics
TASK 12	Initiate Transport Modeling
TASK 13	Conduct Transport Modeling
TASK 14	Prepare Final Report
TASK 15	Submit Final Report to EPA

TABLE 3

SAMPLE COLLECTION TABLE
QUARTERLY GROUNDWATER SAMPLES
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII
DELTA NO. 45-93-033

Parameters	Preservative	Maximum Holding Time	Container Type	Container Volume
Skinner Volatile Organic Compounds (VOCs)	4 Drops of conc. HCL Cool to 4°C	14 days	Glass Vial with Teflon Septum	2 X 40 ml
Skinner Semi-Volatile Organic Compounds (SVOCs)	Cool to 4°C	Extracted within 7 days Analyzed within 40 days	Amber Glass with Teflon Liner	1,000 ml
Skinner Metals (Total)	HNO_3 to pH < 2	6 months except for Mercury (28 days)	HDPE	1,000 ml
Skinner Metals (Dissolved)	Filter on Site: HNO_3 to pH < 2	6 months except for Mercury (28 days)	HDPE	1,000 ml
General Chemistry	Cool to 4°C	14 days except for Surfactants (48 hours)	Plastic	1,000 ml
	H_2SO_4 to pH <2 Cool to 4°C		Plastic	4 ounce
	HNO_3 to pH <2 Cool to 4°C		Plastic	16 ounce
GC Characterization (Free-Product)	Not Required	14 days	Laboratory Provided Glass Capillary Tubes	-
Flashpoint (Free-Product)	Cool to 4°C	14 days	Amber Glass with Septum	8 ounce
Specific Gravity	Cool to 4°C	14 days	Plastic	4 ounce
Total Organic Carbon and Fraction of Organic Carbon	H_2SO_4 to pH < 2 Cool to 4°C	28 days	Amber Glass with Septum	4 ounce

TABLE 4

(Page 1 of 2)
SAMPLE SUMMARY TABLE
QUARTERLY GROUNDWATER SAMPLES
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII
DELTA NO. 45-93-033

Analytical Parameters	Analytical Method Number	Preparation or Extraction Method
Volatile Organic Compounds (VOCs) †		
Benzene	8240	5030
Carbon Disulfide	8240	5030
Chlorobenzene	8240	5030
Chloroform	8240	5030
Cyclohexane	8240	5030
1,2 dichloroethane	8240	5030
1,4, dioxane	8240	5030
Ethylene dibromide	8240	5030
Styrene	8240	5030
Toluene	8240	5030
Xylene (m-, o&p)	8240	5030
Semi-Volatile Base/Neutral Extractable Organic Compounds (SVOCs)		
Anthracene	8270	3510 or 3520
Bis (2,-ethylhexyle)phthalate	8270	3510 or 3520
Butyl benzyl phthalate	8270	3510 or 3520
Chrysene	8270	3510 or 3520
Diben(a,h)acridine	8270	3510 or 3520
Dibenz(a,h)anthracene	8270	3510 or 3520
Dichlorobenzenes	8270	3510 or 3520
Diethylphthalate	8270	3510 or 3520
Dimethyl phthalate	8270	3510 or 3520
7,12-Dimethylbenz(a)-anthracene	8270	3510 or 3520
Di-n-octyl phthalate	8270	3510 or 3520
Di-n-butylphthalate	8270	3510 or 3520
Fluoranthene	8270	3510 or 3520
Indene	8270	3510 or 3520
1-methynapthalene	8270	3510 or 3520
2-methylneapthalene	8270	3510 or 3520
Napthalene	8270	3510 or 3520
Phananthrene	8270	3510 or 3520
Pyridine	8270	3510 or 3520
Pyrene	8270	3510 or 3520
Quinoline	8270	3510 or 3520

TABLE 4

(Page 2 of 2)
SAMPLE SUMMARY TABLE
QUARTERLY GROUNDWATER SAMPLES
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII
DELTA NO. 45-93-033

Analytical Parameters	Analytical Method Number	Preparation or Extraction Method
Semi-Volatile Acid-Extractable Compounds (SVOCs)		
Benzenethiol Cresols	8270	3510 or 3520
2,4,-dimethylphenol	8270	3510 or 3520
2,4-dinitrophenol	8270	3510 or 3520
4-nitrophenol	8270	3510 or 3520
Phenol	8270	3510 or 3520
Metals ‡		
Antimony	6010 (ICAP)	3005 or 3010
Arsenic	7060 (AA/GF)	3020
Barium	6010 (ICAP)	3005 or 3010
Beryllium	6010 (ICAP)	3005 or 3010
Cobalt	6010 (ICAP)	3005 of 3010
Cadmium	7131 (AA/GF)	3020
Chromium	6010 (ICAP)	3005 or 3010
Lead	7421 (AA/GF)	3020
Mercury	7470 (AA/CV)	3020
Nickel	6010 (ICAP)	3005 or 3010
Selenium	7740 (AA/GF)	3020
Vanadium	6010 (ICAP)	3005 or 3010

ICAP = Inductively Coupled Argon Plasma
AA/GF = Atomic Absorption/Graphite Furnace
AA/CV = Atomic Absorption/Cold Vapor

† West Coast Analytical Services performs EPA Method 8260 for analysis of VOCs.

‡ West Coast Analytical Services performs Inductively Couple Plasma Mass Spectrometry (ICPMS) for metals analysis. A sample preparation method of acid digestion is used. Commonly used acids are nitric acid and hydrochloric acid.

TABLE 5

GENERAL CHEMISTRY ANALYSIS
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII
DELTA NO. 45-93-033

PARAMETER	EPA METHOD	TECHNIQUE
Total dissolved solids	160.1	Gravimetric
Alkalinity	310.1	Titrimetric
Fluoride	340.2	Electrode
Nitrate-Nitrite as Nitrogen	353.2	Colorimetric
Surfactants (MBAS)	425.1	Colorimetric
Sulfate	9038	Turbidimetric
pH	9040	Electrode
Electrical Conductivity	9050	Electrode
Chloride	9252	Titrimetric

TABLE 6

FREE-PRODUCT ANALYSES
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII
DELTA NO. 45-93-033

PARAMETER	ANALYTICAL METHOD	TECHNIQUE
Gas Chromatographic Characterization	ASTM 2887	Simulated Distillation
Specific Gravity	SM 213E	Gravimetric
Flashpoint	EPA METHOD 1010	Flashpoint/Redox

TABLE 7

BIODEGRADATION-FIELD GROUNDWATER PARAMETERS
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII
DELTA NO. 45-93-033

Parameter	Data Value
Dissolved Oxygen (DO):	Dissolved oxygen levels in groundwater are indicators of natural inputs of oxygen into the saturated zone, activity of natural bacteria in response to organic chemicals in the groundwater, and a tool to help map chemical plumes in groundwater. Biodegradation generally requires >2 ppm DO in groundwater to be efficient at consuming dissolved-phase chemicals.
Soluble Iron (Fe):	Soluble or dissolved iron in groundwater provides a check on the DO that is measured since only low levels of DO (<1-2 ppm) can provide the correct conditions for the presence of high levels of soluble iron (>10 ppm). Alternately, high levels of DO (>2 ppm) will result in low levels of soluble iron (<10 ppm). High levels of soluble iron will likely cause maintenance problems in the operation of groundwater remediation systems.
Total Iron (Fe):	Total iron in groundwater provides an estimate of potential soluble iron if low oxygen levels are able to influence the groundwater environment.
Temperature:	Groundwater temperature is a controlling factor for the rate of in-situ biodegradation of dissolved chemicals. Better estimates of rates of natural, in-situ biodegradation are possible when the actual in-situ temperature is known. Higher groundwater temperatures result in higher biodegradation activity.
Conductivity:	Conductivity is the opposite of resistance in assessing groundwater for electrical current transport. Generally, the greater the concentration of chemicals, cations, and anions in groundwater, the greater the conductivity. Its measurement provides a relative indicator of the level of chemicals, cations, and anions in different groundwater wells.
pH:	The amount of hydrogen ions in groundwater dictates a corresponding pH value. A pH level of 6.5 up to 8.5 is generally considered acceptable for optimal biodegradation conditions.

TABLE 8

BIODEGRADATION-LABORATORY GROUNDWATER PARAMETERS
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII
DELTA NO. 45-93--33

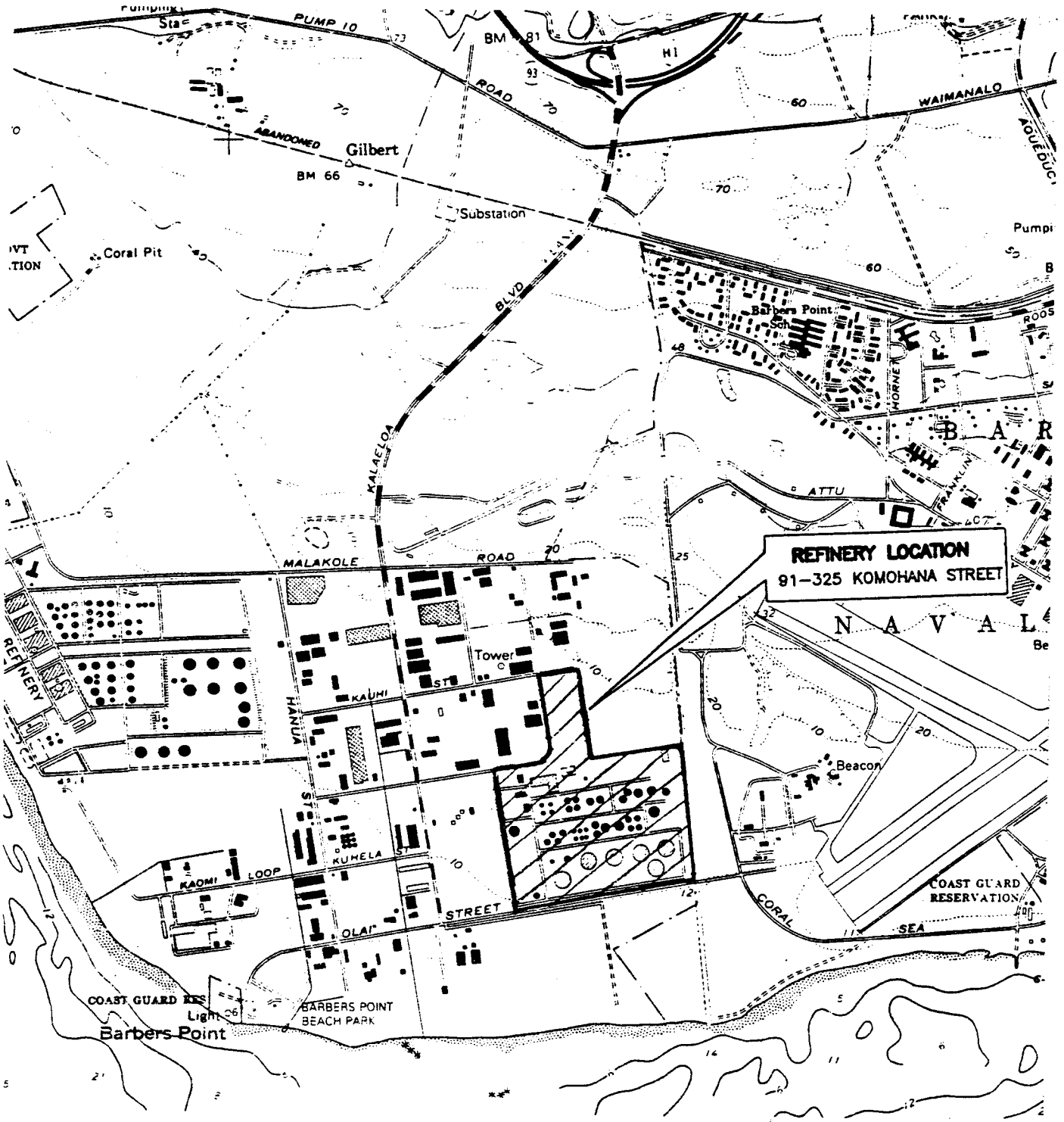
Parameter/EPA Method	Data Value
Total Organic Carbon (TOC): (EPA 415.2)	This parameter measures the total carbon, or "food," that groundwater microbes can use for energy and growth. All organic chemicals in the groundwater are summed in the TOC measurement.
Chemical Oxygen Demand: (EPA 410.4)	Chemical oxygen demand (COD) gives a measurement of the sum total oxygen demand in the groundwater from the dissolved chemicals.
Biochemical Oxygen Demand: (EPA 320.1)	Biochemical oxygen demand is based on the oxygen demand in a 5-day test known as BOD_5. The oxygen demand of the biochemical processes present in the groundwater sample is given as a sum total for all the various microbes present in the sample.
Nitrogen: (Ammonia Nitrogen - EPA 350.1) (Nitrate - Nitrite Nitrogen - EPA 353.2)	Ammonia (NH_3), nitrite (NO_2), and nitrate (NO_3) nitrogen provide an essential nutrient, nitrogen, to microbes for growth. Nitrate can also provide energy to microbes when oxygen levels are low.
Phosphorus: (Phosphorus, Ortho - EPA 365.3)	Reactive phosphorus (o-PO_4), or ortho-phosphate, provides an essential nutrient, phosphorus, to microbes for growth.
Sulfate: (EPA 375.4)	Sulfate (SO_4) is utilized by microbes when the supply of oxygen or nitrate-nitrogen is low. Microbes can reduce the sulfate molecule to provide energy for biodegradation.
Carbonates, Alkalinity Hardness, Total & Soluble Iron and Manganese: (Hardness - EPA 130.1) (Total Iron - EPA 236.1) (Soluble Iron - EPA 236.1) (Total Manganese and Soluble Manganese - EPA 243.1)	These parameters are important for maintenance concerns during the operation of groundwater treatment systems. Knowing these levels in advance of design activities can assist the project in anticipating maintenance schedules and problems.

TABLE 9

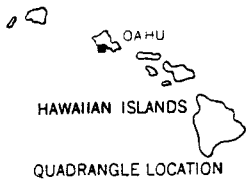
SOIL CHARACTERISTIC ANALYTICAL METHODS
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII
DELTA NO. 45-93--33

CHARACTERISTIC	ANALYTICAL METHOD	TECHNIQUE
Fraction of Organic Carbon (F_{oc})	EPA Method 9060	Carbonaceous Analyzer
Partitioning Coefficient (K_{oc})	TCLP Method	To Be Determined
Total Organic Carbon	EPA Method 9060	Carbonaceous Analyzer

FIGURES



GENERAL NOTES:
BASE MAP FROM U.S.G.S.
EWA, HAWAII QUADRANGLE
7.5 MINUTE TOPOGRAPHIC MAP
PHOTOREVISED 1983



N

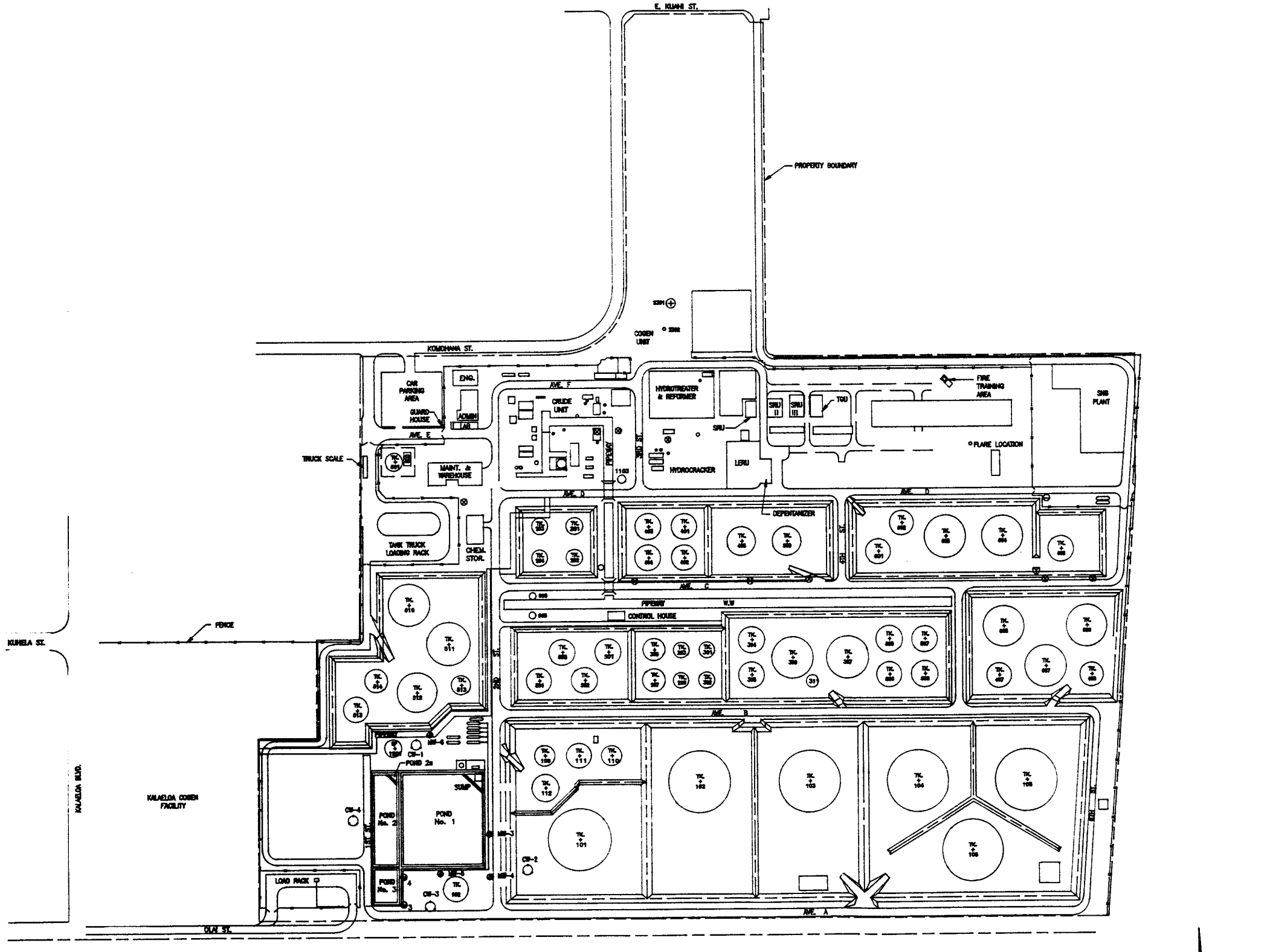
0 2000 FT

SCALE: 1 : 24,000

FIGURE 1

SITE LOCATION MAP
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII

PROJECT NO. 45-93-033	DRAWN BY G. ROSAS	Delta Environmental Consultants, Inc.
FILE NO. 3-033-02	PREPARED BY J. AMATO	
DATE 15 JUL 93 / REV. 0	REVIEWED BY	



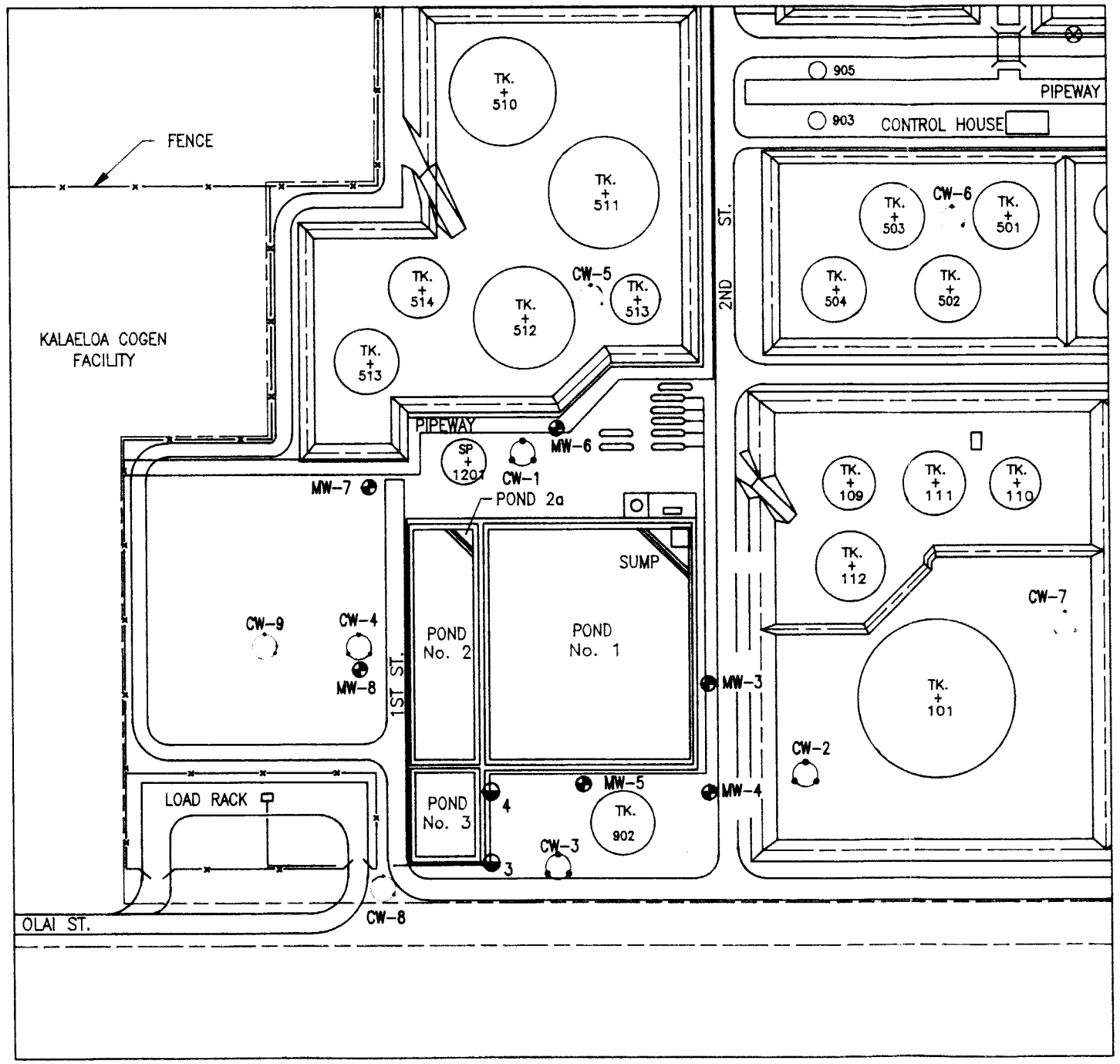
LEGEND

- MW-3 EXISTING GROUNDWATER MONITORING WELL LOCATION
- CW-4 EXISTING WELL CLUSTER LOCATION (SEE FIGURE 4 FOR DETAIL)
- 3 INJECTION WELL LOCATION

FIGURE 2

REFINERY SITE PLAN WITH EXISTING GROUNDWATER MONITORING WELL LOCATIONS
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII

PROJECT NO. 45-93-033	DRAWN BY GREG ROSAS	Delta Environmental Consultants, Inc.
FILE NO. 3-033-06	PREPARED BY JOHN AMATO	
DATE 3 AUG 93 / REV.	REVIEWED BY	



LEGEND

MW-5 EXISTING GROUNDWATER MONITORING WELL LOCATION

CW-4 EXISTING CLUSTER WELL LOCATION (SEE FIGURE 4 FOR DETAIL)

4 INJECTION WELL LOCATION

CW-9 PROPOSED CLUSTER WELL LOCATION

N

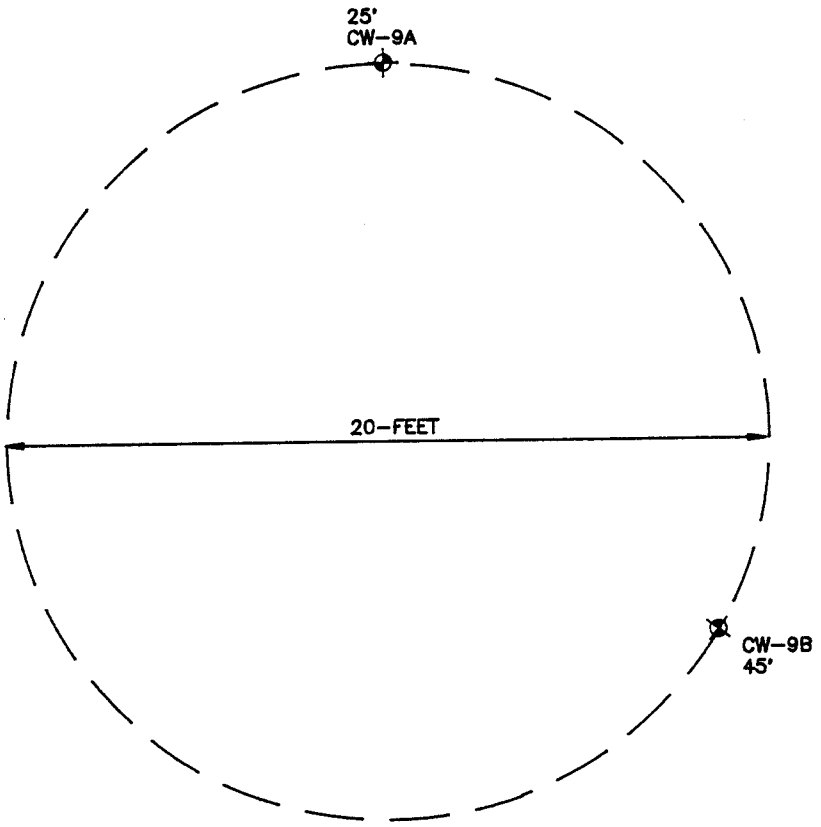
0 100 200

SCALE FEET

FIGURE 3

GROUNDWATER MONITORING WELL NETWORK WITH PROPOSED CLUSTER WELL LOCATIONS
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII

PROJECT NO. 45-93-033	DRAWN BY M. ENTERLINE	Delta Environmental Consultants, Inc.
FILE NO. 3-033-08	PREPARED BY J. AMATO	
DATE 18 OCT 93 / REV.	REVIEWED BY	



LEGEND

CW-9A 25' — CLUSTER WELL WITH TOTAL DEPTH OF WELL IN FEET

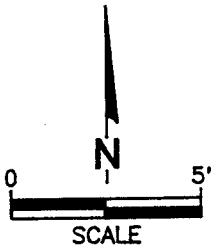
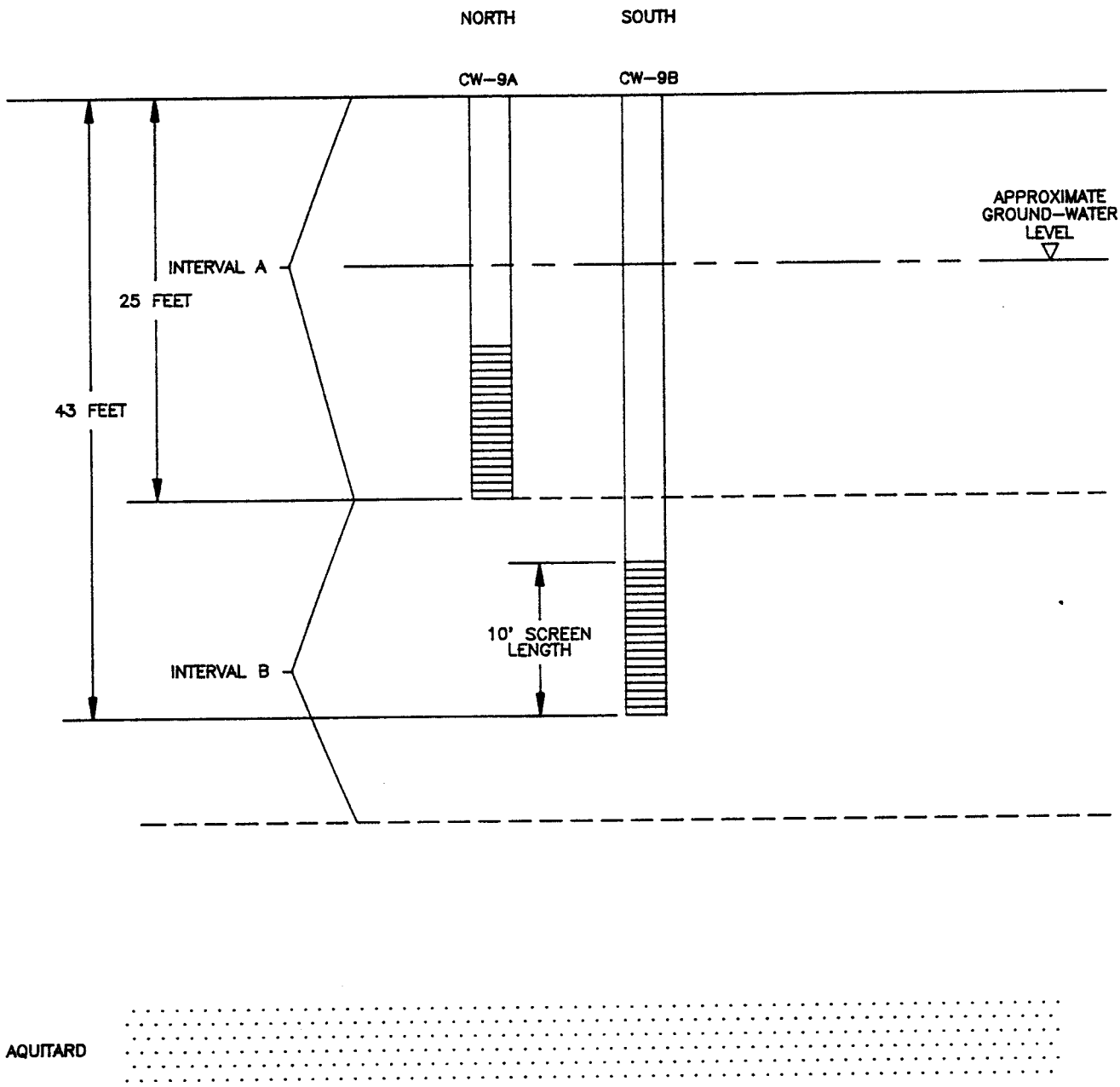


FIGURE 4
DETAIL OF CONFIGURATION OF PROPOSED CLUSTER WELLS (PLAN VIEW)
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII

PROJECT NO. 45-93-033	DRAWN BY G. ROSAS	Delta Environmental Consultants, Inc.
FILE NO. 3-033-04	PREPARED BY J. AMATO	
DATE 30 SEP 93 / REV. 0	REVIEWED BY	



NOT TO SCALE

FIGURE 5

CLUSTER WELL SCHEMATIC
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII

PROJECT NO. 45-93-033	DRAWN BY A. KRUSE	Delta Environmental Consultants, Inc.
FILE NO. 3-033-10	PREPARED BY J. AMATO	
DATE 1 NOV 93 / REV. 0	REVIEWED BY	

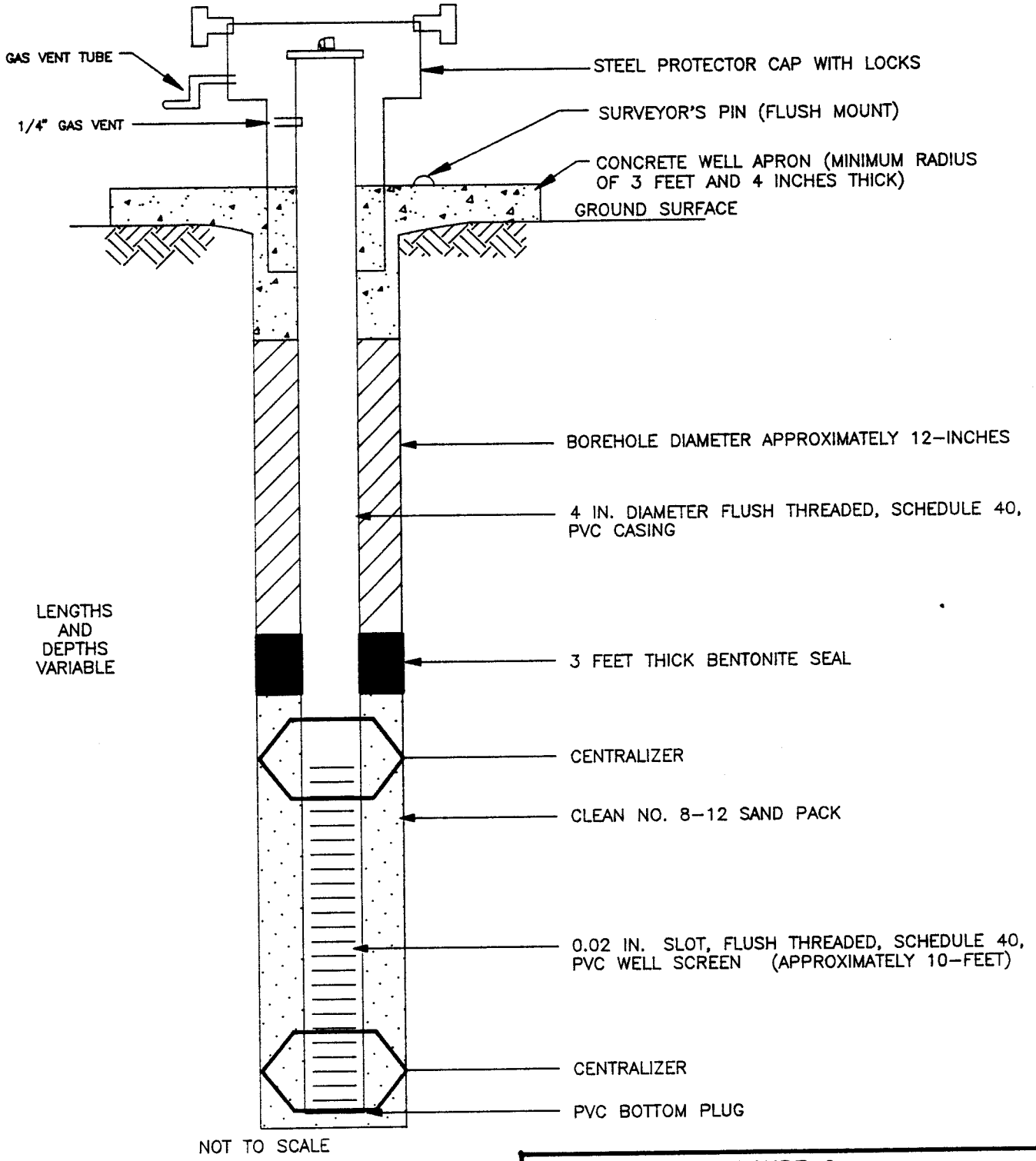


FIGURE 6

CONSTRUCTION DETAIL OF TYPICAL GROUNDWATER MONITORING WELL
BPH PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII

PROJECT NO. 45-93-033	DRAWN BY G. ROSAS	Delta Environmental Consultants, Inc.
FILE NO. 3-033-05	PREPARED BY J. AMATO	
DATE 6 OCT 93 / REV 0	REVIEWED BY	

APPENDIX A

APPENDIX A

Special Drilling Instructions

APPENDIX A

Special Drilling Instructions

Upon encountering free-product during drilling, these special drilling instructions will be employed. The special drilling instructions are designed to prevent free-product from migrating to deeper portions of the uppermost aquifer from advancing the core barrel. Upon encountering groundwater, continuous coring will be ceased and the cored portion of coral will be removed. Visual observations will be made to determine whether or not free-product is present in the borehole. If product is present then coring will be continued (in the same location) using a larger diameter core barrel. Upon re-entering groundwater the larger diameter core barrel will be removed and a steel conductor casing will be installed in the borehole. Cement will be placed in the annulus between the conductor casing and the borehole wall. The cement will be allowed to harden. Before reinstating the continuous coring, the larger diameter core barrel will be removed from the drilling rig and replaced with the 12-inch diameter core barrel. The 12-inch diameter core barrel will be used to drill through the cement at the bottom of the conductor casing and through the remaining coral until terminal depth is reached, 25 or 43 feet. Any free-product in the conductor casing will be removed prior to completion of the borehole.

APPENDIX B

APPENDIX B

Sample Well Construction Log

Delta
Environmental Consultants, Inc.

WELL CONSTRUCTION LOG

BORING/WELL LOCATION SKETCH MAP

N

BORING/WELL NO.	
PROJECT NO./NAME	LOCATION
DRILLING CONTRACTOR/DRILLER	
GEOLOGIST/OFFICE	APPROVED BY
DRILLING EQUIPMENT/METHOD	SIZE/TYPE OF BIT; SAMPLING METHOD; START/FINISH DATE

WELL INSTALLED? YES ☐ NO ☐ | CASING MAT./DIA. | SCREEN: TYPE, MAT., LENGTH, DIA., SLOT SIZE

ELEVATION OF: (FT. ABOVE M.S.L.) GROUND SURFACE, TOP OF WELL CASING, TOP & BOTTOM SCREEN, GW SURFACE, DATE

WELL CONSTRUCTION	LITHOLOGY			SAMPLING DATA	
Depth, feet			Graphic Log	Visual Description	Sample No. and Interval	Values (ppm)
5					5	
10					10	
15					15	
20					20	
25					25	
30					30	
35					35	

Continued ...

Delta
Environmental
Consultants, Inc.

WELL CONSTRUCTION LOG

BORING/WELL NO.	
PROJECT NO./NAME	LOCATION

WELL CONSTRUCTION		LITHOLOGY		SAMPLING DATA	
Depth, feet	Continued	Graphic Log	Visual Description	Sample No. and Interval	Values (ppm)
40				40	
45				45	
50				50	
55				55	
60				60	
65				65	
70				70	

Delta
Environmental
Consultants, Inc.

WELL CONSTRUCTION LOG

BORING/WELL NO.

PROJECT NO./NAME

LOCATION

WELL CONSTRUCTION		LITHOLOGY		SAMPLING DATA	
Depth, feet	Continued	Graphic Log	Visual Description	Sample No. and Interval	Values (ppm)
80				80	
85				85	
90				90	
95				95	
100				100	

APPENDIX C

APPENDIX C

Sample Label

SAMPLE LABEL

Analytical **Technologies,** Inc.
5550 Morehouse Drive, San Diego, CA 92121

Client:

Date Sampled:

Source:

Analysis:

Unpreserved Preserved: _____

APPENDIX D

APPENDIX D

Sample Chain-of-Custody

AnalyticalTechnologies,Inc.
5550 MOREHOUSE DRIVE
SAN DIEGO, CA 92121-1709
(619) 458-9141

Chain of Custody

DATE ..... PAGE ..... OF .....

PROJECT MANAGER:
COMPANY:
ADDRESS:

BILL TO:
COMPANY:
ADDRESS:

SAMPLERS: (Signature) ( ) - PHONE NUMBER

Recommended Quantity and Preservative (Provide triple volume on QC Samples)

SAMPLE ID	SAMPLE DATE	TIME	MATRIX	LAB ID	Petroleum Hydrocarbons 418.1 (1L (H_2SO_4)/100g)	Oil and Grease 413.2 (1L (H_2SO_4)/100g)	Gasoline (MOD 8015/DOHS) (4 oz (HCl)/50g)	Diesel (MOD 8015/DOHS) (4 oz (HCl)/50g)	Gasoline/BTXE (MOD 8015/8020) Maximum Contamination Level of Gasoline: 2ppm (water), 50ppm (Soil) (2X40ml (HCl)/50g)	MOD 8015 (Unknown) (4 oz (HCl)/50g)	BTXE (8020) (2X40ml (HCl)/50g)	Chlorinated Hydrocarbons (8010) (2X40ml (HCl)/50g)	Aromatic Hydrocarbons (8020) (2X40ml (HCl)/50g)	Chlorinated/Aromatic Hydrocarbons (8010/8020) (2X40ml (HCl)/50g)	Organic Pb (500ml/50g)		Pesticides/PCB (8080) (1L/50g)	Base/NEU/Acid Cmpds GC/MS (8270) (1L/100g)	Volatile Cmpds GC/MS (8240) (2X40ml (HCl)/100g)	Polynuclear Aromatic (8310) (1L/100g)	CCR Metals (500ml/100g)	Priority Pollutant Metals (500ml/100g)								Number of Containers

PROJECT INFORMATION	SAMPLE RECEIPT	
PROJECT NUMBER:	TOTAL NUMBER OF CONTAINERS	
PROJECT NAME:	CHAIN OF CUSTODY SEALS Y/N/NA	
PURCHASE ORDER NUMBER:	SEALS INTACT? Y/N/NA	
VIA:	RECEIVED GOOD COND./COLD	
TAT: ☐24HR ☐48HRS ☐72HRS ☐1WK ☐2WK	LAB NUMBER	

SAMPLE DISPOSAL INSTRUCTIONS

☐ ATI Disposal @ $5.00 each ☐ Return ☐ Pickup

Comments:

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature: Time:	Signature: Time:	Signature: Time:
Printed Name: Date:	Printed Name: Date:	Printed Name: Date:
Company:	Company:	Company:
RECEIVED BY: 1.	**RECEIVED BY: 2.**	**RECEIVED BY: (LAB) 3.**
Signature: Time:	Signature: Time:	Signature: Time:
Printed Name: Date:	Printed Name: Date:	Printed Name: Date:
Company:	Company:	Analytical Technologies, Inc.

DISTRIBUTION: White, Canary - ANALYTICAL TECHNOLOGIES, INC. • Pink - ORIGINATOR

APPENDIX E

APPENDIX E

Summary of Analytical Laboratory Procedures

APPENDIX E

Summary of Analytical Laboratory Procedures

EPA Method 8240 - VOCs

Groundwater samples collected for VOC analysis will be analyzed according to EPA Method 8240. EPA Method 8240 is based upon a purge-and-trap, gas chromatographic/mass spectrographic (GC/MS) procedure. The practical quantitation limit (PQL) of Method 8240 for an individual compound is approximately 5 μg/L. The target VOCs are listed in Table 4.

EPA Method 8270 - SVOCs

Groundwater samples collected for SVOC analysis will be analyzed according to EPA Method 8270. EPA Method 8270 is based upon the direct injection of a sample extract into a GC/MS. EPA Method 8270 can be used to quantify most neutral, acidic, and basic organic compounds that are soluble in methylene chloride and capable of being eluted without derivatization as sharp peaks from a gas chromatographic fused-silica capillary column coated with a slightly polar silicone. The lowest PQL of Method 8270 is approximately 10 μg/L for groundwater samples. The target SVOCs are listed in Table 4.

EPA Method 9252 - Chloride

Method 9252 is suitable for all concentration ranges of chloride content. An acidified sample is titrated with mercuric nitrate in the presence of mixed diphenylcardazone-bromophenol blue indicator. The end point of the titration is the formation of the blue-violet mercury diphenylcardazone complex.

EPA Method 6010 - Antimony, Barium, Beryllium, Cobalt, Chromium, Nickel and Vanadium

Inductively coupling plasma atomic emission spectroscopy (ICP), determines trace elements, including metals, in groundwater. Detection limits, sensitivity, and optimum ranges of the metals will vary with the model of the spectrometer. Prior to analysis, groundwater samples must be solubilized or digested using the appropriate sample preparation methods (e.g., Methods 3005-3050). The methods measure element-emitted light by optical spectrometry. The samples are nebulized and the resulting aerosol is transported to the torch. Photomultiplier tubes are used to monitor the intensity of the dispersed spectral lines. Estimated detection limits range from 32 μg/l for antimony to 0.3 μg/l for Beryllium.

EPA Method 7060 - Arsenic

Method 7060 is an atomic absorption (AA) procedure approved for determining the concentration of arsenic in groundwater. Samples must be subject to a dissolution step prior to analysis. Samples must be prepared in order to convert organic forms of arsenic to inorganic forms to minimize organic interferences. The

absorption of hollow cathode or EDL radiation during atomization in the graphite furnace will be proportional to the arsenic concentration. Detection limits are typically as low as 1 μg/l.

EPA Methods 7131 and 7421 - Cadmium and Lead

EPA Methods 7131 and 7421 are AA spectroscopy methods approved for determining the concentration of cadmium and lead, respectively, in groundwater. Detection limits will vary with the model of AA spectrometers but using the furnace procedure detection limits as low as 0.1 μg/l and 1.0 μg/l can be obtained in cadmium and lead, respectively.

EPA Method 7470 - Mercury

Method 7470 is a cold-vapor AA procedure approved for determining the concentration of mercury in groundwater. Samples must be subjected to an appropriate dissolution step prior to analysis. This method is based on the absorption of radiation at 253.7 nanometers by mercury vapor. The absorbance is measured as a function of mercury concentration. Detection limits for this method as low as 0.2 μg/l are achievable.

EPA Method 7740 - Selenium

Method 7740 is an AA method procedure approved for determining the concentration of selenium in groundwater. Samples must be prepared in order to convert organic forms of selenium to inorganic forms to minimize interferences. Aqueous samples are subject to an acid-digestion procedure. The prepared samples is subjected to evaporation in a graphite furnace. The absorption of lamp radiation during atomization will be proportional to the
selenium concentration. The typical detection limit for this method is 2 μg/l.

General Minerals

The parameters included in the general minerals analysis include carbonate as $CaCO_3$, bicarbonate as $CaCO_3$, hydroxide as $CaCO_3$, alkalinity as $CaCO_3$, chloride, electrical conductivity, fluoride, nitrogen, pH, sulfate and total dissolved solids (TDS). See Table 6 for a summary of general minerals analyses and their respective analytical methods.

APPENDIX F

APPENDIX F - 1

Analytical Technologies, Inc. - Laboratory Quality Assurance Manual

Laboratory Quality Assurance Manual

Analytical **Technologies,** Inc.

5550 Morehouse Drive
San Diego, CA 92121
(619) 458-9141

QUALITY ASSURANCE MANUAL

ANALYTICAL TECHNOLOGIES, INC.
5550 MOREHOUSE DRIVE
SAN DIEGO, CA 92121

Revised 2/93

M.E. Shigley
M.E. Shigley
Laboratory Manager

4/28/93
Date

Patricia A. Schroder
Patricia A. Schroder
Quality Assurance Manager

4/28/93
Date

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3.0 INTRODUCTION AND QA POLICY STATEMENT

Quality Assurance, as practiced at Analytical Technologies, Inc. (ATI) in San Diego, consists of general quality control and assessment procedures that are adapted to the specific operating conditions in each section. This Laboratory Quality Assurance Manual describes the quality control and quality assessment systems which constitute the comprehensive Quality Assurance Program at ATI.

3.1 Quality Control

Quality Control consists of specific procedures applied to all phases of analysis from sample receipt through the final reporting of results. The purpose of Quality Control is to ensure the quality of data and service provided to our clients.

3.2 Quality Assessment

Quality Assessment involves the continuous evaluation of data and monitoring of analytical processes for the purpose of ensuring that the Quality Control systems are performing effectively.

3.3 Program Elements

The major elements of the overall Quality Assurance Program are summarized below:

3.3.1 Use of appropriate methodologies by technically competent, well-trained personnel with state-of-the-art instrumentation and equipment.

3.3.2 Adherence to well-defined standard operating procedures, with emphasis on good laboratory and measurement practices.

3.3.3 Analysis and assessment of Quality Control samples including (but not limited to) matrix spike samples, duplicate samples, surrogate spikes, blanks, blank spikes, and independent laboratory control standards.

3.3.4 Internal and external system and performance audits to monitor compliance to procedures and to assess the performance of the analytical methods.

4.0 LABORATORY ORGANIZATION AND PERSONNEL - QA RESPONSIBILITIES

Please see Figure 1 for a general overview of laboratory organization and personnel.

4.1 President and General Manager

As the chief executive officer for all of the ATI laboratories, it is incumbent upon the President and General Manager to set the example for all ATI employees to follow.

With respect to the Quality Assurance program, it is the responsibility of the President and General Manager:

4.1.1 To establish the quality policy for all ATI laboratories.

4.1.2 To establish and support a positive attitude toward quality throughout the entire ATI laboratory network.

4.2 Laboratory Manager - QA Responsibilities

The Laboratory Manager is directly responsible for the success of the QA program by mandating adherence to procedures throughout the San Diego laboratory.

With respect to the Quality Assurance program, the Laboratory Manager must:

4.2.1 Direct the operations of all sections of the San Diego laboratory to accomplish the goals of timely, cost-effective production of quality data.

4.2.2 Assist in the resolution of quality problems by offering technical expertise and experience in planning and implementing corrective action plans.

4.2.3 Support the QA manager in the execution of all of the functions listed in section 4.3.

4.3 Quality Assurance Manager

The Quality Assurance Manager functions independently in the laboratory, reporting to the Laboratory Manager directly, and to the General Manager through quarterly reports or on specific topics whenever required.

The primary function of the QA Manager is to direct and monitor the QA Program through the following activities:

4.3.1 Establishment and maintenance of QA and QC systems to accomplish the stated Quality Assurance objectives.

4.3.2 Assessment of QC data to insure that analytical systems are operating in a state of statistical control.

4.3.3 System and performance audits to monitor completeness and effectiveness of QC systems.

4.3.4 Maintenance of up-to-date standard operating procedures, analytical methods, and project specific QA plans.

4.3.5 Execution of training and technical review program.

4.3.6 Interaction with local, state, and federal agencies in matters pertaining to regulations, certifications, methodologies, audits and performance evaluations.

4.3.7 Interaction with clients on matters pertaining to data integrity and quality.

4.3.8 Support of the laboratory manager, supervisors, group leaders, analysts, and technicians in addressing quality issues and/or training in their areas of operation.

4.4 Section Supervisors/Group Leaders

The Section Supervisors and Group Leaders are the first line of enforcement of QA Policy, as such it is their responsibility to:

4.4.1 Support the QA Manager in the execution of all of the functions listed in section 4.3, within their respective departments.

4.4.2 Monitor compliance to the QA plan, SOP's, and methods by their analysts and technicians.

4.4.4 Review data for accuracy, precision, and completeness in accordance with standard operating procedures.

4.4.5 Ensure compliance to QA requirements on all projects for tests within their section.

4.5 Analysts/Technicians

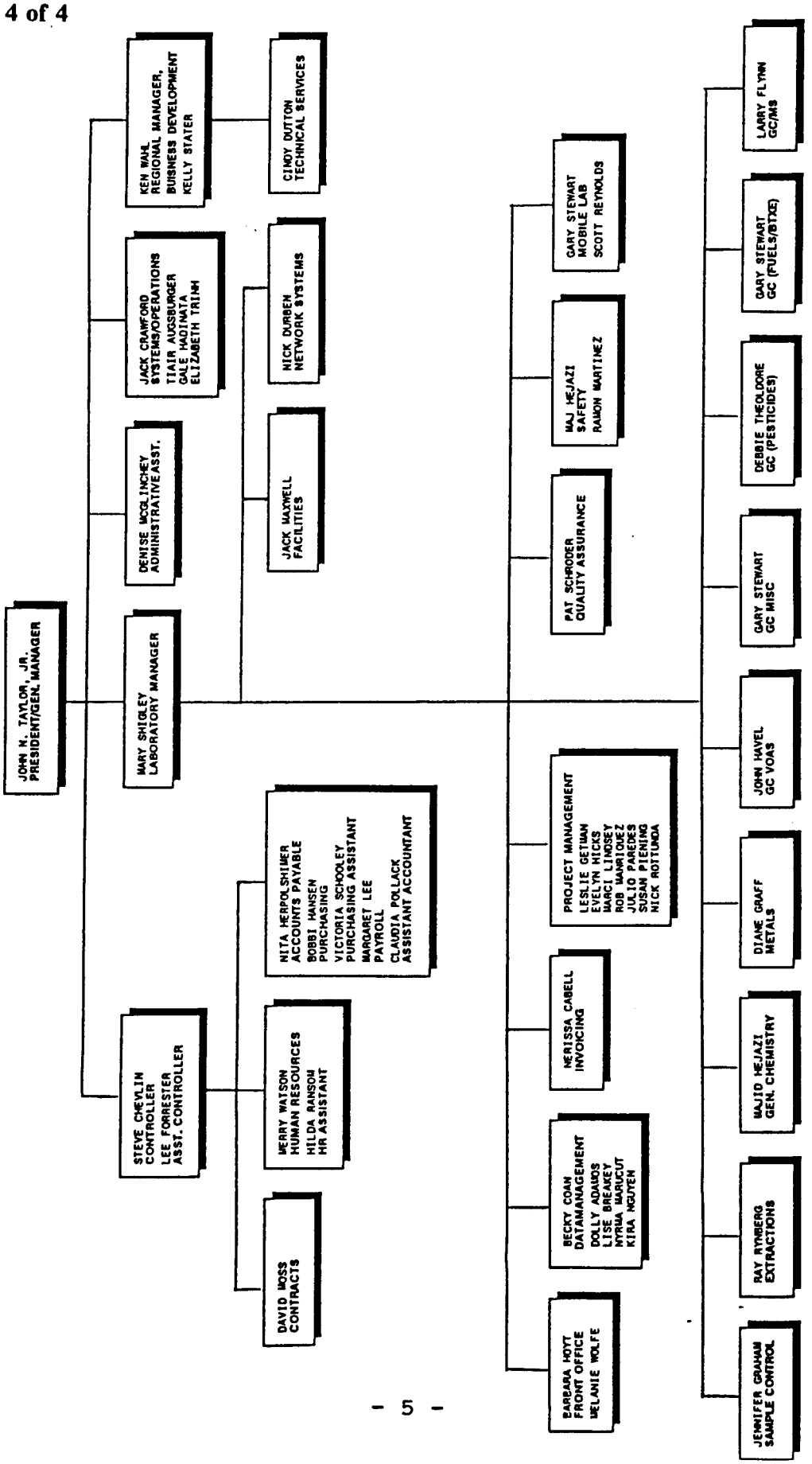
As the individuals responsible for performing the work in the laboratory, the analysts/technicians must have a thorough knowledge of the QA Program at ATI San Diego and how they fit into that program.

They must:

4.5.1 Understand and operate in compliance with the laboratory QA program and standard operating procedures, utilizing good laboratory practices.

4.5.2 Be able to recognize problems with a potential impact on data quality and to inform the appropriate individual(s) of such problems in accordance with established procedures.

FIGURE 1. ATI ORGANIZATION CHART



ATIFRMORG(4/93)

5.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS AND COMPARABILITY

5.1 Quality Assurance Goals

The goal of the quality assurance program is to ensure the production of consistently accurate data of known and defensible quality at the highest levels of efficiency, timeliness, and cost-effectiveness. Toward that end, the specific objectives of the QA Program are:

5.1.1 To establish and maintain standard operating procedures which govern all laboratory practices, procedures, and analytical methods.

5.1.2 To adhere to accepted "Good Laboratory Practices" in all areas.

5.1.3 To ensure that procedures utilized at ATI do not conflict with procedures established by and for the U.S. Environmental Protection Agency or other responsible agency.

5.1.4 To establish and maintain systems which identify problems at the earliest stages and provide direction for the investigation and resolution of such problems.

5.1.5 To ensure that all employees are technically competent in their positions and that QA requirements are well understood and faithfully practiced.

5.1.6 To promote a positive attitude towards quality throughout the laboratory.

5.2 Quality Assurance Objectives for Accuracy

Accuracy is expressed as the percent recovery of an analyte which has been used to fortify (spike) a sample or a standard matrix such as reagent grade water or blank soil.

See Table 3 (Section 11, page 9 of 9) and Section 14 for additional information regarding accuracy.

A listing of the most recent acceptance criteria for matrix spike recoveries, for the more common tests run at ATI, can be found in Table 1.

A listing of the most recent acceptance criteria for blank spike recoveries, for the more common tests run at ATI, can be found in Appendix C, Exhibit I.

5.3 Quality Assurance Objectives for Precision

Precision is the difference between results of duplicate samples, relative to the average of those results, expressed as a percentage.

See Table 3 (section 11, page 6 of 6) and section 14 for additional information regarding precision, calculated and expressed as relative percent difference (RPD).

A listing of the most recent acceptance criteria, for the more common tests run at ATI, can be found in Table 1 and in Appendix C, Exhibit I.

5.4 Quality Assurance Objectives for Data Completeness

Completeness is a measure of the number of analytical data points which meet all of the acceptance criteria for accuracy, precision, reasonableness and any criteria required by the specific methods used, relative to the total number of data points generated.

5.4.1 Under ideal circumstances, it might be expected to be able to use 100% of the data generated, realistically 5 - 10% of the data will be unusable. Samples received and analyzed at ATI are generally not ideal.

5.4.1.1 Completeness for all organic analyses will be 90% or greater.

5.4.1.2 Completeness for all inorganic analyses will be 95%.

See Table 1 for a breakdown of completeness, by test and matrix.

Table 1

Completeness Data by Method

Organics:

Matrix	Method	%
Water	502.2	90
Water	504	90
Water	524.2	90
Water	524.1	95
Water	601/8010	95
Water	8015	95
Water	Modified 8015	95
Water	602/8020	95
Water	604/8040	93
Water	606/8060	93
Water	608/8080	93
Water	610/8100	93
Water	610/8310	93
Water	612/8120	93
Water	614/8140	93
Water	615/8150	93
Water	617	93
Water	619	93
Water	622	93
Water	624/8240	95
Water	625/8270	95

Matrix	Method	%
Soil/Sludge	8010	90
Soil/Sludge	8015	90
Soil/Sludge	Modified 8015	90
Soil/Sludge	8020	90
Soil/Sludge	8040	90
Soil/Sludge	8060	90
Soil/Sludge	8080	90
Soil/Sludge	8100	90
Soil/Sludge	8120	90
Soil/Sludge	8140	90
Soil/Sludge	8150	90
Soil/Sludge	8240	90
Soil/Sludge	8270	90
Soil/Sludge	8310	90

Inorganics:

Matrix	Method	%
Water	200-289 (Metals)	98
Soil/Sludge	6010	95
Soil/Sludge	7000-7950	95

References:

1) EPA 600/4-79-020, Revised March 1983
2) SW846, 3rd Edition, November 1986
3) Federal Register, 40CFR, Part 136, July 1, 1988
4) EPA 500 Series, Federal Register, 40CFR, Part 141 and 142, Wednesday, July 8, 1987
5) American Standards for Testing Materials.
6) NIOSH, 3rd Edition, Volume 1, February 1984
7) Standard Methods, 16th Edition, 1985

6.0 SAMPLING PROCEDURES

Analytical Technologies, Inc. receives samples collected by clients. These samples are considered to have been collected according to established procedures, accepted by the Environmental Protection Agency or other responsible state agency.

6.1 Sample Containers

ATI makes available to our clients sample containers, prepared in accordance with EPA issued guidelines for container and preservation requirements for most commercial clients.

6.1.1 Two classifications of sample containers are purchased from I-CHEM, series 200 and series 300. Quality control of the containers is performed by I-CHEM. The containers are certified, by I-CHEM, to have been cleaned according to EPA protocols.

6.1.1.1 Series 200 containers are precleaned to EPA specifications by I-CHEM.

6.1.1.2 Series 300 glassware are uniquely identified by lot # and a certificate of analysis accompanies the containers, giving the results of the Quality Control performed on them.

6.1.2 Clients request sample containers for specified tests and are sent the appropriate sample containers.

6.1.2.1 Sample containers are properly preserved by ATI personnel in Sample Control, prior to being sent to the client.

6.2 Technical Assistance

Technical assistance is available to clients from all supervisory and project management staff when needed. Appendix A lists sample size, container, preservation, and holding time requirements for all parameters analyzed at ATI.

7.0 SAMPLE CUSTODY

All samples received at ATI are considered to be physical evidence and are handled accordingly. The Sample Control Standard Operating Procedures Manual defines procedures for sample receipt, log-in, "Chain of Custody", storage, and tracking of the raw sample throughout the analytical process. These procedures are briefly described in the following sections.

7.1 Facility Security

ATI is a secure facility, as such it is the policy of ATI to allow only authorized personnel beyond the reception area, at the front entrance. There is a rear entrance allowing access to Sample Control, to facilitate receipt and check-in of samples. Only authorized personnel are allowed beyond the Sample Control area.

7.2 Sample Receipt

Sample shipments are received at the rear entrance of ATI. Sample Control personnel verify the number of shipping containers being received against the number listed on the shipping manifest or airbill before signing it.

Any damage to the shipping containers or other discrepancy observed is noted on the airbill before signing it. A copy is kept for future reference.

The external "Chain of Custody" should be signed by the carrier for relinquishment of samples and signed by Sample Control personnel for sample receipt. The actual "Chain of Custody" may be supplied by ATI (Appendix B, Exhibit I) or may be the client's own form. The "Chain of Custody" remains in the project file at all times.

7.3 Sample Verification

After a sample shipment has arrived, Sample Control personnel perform sample inspection. ATI's "SAMPLE CONDITION UPON RECEIPT (SCUR) CHECKLIST" (Appendix B, Exhibit II) serves as both a checkoff list of procedures to follow and as documentation of the following:

1. Does this project require special handling according to protocols such as CLP, NEESA, HAZWRAP? If so:

   a) Record the cooler temperature.

   b) Check the pH of preserved water samples other than volatiles.

   c) Record sample container lot numbers.

2. Are custody seals or tapes present on the cooler?
   Are custody seals intact?

3. Are custody seals or tapes present on the sample containers?
   Are custody seals intact?

4. Is there a "Chain of Custody?"

5. Is the "Chain of Custody" complete?
   Does it include the date relinquished, the client project manager and the requested analyses?

6. Is the "Chain of Custody" in agreement with the samples received?
   Do the number of samples received and the sample matrices agree with the "Chain of Custody"? Are sample tags, sample containers and "Chain of Custody" all in agreement?

7. Are the samples preserved correctly? (Check the pH of preserved water samples other than volatiles. For volatiles, ensure that the labels note that they have been preserved.)

8. Is there enough sample to analyze?

9. Are all samples within the holding times for requested analyses?

10. Are the samples cold?

11. Are the sample containers intact (i.e., not broken, leaking, etc.)?

12. Are samples requiring no headspace, headspace free (i.e., VOA vials)?

The client is notified immediately of any problems noted during sample verification.

7.4 Sample Log-In and Storage

There are three distinct steps to the process of logging in samples.

7.4.1 Manual Log-in

All samples are entered into the Sample Receipt Log Book when they are received. A unique ATI accession number is assigned to the batch, and a sample ID number is assigned to each sample within the batch.

The ATI batch accession number and sample number are designated as follows:

a	b	c	d
3	01	256	03

a = Last digit of the current year, i.e., 3 = 1993.

b = Calendar month, i.e., 01 = January.

c = Batch number, assigned in ascending order from 001 each month.

d = Individual sample numbers assigned in ascending order within each batch, from 01 through 99.

The client's name, sample ID, brief description, date received, analysis due date, and storage location are also listed in the receipt record. A file is created for all paperwork.

7.4.2 Laboratory Information Management System (LIMS)

After samples are manually recorded, all of the above information is entered into the LIM system. At this time, analyses are assigned to each sample.

Additional information concerning the LIMS can be found in Section 10.2.

7.4.2.1 A computer generated verification sheet is compared to the Chain of Custody to make certain the information was entered into the computer correctly. Project Management then reviews the project file and okays the login conformation for faxing to the client. The client, at this point, has the opportunity to review our interpretation of the Chain of Custody. If the client does not agree, they are requested to contact ATI as soon as possible. The computer generated verification sheet is attached to the project file, and the file is stored in data management until all analyses are completed.

7.4.2.2 An in-house due date for the final report is entered into the LIMS by Sample Control personnel. The report due date is based on a standard two week turn around time for all routine analyses.

7.4.2.2.1 More rapid turn around times are possible, with prior notification. There is a surcharge for turnaround times less than two weeks.

7.4.2.3 An analysis due date is determined by the LIMS, based on the tests requested and the matrix of the sample. The analysis due date is always less than the holding times allowed by SW-846.

7.4.3 Sample storage

After manual log-in, all samples are stored under refrigeration at 4°C, according to ATI SOP 105. Most soils, nonvolatile organics, and inorganics are kept in a walk-in refrigerator in the Sample Control room. Volatile organic samples are subject to special handling procedures, including extraction of soils within 24 hours of receipt, and are stored in a separate VOA refrigerator. All locations are recorded manually and in the LIMS file.

7.5 Internal Chain of Custody

Receipt of samples at ATI does not preclude the necessity for accountability. Therefore, all analysts are responsible for signing samples in and out of Sample Control.

7.5.1 Intralaboratory (In-house)

Analysts and technicians follow strict internal chain of custody procedures to further insure the validity of all data.

7.5.1.1 The sample ID, date, time, analyst, storage location, and lab of analysis is recorded in the Sample Custody Log (Appendix B, Exhibit III).

7.5.1.2 Samples are signed back-in, noting the date and time they are returned. Depleted samples are recorded in a separate log.

7.5.2 Interlaboratory

Samples and extracts transfered between laboratories in the ATI network require and receive the same documentation as samples received from our regular clients. Samples and extracts are transferred between laboratories in the ATI network, according to ATI SOP 103.

7.6 Sample Disposal

Samples are disposed of twenty one days after the final report date unless otherwise requested. The disposal date is recorded in the Sample Log Book in Sample Control.

7.6.1 Samples are disposed of according to ATI SOP 907, in compliance with all applicable local, state and federal regulations.

8.0 CALIBRATION PROCEDURES AND FREQUENCY

Most measurements produced in the laboratory are based upon comparison to reference standards as analyzed by the standard method. The standard results are utilized to generate calibration curves or calibration factors, which are then used to quantify the results of the sample analysis.

All instruments are calibrated through the use of standard solutions of known concentrations. The standards are prepared from certified reference materials and are traceable back to the certification. (See Section 11.6)

8.1 Initial Instrument Calibration

Initial Calibration (IC) is performed on all instruments, as stipulated in the method or as needed, prior to the analysis of any samples.

8.1.1 Initial calibration of any instrument is performed according to the requirements of the method being used. If not specified in the method, initial calibration of instruments will be performed according to the instrument manufacturer's recommendations.

8.1.2 Initial calibration is performed at specified time intervals, or when the continuing verification procedure indicates the need.

8.1.3 Initial calibration is subject to acceptance criteria defined in Table 3.

8.1.4 See Section 14.0 for additional information concerning calibration of instruments for specific analyses.

8.2 Continuing Calibration Verification

Continuing Calibration Standards are run to verify calibration on all instruments, either as stipulated in the method or more often if needed, during the course of sample analysis.

8.2.1 Calibration is continuously verified by the analysis of Continuing Calibration Standards or Laboratory Control Samples at regular intervals.

8.2.2 Recalibration is performed at specified time intervals, or when the Continuing Calibration Standard indicates the need.

8.2.3 Continuing Calibration is subject to acceptance criteria defined in Table 3 following Section 11.

8.2.4 See Section 14.0 for additional information concerning calibration of instruments for specific analyses.

8.3 Laboratory Control Samples (LCS's) or Check Samples

Laboratory Control Samples or Check Samples are prepared solutions of analytes at known concentrations which are independent from the calibration standards. LCS's are utilized for all methods, and provide a very effective method for monitoring accuracy as well as verifying instrument calibration.

8.3.1 QC Check Samples

For most analyses, there are mixes of various analytes prepared at known concentrations and made available by various vendors such as ULTRA Scientific, SUPELCO, APG, ERA and NIS Environmental Solutions. These will be used by the analysts as LCS's or Check Samples. Since EPA is no longer providing these to the laboratory, a second source standard (other than that used for the calibration curve) will need to be found when the EPA QC samples are depleted or expired.

9.0 ANALYTICAL PROCEDURES

9.1 Analytical Methods

Analytical methods employed at ATI are generally EPA methodologies from the Federal Register and SW 846 (References 2 and 3) or equivalent approved methods. In a few cases, industrial methods are utilized to analyze for very specific compounds for which there are no EPA methods. A complete list of analytical methods utilized at ATI is given in Table 2, following Section 9.2.

9.2 Methods Manuals

ATI maintains comprehensive in-house method manuals detailing specific operating procedures for each method.

9.3 Standard Operating Procedures

All Standard Operating Procedures (SOP's) are considered controlled documents, as mentioned in Section 19.0. Section 19.0 contains a general description of ATI's Document Control.

TABLE 2

LIST OF ANALYTICAL METHODS

I. ORGANIC ANALYSES (SOIL, SOLID WASTE AND WASTE WATER)

8010	Purgeable Halocarbons: GC-HALL
8011	EDB & DBCP: GC-ECD
8015	Non-Halogenated Volatile Organics: GC-FID
8015(mod.)	Fuel Hydrocarbons and BTXE: GC-FID
8020	Purgeable Aromatics: GC-PID
8040	Phenols: GC-FID
8060	Phthalate Esters: GC-ECD
8080	Organochlorine Pesticides & PCB's: GC-ECD
8080(mod.)	Analysis of Pounce & Pydrin: GC-ECD
8120	Chlorinated Hydrocarbons: GC-ECD
8140	Organophosphorous Pesticides: GC-FPD or NPD
8150	Chlorinated Herbicides: GC-ECD
8220	Organophosphate Pesticides: GC-ECD
8240	Volatile Organics (VOA): GC-MS
8260	Volatile Organics by Capillary (VOA): GC-MS
8270	Base/Neutrals, Acids (BNA): GC-MS
8310	Polynuclear Aromatic Hydrocarbons: HPLC-UV/FLUOR
619	Triazine Pesticides: GC-NPD
632	Carbamates & Urea Pesticides: HPLC-UV
EPA-DRAFT	PCB's in Transformer Oil: GC-ECD
USATHAMA	Identification & Determination of Explosives & Related Materials: HPLC-UV
504 Mod	EDB & DBCP: GC-ECD Chlorobenzene Sulfonic Acid: HPLC-UV

II. ORGANIC ANALYSES (DRINKING WATER)

502.2	Volatile Organic Contaminants: GC-HALL/PID
504	EDB & DBCP: GC-ECD
508	Organochlorine Pesticides & PCB's: GC-ECD
524.2	Volatile Organic Contaminants: GC-MS

III. INORGANIC ANALYSES

305.1	Acidity
310.1	Alkalinity; Titrimetric
350.1	Ammonia; Colorimetric; Automated Phenate
405.1	Biochemical Oxygen Demand (BOD)
410.1	Chemical Oxygen Demand; Titrimetric; Mid level
410.2	Chemical Oxygen Demand; Titrimetric; Low Level
325.1,9251	Chloride; Colorimetric, Automated Ferricyanide
325.3	Chloride; Titrimetric, Mercuric Nitrate
330.5 HACH	Chlorine, Total Residual; Colorimetric
330.4	Chlorine, Total Residual; Titrimetric
7196	Chromium, Hexavalent; Colorimetric (Cr6+)
110.2	Color; Colorimetric - Platinum - Cobalt
120.1	Conductance; Specific Conductance
9010	Cyanide, Total; Titrimetric, Spectrophotometric
335.3,9012	Cyanide,Total and Amenable;Colorimetric;Automated UV
360.1	Dissolved Oxygen; Membrane Electrode
340.2	Fluoride; Potentiometric; Ion Selective Electrode Electrode
P&CAM 125	Formaldehyde (NIOSH)
130.2	Hardness in Drinking Water, Titrimetric, EDTA
6010	Hardness (By Calculation, from ICAP results)
351.2	Nitrogen, Total Kjeldahl; Colorimetric, Semi-Automated, Block Digester, (TKN)
353.2	Nitrogen; Nitrate-Nitrite; Colorimetric; Automated, Cadmium Reduction
415.1	Organic Carbon, Total (TOC); Combustion or Oxidation; UV Promoted Persulfate Oxidation
415.2	Organic Carbon, Total (TOC); Low Level; UV Promoted Persulfate Oxidation
140.1	Odor
9020	Organic Halides, Total (TOX), Combustion
413.1	Oil & Grease, Total recoverable; Gravimetric, Seperatory Funnel Extraction
413.2	Oil & Grease, Total Recoverable; IR
Chevron	Paraquot Residues
418.1	Petroleum Hydrocarbons; IR Spectrophotometric
150.1,9040	pH in Water, Electrometric
9045	pH in Solids and Water, Electometric
365.2	Phosphorus, All Forms; Colorimetric, Automated Ascorbic Acid
420.1,9065	Phenolics, Total Recoverable; Manual 4-AAP, Spectrophotometric with Distillation
420.2,9066	Phenolics, Total Recoverable; Automated 4-AAP, Colorimetric with Distillation
160.1	Residue, Filterable (TDS)
160.2	Residue, Non-Filterable (TSS)
160.3	Residue, Total (TS)
160.4	Residue, Volatile (TVS)

210A(S.M.)	Salinity
370.1	Silica
375.2,9036	Sulfate; Colorimetric, Automated, Methylthymol Blue
375.4,9038	Sulfate; Colorimetric, Automated, Methylthymol Blue
376.1	Sulfide, Titrimetric
376.2	Sulfide, Colorimetric
9030	Sulfide, Acid-Soluble and Acid-Insoluble
377.1	Sulfite; Titrimetric
425.1	Surfactants; Colorimetric; (MBAS) Methylene Blue Active Substances
180.1	Turbidity; Nephelometric
1010	Flash Point; Pensky-Martens Closed cup
1020	Flash Point; Setaflash Open Cup
7.3 SW-846	Reactivity

IV. METALS ANALYSES (Primary/Secondary)

6010 ---	Aluminum (Al)
6010/7041	Antimony (Sb)
7060/6010	Arsenic (As)
6010/7080	Barium (Ba)
6010/7091	Beryllium (Be)
6010 ---	Boron (B)
7131/6010	Cadmium (Cd)
6010 ---	Calcium (Ca)
6010/7191	Chromium (Cr)
7196 ---	Chromium, Hexavalent (Cr6+)
6010/7201	Cobalt (Co)
6010/7210	Copper (Cu)
6010/7380	Iron (Fe)
7421/6010	Lead (Pb)
7421/6010	Organic Lead
6010 ---	Magnesium (Mg)
6010 ---	Manganese (Mn)
7470&7471	Mercury (Hg)
6010 ---	Molybdenum (Mo)
6010 ---	Lithium (Li)
6010/7620	Nickel (Ni)
6010 ---	Phosphorous (P)
6010 ---	Potassium (K)
7740 ---	Selenium (Se)
6010 ---	Silicon (Si)
6010/7760	Silver (Ag)
6010 ---	Sodium (Na)
6010 ---	Strontium (Sr)
7841/6010	Thallium (Tl)
6010 ---	Tin (Sn)
6010 ---	Titanium (Ti)
6010/7911	Vanadium (V)
6010/7950	Zinc (Zn)

* Metals may be analyzed as totals, dissolved, TCLP or otherwise, depending on the sample preparation technique employed.

V. SAMPLE PREPARATION METHODS

CA. WET	California Waste Extraction Test, Title 22, CCR
1310	Extraction Procedure Toxicity (EP TOX)
1311	Toxicity Characteristic Leaching Procedure (TCLP), Part 261, Appendix II, 40 CFR Chapter I
3005	Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by Flame AA or ICP
3010	Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by Flame AA or ICP
3020	Acid Digestion of Aqueous Samples and Extracts for Total Metals by Furnace AA
3050	Acid Digestion of Sediments, Soils, and Sludges
3510	Separatory Funnel Liquid - Liquid Extraction
3520	Continuous Liquid - Liquid Extraction
3540	Soxhlet Extraction
3550	Sonication Extraction
3580	Waste Dilution
5030	Purge and Trap

*Method numbers refer to EPA Methods except:

1.S.M. = Standard Methods for the Examination of Water and Wastewater

2.USATHAMA = US Army Toxic and Hazardous Materials Agency

3.NIOSH = National Institute of Occupational Safety and Health, Manual of Analytical Methods

4.Hach, Chevron, Calgon are industrial methods provided by these companies.

5.CCR = California Code of Regulations

6.CFR = Code of Federal Regulations

10.0 DATA REDUCTION, VALIDATION AND REPORTING

The individual analysts and technicians are responsible for maintaining accurate, legible records and logs in accordance with standard operating procedures. The supervisors are responsible for insuring adherence to procedures.

Raw data and its reduction to final results is reviewed by the section supervisor or group leader periodically. The frequency and completeness of the review is individually determined, but is not less than 10% of all data every two weeks.

Figure 2, at the end of Section 10, is a flow diagram, outlining the procedure by which data and the Final Reports are reviewed

The laboratory QA Manager is responsible for routinely auditing records and logs and reporting deficiencies to the supervisor for corrective action. (See Sections 12.2.1 and 15.4)

10.1 Record Keeping and Review

It is imperative that records are maintained, that they are reviewed and that they can be used to reconstruct the events leading to the generation of the reported data.

10.1.1 Inorganic records, including QC data, are maintained in analysis-specific laboratory notebooks. ICP and GF/AA data is recorded on computer printouts, which are filed by date of analysis and accession number.

10.1.2 The extractions section utilizes method specific bound books to record all data associated with sample extraction and preparation. A copy of the extraction benchsheet is transferred to GC or GC/MS with each extracted sample.

10.1.3 The GC and GC/MS laboratories utilize benchsheets maintained in analysis specific binders for QC data, and bound log-books (instrument-specific) for injection data. Computer generated quantification reports and chromatograms are filed for each test, by accession number in the GC laboratory, and by 12 hour shift in the GC/MS laboratory.

10.2 Scheduling

Scheduling of work in-house is important in assuring that results and the final report are completed in a timely fashion.

10.2.1 Each morning, listings of all samples in-house, and the tests to be performed on them, are generated by the Laboratory Information Management System (LIMS). These listings are used by the Supervisors and Group Leaders to schedule work in their group.

10.2.2 In addition to the listings of samples in house, the LIMS generates worksheets for each of the groups within the laboratory. These worksheets list the samples to be tested, the analytes to be tested for, and the date due.

10.3 Results - Reporting and Verification

10.3.1 On the worksheets there are spaces for results, as well as the date analyzed and other information. These worksheets are filled in by the analysts. The data is reviewed and verified by the group leader or supervisor. At this point, data is given to Data Management, where a data entry person inputs the information.

10.3.1.1 Some groups have designated individuals within the group, responsible for entering data generated by that group.

10.3.2 Results verification sheets are generated by the LIMS after data has been entered. These verification sheets contain the information previously entered into the computer, which has not already been verified. A second Data Management person (a person other than the person who entered the data) verifies that the numbers generated by the LIMS are the same numbers submitted by the analyst. The verification sheet is initialled acknowledging that the numbers are correct and then verified in the LIMS. Due to systems programming, no results can be verified in LIMS without associated QC data.

10.3.2.1 Supervisors and Group Leaders may verify results in the LIMS, after reviewing the results which have been entered, without going through Data Management.

10.3.3 After the results of an analysis are verified, the sample is listed as data complete for that analysis. When all of the required analyses on all of the samples in an accession number are complete, entered, and verified, a report will be generated.

10.3.4 At this point, the report is given to the project manager by Data Management for review.

10.3.4.1 Attached to every Accession file is a checklist of items to look for within the report, see Attachment. After each item is checked off, the individual responsible for performing the review initials and dates the form, in the appropriate space.

10.4 Management Review of Data

Each project is assigned to a project manager when the first samples are received at ATI. The project manager will be one of the section supervisors or a member of the project management staff, depending upon the scope of work required, or in some cases, upon the client's specific needs.

10.4.1 The project manager is responsible for tracking the progress of the samples while they are in-house and insuring timely analysis.

10.4.2 When the data is complete, the project manager reviews the final report as specified in the "Report Checklist," especially for the following criteria:

10.4.2.1 Reasonableness of data (i.e., whether results reported on various analyses on the same sample make sense when compared to each other). They compare analyses such as BOD, COD, and the amount of organic contamination reported; general mineral balances; etc. They compare data on samples within the same accession number, and if descriptive information about the samples is available, may take that into account. They then conclude that these results are reasonable when compared to one another.

10.4.2.2 If this accession number is part of a known monitoring project, results are checked against historical data to ensure comparability. Any unreasonable deviance in concentration or appearance of an unfamiliar compound will cause a review of raw data and/or rerun of samples to confirm the anomaly. The project manager is responsible for making sure this check is made.

10.4.2.3 Accuracy in transcription of names, dates, sample numbers, results, and consistency in labeling throughout the report.

10.4.2.4 Acceptability of QA/QC data:

The LIM system has the built in feature of not allowing sample results to be verified without corresponding QC data. The Project Manager ensures that the QC data is within acceptance limits and that all QC data is included in the final report. The LIM system has the built in feature of not allowing sample results to be verified without corresponding QC data and flags any result out of acceptance limits.

The Project Manager ensures that all QC data is included in the final report and that the QC data is within acceptance limits, or a sufficient explanation for accepting the out of control data (i.e., matrix interference) is listed on the report. The Project Manager also ensures that either an out of control form is in the client file for each of control events, or that the QA Manager is informed of the omissions.

10.4.3 The final report is then received by the laboratory manager. The report requires the signature of both the laboratory manager and the project manager before it is released.

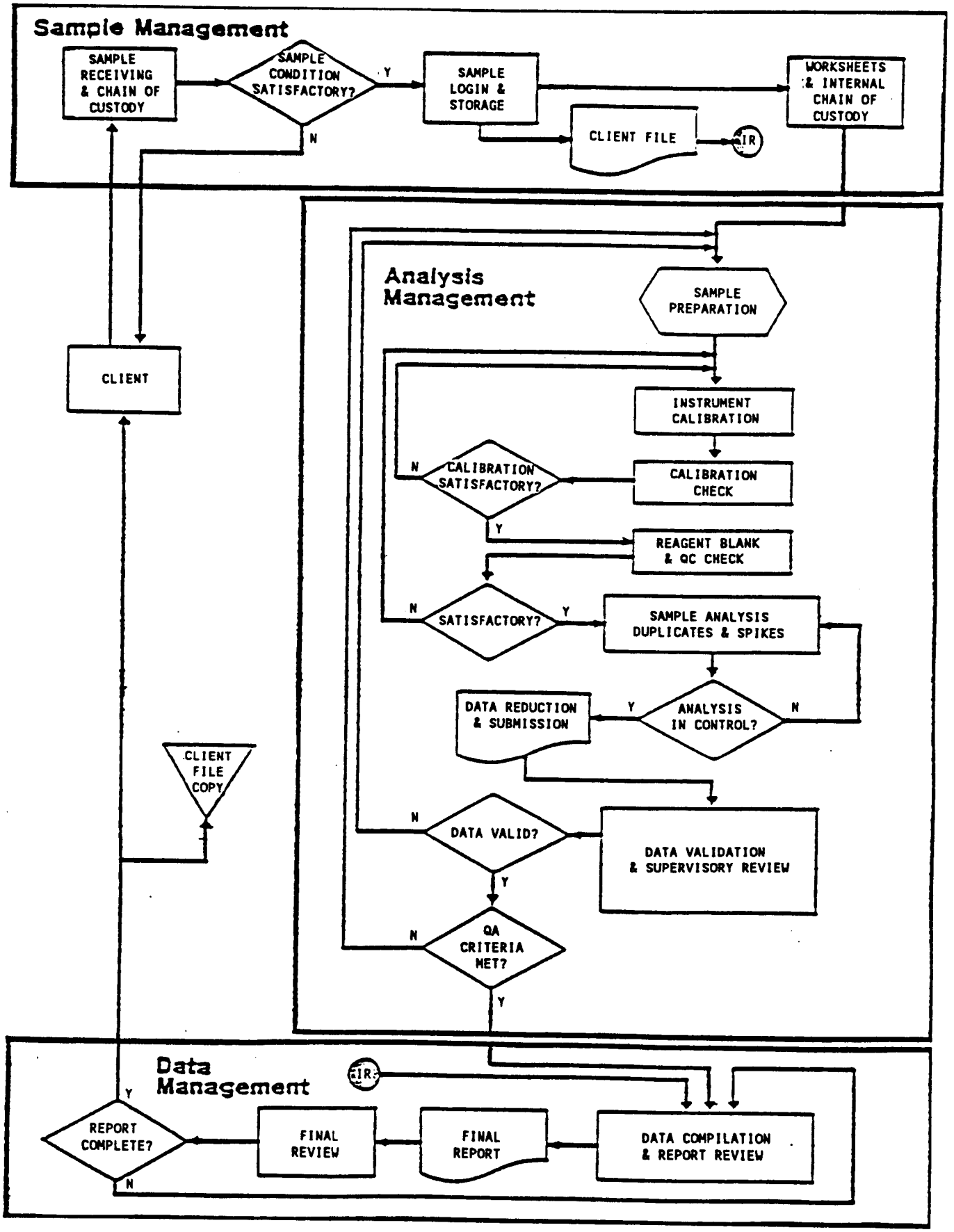
10.4.4 The QA Manager reviews 10% of the final reports after signature to monitor the quality.

10.4.5 Clients' questions about the final report may be directed to either signatory or to the QA Manager when appropriate.

10.5 Record Storage

All data and reports are archived on computer tape and in written documents for storage within a secured building. These documents will be stored for a period of no less than ten years.

FIGURE 2


Sample Management
SAMPLE RECEIVING & CHAIN OF CUSTODY
SAMPLE CONDITION SATISFACTORY?
Y
N
SAMPLE LOGIN & STORAGE
CLIENT FILE
IR
WORKSHEETS & INTERNAL CHAIN OF CUSTODY
CLIENT
Analysis Management
SAMPLE PREPARATION
INSTRUMENT CALIBRATION
CALIBRATION CHECK
CALIBRATION SATISFACTORY?
N
Y
REAGENT BLANK & QC CHECK
SATISFACTORY?
N
Y
SAMPLE ANALYSIS DUPLICATES & SPIKES
ANALYSIS IN CONTROL?
Y
N
DATA REDUCTION & SUBMISSION
CLIENT FILE COPY
DATA VALID?
N
Y
DATA VALIDATION & SUPERVISORY REVIEW
QA CRITERIA MET?
N
Y
Data Management
IR
REPORT COMPLETE?
Y
N
FINAL REVIEW
FINAL REPORT
DATA COMPILATION & REPORT REVIEW

11.0 LABORATORY QUALITY CONTROL CHECKS

Quality assurance, as practiced at ATI, consists of general quality control and assessment procedures that are adapted to the specific operating conditions in each section. The general elements of quality control are outlined below. More specific procedures for each group are defined in the pages that follow.

11.1 Blank Analysis

It is standard practice throughout the laboratory to prepare and analyze a reagent or method blank (or both, whichever is appropriate) with each batch of samples.

11.1.1 Surrogates in Blanks

For methods utilizing surrogate compounds, the surrogates will be added to all blanks and be subject to meeting acceptance criteria.

11.1.2 Reagent Blanks (Inorganics)

A reagent blank consists of laboratory pure water and any reagents added to a sample during analysis only, or straight solvent.

11.1.2.1 Reagent blanks may be inserted at regular intervals on large (>20 samples) batches, or after highly concentrated samples to check for carryover contamination.

11.1.3 Method Blanks (Inorganics) and Reagent Blanks (Organics)

The blank is a water or soil blank which undergoes all of the preparation procedures applied to a sample (i.e. extraction, digestion). Separate water and soil method blanks are prepared for batches of mixed matrices (one per batch of 20).

11.1.3.1 The "Soil" used to prepare a method blank is typically sterilized silica sand, washed with solvent and muffled.

11.1.3.2 An alternative is to use Na_2SO_4 which has been muffled.

11.1.4 Trip Blanks

Trip Blanks consisting of laboratory pure water, are sent to the client along with sample containers, whenever containers are requested for Volatile Organic Analysis (VOA). They should never be opened in the field and are submitted with samples to be analyzed for Volatile Organic Compounds in order to verify that the sample containers were not contaminated during shipment.

11.1.4.1 Trip blanks are analyzed by ATI, only upon request of and submission by the client.

11.1.5 Field Blanks

Field Blanks consisting of source water used in the field for steam cleaning and for decontamination, are often collected during the course of a sampling event and submitted for analysis.

11.2 Laboratory Control Samples (LCS's) or Calibration Check Standards

Laboratory Control Samples or Calibration Check Standards are prepared solutions of analytes at known concentrations which are prepared from stock solutions other than the stock solution used to prepare the calibration standards. It is therefore independent from the calibration standards. LCS's are utilized for all methods, and provide a very effective method for monitoring accuracy as well as verifying instrument calibration.

11.2.1 LCS's or Calibration Check Standards are prepared from certified reference material, from a source other than the source of the stock material from which the calibration standards have been prepared.

11.2.1.1 Some sources for LCS or Calibration Check Standard stock material are NSI Environmental Solutions, Inc., ULTRA Scientific and SUPELCO.

11.2.2 Results from the LCS's or Calibration Check Standards must fall within limits which have been statistically established through intra-laboratory studies. The limits represent the 95% confidence interval for the parameters being measured. Other LCS's are subject to the acceptance criteria of ±15% of the true value (see Table 3 following Section 11).

11.2.3 The frequency of use of Laboratory Control Samples or Calibration Check Standards varies by section. See Section 14.0 for details concerning frequency.

11.3 Blank Spikes or Check Sample

A Blank Spike or Check Sample is a sample with a known concentration of analyte, subjected to sample preparation and analyzed with the samples. They are used to monitor the efficiency and execution of the analytical method.

11.3.1 Blank Spike

A Blank Spike is a Method Blank which has been spiked with the Matrix Spiking solution, subjected to sample preparation and analyzed with the samples which have also been run through the analytical procedure.

11.3.2 Check Sample

A Check Sample is a sample which is purchased for the purpose of monitoring the efficiency and execution of the analytical method. A Check Sample is carried through the entire process, from sample preparation through analysis. The samples are provided with statistically generated recovery values obtained using data provided through inter-laboratory analysis programs. It is standard practice throughout the laboratory to prepare and analyze one blank spike (or check sample) for each batch of twenty samples or less, and one in twenty samples thereafter. This represents a blank spike frequency of 5% for each batch of samples analyzed.

11.4 Matrix Spikes and Surrogate Additions

Accuracy and matrix bias are monitored by the use of spiked samples and, where possible, surrogate additions. Matrix Spikes and Surrogate are added to samples prior to extraction or digestion.

11.4.1 A Matrix Spike (MS) is an aliquot of sample, which is spiked with a solution containing analytes of interest at known concentrations, prior to extraction/digestion.

11.4.2 A Matrix Spike Duplicate (MSD) is a second aliquot of the same sample, which is also spiked with the same solution as the MS.

11.4.3 It is standard practice throughout the laboratory to prepare and analyze one matrix spike for each batch of twenty samples or less, for each matrix type within the batch, and one spike for every twenty samples thereafter. This represents a matrix spike frequency of 5% for each batch of samples analyzed.

11.4.4 Surrogates are compounds which are chemically similar to the compounds of interest, but which are not on the target list for the analytical method in which they are to be used as surrogates.

11.4.4.1 Where surrogate spiking compounds are available, they will be added to and analyzed with every sample.

11.4.4.2 Surrogates are routinely used in all GC/MS and most GC analyses. ATI also routinely adds a surrogate spike to samples for metals analysis by ICP.

11.4.5 See Section 14.0 for additional information regarding the use of Surrogate and Matrix Spike recovery data.

11.5 Duplicate Sample Analysis.

Precision is assessed by the comparison of the results of a sample, or matrix spike sample, prepared and analyzed in duplicate.

11.5.1 It is standard practice throughout the laboratory to prepare and analyze one duplicate sample for each batch of twenty samples or less, for each matrix type within the batch, and one duplicate for every twenty samples thereafter. This represents a duplicate sample frequency of analyses 5% for each batch of samples analyzed. Inorganics accomplishes this by running a sample in duplicate. Organic analyses run a matrix spike duplicate.

11.5.2 See Section 14.0 for additional information regarding the use of Duplicate sample results data.

11.6 Standards

The term standard applies to any solution of an analyte prepared at a known concentration. This includes calibration standards, spiking solutions, and laboratory control samples. The purpose of all claims of traceability is to establish the accuracy of measurements. Therefore, maintaining standard traceability is critical to the achievement of data of known and defensible quality.

11.6.1 Log Books

To establish traceability, all purchased reference standards (neat and stock solutions) are recorded in the section-specific standard log books when they are received. All entries and ATI standard labels contain a unique ATI ID number, date opened, and expiration date. Log book entries also include the manufacturer's lot number, certified purity, and storage location. Subsequent preparations of stock, intermediate, and working solutions are also recorded in standard log books. These entries must include all discrete measurements made during a preparation, parent materials, solvent used, and an ATI ID number. Appendix D illustrates a Standard Log Book entry.

11.6.2 Standard Operating Procedures

SOP ATI 120, Standard Operating Procedure For Standard Preparations, contains further instructions on assigning unique ID numbers, proper syringe technique, shelf life of standards, and good laboratory practices for preparation of standards.

11.6.3 Vendors/Suppliers

Reference Standards are purchased from approved commercial vendors.

11.6.3.1 Organic Standards are purchased from Supelco, Chem-Service Inc., Nanogen, Aldrich Chemical Company Inc., or similar vendors. Certificates of analysis are requested with each purchase.

11.6.3.2 Inorganic standards are purchased from the major scientific supply companies (i.e., Fisher, American Scientific and VWR). Certificates of analysis are requested with each purchase.

11.7 Detection Limits

There can be considerable confusion when communicating about detection limits. Below lists Analytical Technologies - San Diego's definitions and protocols.

11.7.1 Instrument Detection Limits (IDL)

These detection limits are used in reference to metals analysis only. IDL studies are run quarterly in compliance with and according to the procedure described in the CLP Statement of Work 2.1 (Sept '91).

A standard solution of each analyte in laboratory pure water at a concentration of 3-5 times the estimated instrument detection limit is analyzed seven consecutive times on 3 separate, non-consecutive days. The MDL is set at 3 times the average of the 3 standard deviations determined for each of the seven consecutive measurements.

11.7.2 Method Detection Limit

Theoretical Definition:

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero.

11.7.2.1 The MDL for Organic and Inorganic analyses, are determined according to the procedure described in 40 CFR, Part 136, Appendix B, "Definition and Procedure for the Determination of the Method Detection Limit."

11.7.2.2 The MDL studies are done yearly for each test and each matrix, where appropriate.

Inorganic:

The MDL's for metals analyses are four times the instrument detection limits.

The general chemistry group uses a mixture of the "organic and inorganic" procedures in their determination of MDLs.

11.7.3 Reporting Detection Limit (RDL)

ATI Determination of Reporting Limits

The standard reporting limit has been determined using five separate factors. 1) The capability of the instrumentation and methodology, determined in part by Instrument Detection Limits and Method Detection Limits studies. 2) Expererience with the matrices interferences and our ability to overcome these. 3) The Action Limits of the agencies. 4) The desire/need of the client. 5) The industry norm and/or program specific reporting limits (such as a RFI QAPP, CLP, etc.). Each factor is weighed and a balance is reached. Although we strive to meet all of these criteria, we ensure that the detection limits can be seen by the instrumentation by running a standard at or near the proposed detection limit. Generally an "instrument reporting limit" is decided upon and then the concentration/dilution factor of the extraction is used to calculate the actual reporting limit.

TABLE 3. ACCEPTANCE CRITERIA FOR QUALITY CONTROL SAMPLE AND INSTRUMENT CALIBRATION (exceptions noted in Section 14)

	GC	GC/MS	GENERAL CHEMISTRY	METALS
INITIAL CALIBRATION LINEARITY	RSD < 20% or correlation coefficient of >0.995	RSD < 30%	Correlation coefficient of > 0.995	Correlation coefficient of > 0.995
CONTINUING CALIBRATION VERIFICATION	± 15% of true value or initial response	± 25% of true value or initial response	± 10% of true value	± 10% of true value
LABORATORY CONTROL SAMPLE/QC CHECK SAMPLE	± 15% of true value or established limit	± 15% of true value or established limit	± 15% of true value or established limit	established limit (interlab)
MATRIX SPIKE % RECOVERY	Within established control limits*	Within established control limits*	Within established control limits*	Within established control limits*
SURROGATE SPIKE % RECOVERY	Within established control limits*	Within established control limits*	None Added	None Added for GF/AA. Within established control limits for ICP.*
RPD FOR DUPLICATE SAMPLE ANALYSIS	Must be < maximum RPD acceptance limit*	Must be < maximum RPD acceptance limit*	<67% for samples with hits, if the hits are <10 x MDL <20% for samples with hits, if the hits are >10 x MDL	

Control Limits are established according to ATI SOP 115, Establishment and Utilization of Acceptance Criteria.

RPD: Relative Percent Difference
MDL: Method Detection Limit
RSD: Relative Standard Deviation

* Reference Appendix C, Exhibit I for method acceptance limits.

12.0 LABORATORY CERTIFICATIONS/ACCREDITATIONS, PERFORMANCE AUDITS AND SYSTEMS AUDITS

12.1 Certifications/Accreditations

ATI San Diego strives to maintain Certification or Accreditation for Environmental, Drinking Water, Waste Water and Hazardous Waste Testing, in all states in which ATI operates a laboratory. A list of present certifications is shown in Table 4. This list changes periodically. Call the laboratory for the lastest revision date.

12.1.1 California Environmental Laboratory Accreditation Program (California ELAP)

Accreditation is required for all laboratories, either inside or outside the State of California, which analyze environmental samples from within the state for regulatory purposes.

12.1.1.1 Accreditation assures the user of the data, that the laboratory is adequately staffed, equipped to perform environmental analyses and capable of performing to generally accepted standards.

12.2 Audits

Various performance and systems audits are conducted routinely throughout the year. These audits originate both in-house and from external sources.

12.2.1 Performance Audits

Performance audits are designed to measure how well a laboratory can obtain the known true value (accuracy) and how closely the results match other laboratories results (precision). They are usually in the form of prepared samples, submitted blind, for various tests.

12.2.1.1 USEPA Performance Evaluation Studies: ATI participates in the EPA semiannual drinking water (WS series) and semiannual wastewater (WP series) performance evaluation studies (4 studies per year).

12.2.1.2 ATI participates in various client sponsored performance evaluations by analyzing QC samples prepared and submitted by commercial clients in conjunction with their own QA programs.

12.2.2 Several government proficiency samples are analyzed annually to maintain various laboratory certifications (i.e.; NEESA, USAFOEHL, HAZWRAP).

12.3 Systems Audits

12.3.1 Internal Systems Audits

ATI's internal systems audits are performed by the Quality Assurance Manager, at least once each year. An Audit Checklist is utilized, all discrepancies are documented and all "Out of Control" conditions are addressed immediately. The internal systems audit consist of the following procedures:

12.3.1.1 Records, logs, and data files are audited for completeness, accuracy, and adherence to standard operating procedures, and several random project files are pulled and audited for compliance to procedure throughout the analytical process (i.e. from sample receipt through the final report) annually.

12.3.1.2 This procedure is performed on one specific area of the laboratory at a time.

12.3.1.3 Supervisors, group leaders, and the QA Manager routinely check records for the same criteria.

12.3.2 External Systems Audits

ATI is also audited as required by regulatory agencies to maintain laboratory certifications, and by various commercial clients with laboratory auditing programs.

12.3.2.1 Once every two years, the State of California performs a systems audit of the laboratory. This is done as part of the California ELAP process.

12.3.2.2 ATI is audited by other state, agencies as their programs require, in order to receive and maintain certification.

12.3.2.3 Various commercial clients perform systems audits of the laboratory as needed. These include the third party government contractors for NEESA, USAFOEHL and HAZWRAP projects.

12.4 Audit Findings and Corrective Actions

The findings of all audits are released to the Lab Manager, Section Supervisors and Group Leaders. Corrective plans are formulated and implemented by the supervisors working in conjunction with the QA manager.

The effectiveness of all corrective actions issued, whether in response to an audit deficiency or an "Out of Control" event, is determined through the use of follow-up blind QC samples or spot audits, depending upon the specifics of the condition.

TABLE 4

San Diego Laboratory Certifications

State of Arizona (Provisional)

State of California (Drinking Water/Wastewater/Hazardous Waste)

State of Nevada (Wastewater/Hazardous Waste)

State of Tennessee (Underground Storage Tanks)

State of Utah (Certificate No. E-179)

State of Washington (Chapter 173-50 WAC)

Naval Energy & Environmental Support Activity (NEESA)

Special Analytical Services Program (SAS)

USDA, APHIS - Import of Foreign Soil Permit

U.S. Army Corps of Engineers (USACE)

Currently seeking the following certifications

State of Alaska

State of Florida

Note: See next page for ATI combined certifications

Environmental Protection Agency Selection as a Superfund Contract Laboratory (CLP) 1983-1986 [SD]

Naval Energy & Environmental Support Activity (NEESA) [SD, PE]

Comprehensive Long-term Environmental Action Navy (CLEAN) [FC (pending), SD, PE]

Hazardous Waste Remedial Action Program (HAZWRAP) [PE, RN]

Special Analytical Services Program (SAS) - USEPA [FC, SD]

USDA, APHIS - Importation of Foreign Soils Permit [FC, SD]

U.S. Department of Commerce, National Institute of Standards & Technology, NVLAP Program Laboratory #1250

U.S. Army Corps of Engineers (USACE) [SD, PH, RN, PE]
USAE Certification [PE]

National Institute of Occupational Safety & Health (NIOSH) [PE]

Nuclear Power Electric Utilities Accreditation Program [PH]

States of:	Alabama	PE
	Alaska	RN, SD (pending)
	Arizona	PH, RN, SD, FC (pending), PE (pending), AL (pending)
	Arkansas	PE (pending)
	California	FC, PH, PE, RN, SD
	Colorado	FC
	Connecticut	FC (pending)
	Florida	PE, SD (pending)
	Idaho	FC (pending)
	Illinois	PE
	Iowa	PE, FC (pending)
	Kansas	FC
	Kentucky	PE
	Louisiana	PE
	Massachusetts	PH
	Michigan	PH, PE
	Minnesota	FC (pending)
	Nevada	PH, SD
	New Hampshire	PE
	New Jersey	PE (pending)
	New Mexico	PH (pending), AL
	North Carolina	PE
	North Dakota	FC
	Oregon	PO (pending)
	Pennsylvania	PE (pending)
	South Carolina	PE
	Tennessee	PE, FC
	Tennessee (UST)	PE, PH, SD
	Texas	PH
	Utah	PH, SD
	Virginia	PE
	Washington	RE, SD, PH (pending), FC, PO (pending)
	Wisconsin	FC, PH, PE

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*Albuquerque (AL), Fort Collins (FC), Pensacola (PE), Phoenix (PH), Portland (PO), Renton (RN), San Diego (SD)

13.0 FACILITIES AND EQUIPMENT

13.1 Facilities

ATI San Diego moved to its present location in April 1986. The laboratory occupies 28,500 square feet of a building constructed in 1985, is modern and designed for efficient, high-quality operations. The rooms are equiped with dedicated conditioned air and exahust systems, and are arranged to minimize interference during operation.

13.2 Instrument and Equipment Maintenance

ATI maintains service contracts for all major analytical equipment including all chromatography and mass spectroscopic instruments, atomic absorption and inductively coupled plasma instruments, and balances. All instruments and equipment also receive routine preventive maintenance. Routine maintenance insures that all equipment is operating under optimum conditions, thereby reducing the possibility of instrument malfunction affecting sample results. Appendix F is a listing of all major equipment at ATI, San Diego.

13.2.1 All major analytical instruments have "Instrument Specific Maintenance Logs." These logs are used to record routine maintenance performed on the instrument, as well as all maintenance problems and their solutions.

13.2.2 Preventive maintenance helps reduce instrument down time. This contributes to the achievement of the goal of cost-efficient, timely analysis producing data of consistently high quality and integrity.

13.2.3 Excessive down time, resulting in an inability to meet sample holding times, is controlled by duplicating major laboratory equipment. If an instrument fails, the sample load can be adjusted to a backup instrument.

14.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND COMPLETENESS

14.1 Blank Spikes, Matrix Spikes and Surrogate Additions

As mentioned in section 11.4, accuracy and matrix bias are monitored by the use of spiked samples and, where possible, surrogate additions.

14.1.1 The actual test result is compared to the theoretical result of 100% recovery and the percent recovery is calculated using the following equation:

$$\% \text{ Recovery} = \frac{\text{Spike result} - \text{Sample result}}{\text{Amount spiked}} \times 100$$

14.1.2 The percent recovery must fall within specified control limits for the result to be accepted and subsequent data validated. (See Table 3 and Appendix CI)

14.2 Duplicate Analysis

As mentioned in section 11.5, precision is assessed by the comparison of the results of a sample or spiked sample prepared and analyzed in duplicate.

14.2.1 The results of the duplicate analyses are compared, and the relative percent difference (RPD) is calculated using the following equation.

$$\text{RPD} = \frac{\text{Sample result} - \text{Duplicate result}}{\text{Average result}} \times 100$$

The formula above is also used for RPD calculations of Matrix Spike and Matrix Spike Duplicates, substituting these values for sample and duplicate results.

14.2.2 The RPD must fall below set control limits for the results to be accepted and subsequent data validated. [(See Table 3 and Section 11.4) See Acceptance Limits, Appendix CI]

14.3 Gas Chromatographic (GC) Analyses

All GC methods are calibrated by external calibration procedures, using three to five standard concentrations, depending upon the method. A new calibration is performed as needed on routine analyses. Methods not utilized on a consistent basis are calibrated before each run.

14.3.1 Initial Calibration

A calibration factor (the ratio of peak area (or peak height) to concentration) is generated for each standard. If the percent relative standard deviation (% RSD) of the calibration factors is less than 20%, the calibration curve may be assumed to be linear and pass through the origin. If the % RSD is greater than 20%, the calibration curve is graphed and used to quantify sample results. For those tests whose RPD have consistantly fallen below 20%, RPDs above this level signal that a problem exists. The GC system and/or calibration standards should be investigated and brought into control before rerunning the calibration curve.

Alternatively, the linearity of the curve may be tested using the correlation coefficient. Linearity is assured with the correlation coefficient >0.995.

14.3.2 Continuing Calibration Verification

The current calibration is verified at the start of each run by the analysis of either the midpoint calibration standard or the Laboratory Control Standard (LCS) that was run at the time of the curve. The acceptance criteria is ±15% of the initial response for each analyte. Exceptions exist. See individual method SOPs for specifics. A deviation of greater than 15% indicates that the system is in need of attention, and calibration control must be reestablished before quantitation of any deviant analyte. Attention required may consist of instrument maintenance, standard replacement or the like, and recalibration upon completion.

A new five point curve will be run if the continuing criteria cannot be met for an analyte needing quantitation.

14.3.2.1 After meeting acceptance criteria, the response factors from the Continuing Calibration Standard, run at the beginning of each analytical sequence, are used in the quantification of sample results, or quantitation response factors may be updated after each continuing calibration standard depending on the method. See individual method SOP for specifics.

14.3.2.2 In some cases, the midpoint calibration standard is analyzed after every five to ten samples during a run, as a continuing check of the calibration.

The method SOP may call for updating the response factors to quantitate using the most recent continuing calibration standard.

14.3.2.3 Retention Time Window

Retention time windows are established for all single component analytes using the retention times of the first continuing calibration standard of the analytical sequence as the midpoint of the retention time window. Retention time shifts are identified by monitoring for shifts in surrogate retention times of each run (where available) and in continuing calibration standards.

14.3.3 Laboratory Control Sample or Calibration Check

As mentioned in section 11.2, a standard solution made up from a separate stock solution than the curve used to prepare the calibration standards is analyzed whenever a

new calibration curve is run. This stock is prepared from a second source wherever possible. The RPD between the LSC and calibration curve must be with ±15%.

14.3.4 Matrix Spike/Matrix Spike Duplicate

Because many samples contain nondetectable amounts of the parameters to be measured, the matrix spike is duplicated in GC and GC/MS analyses. An MS/MSD is analyzed at a frequency of 10% of the batch, that is one set of MS/MSD per 20 samples.

14.3.5 Blank Spike

The blank spike is run in order to verify that the method is working. The use of the blank spike allows matrix interference of MS/MSD to be differentiated from an out of control process.

The blank spike is analyzed at a frequency of one per batch of up to 20 samples.

14.3.6 Surrogate Spike

Surrogates are added to and analyzed for in every sample, for methods for which surrogates are available, including; 8010, 8020, 8080, Mod 8015, 8150 and 8310.

14.3.7 Blank Analysis

The reagent/method blank must have no contaminants greater than the reporting detection limit of the method, except for analyses by modified 8015.

For modified 8015, the area of the blank that corresponds to the change in the baseline throughout the run due to column bleed alone will be subtracted from the samples when necessary. The use of this procedure is clearly defined in the SOP for modified 8015 (ATI-SD SOP 605).

14.3.8 Other QC criteria

Method 8080 is subject to the following additional QC criteria:

14.3.8.1 Combined breakdown of Endrin and DDT may not exceed 20%. This is monitored through the daily analysis of an LCS containing these compounds.

14.3.8.2 Two LCS's (each containing 1/2 the compounds of the method) are alternately analyzed after every tenth sample.

14.4 Gas Chromatographic/Mass Spectrometric Analyses

Protocols vary for samples to be run by CLP vs. commercial methods. The procedure discussed here is for commercial sample analysis. CLP samples will be run on instruments calibrated accordingly.

14.4.1 Initial and Continuing Calibration

An initial five point calibration is performed using Initial Calibration Standards (ICS) as necessary.

14.4.1.1 Tables 5 and 6 list criteria that must be met during the initial calibration for the analyses of volatile organic compounds (8240 mod.) and semivolatile organic compounds (8270 mod.). However, two compounds from the 8240 mod. and four compounds from the 8270 mod. may be of specifications as long as the RRF is greater than 0.010 and the %RSD of those four compounds is less than or equal to 40%

14.4.2 Continuing Calibration Standard (CCS)

One CCS is analyzed at the beginning of each 12 hour shift to verify that the initial calibration is still valid.

14.4.2.1 The acceptance criteria for the CCS is to meet minimum relative response factors (RRF) and maximum % Difference of RRFs of the CCS versus the average RRF of the initial calibration curve as listed in Tables 5 and 6. As in the initial calibration, up to

two of the volatile organic compounds and four of the semivolatile organic compounds may be out of specifications as long as their RRF is greater than 0.010 and the % difference is less than 40%.

14.4.2.2 Recalibration is necessary wherever the CCS fail to meet criteria. Instrument maintenance may be performed in an attempt to meet CCS requirements, however, a CCS must be run after maintenance is completed to demonstrate the GC/MS system now meets necessary calibration requirements.

14.4.2.3 All HSL compounds identified in sample runs performed during that 12 hour shift, are quantified using the RRF's from the CCS run at the beginning of the shift.

14.4.3 GC/MS Tuning

Validation of Mass Spectrometer hardware is accomplished by performing a tune at the start of each shift, according to the procedure described in CLP 3/90 (OLM 1.8).

14.4.3.1 The tuning procedure utilizes the EPA recommended compounds 4-Bromofluorobenzene (BFB) for 8240 mod. and Decafluorotriphenylphosphine (DFTPP) for 8270 mod.

14.4.4 Internal Standards

All sample results are quantified using the internal standard technique described in EPA methods 8240 mod. and 8270 mod.

14.4.4.1 Three (VOA) or six (BNA) internal standard compounds are added to each sample immediately prior to analysis.

14.4.4.2 The internal standard nearest the retention time of the analyte of interest is in the quantification of the analyte.

14.4.5 Laboratory Control Standard

As mentioned in section 11.2, a standard solution made up from a stock solution different than the stock solution used to prepare the calibration curve standards is analyzed at least once per week, and whenever a new five point calibration is performed.

14.4.6 Matrix Spike/Matrix Spike Duplicate

Because many samples contain nondetectable amounts of the parameters to be measured, the matrix spike is duplicated in GC and GC/MS analyses. An MS/MSD is analyzed for every 20 samples.

14.4.7 Surrogate Spikes

Surrogate spiking compounds are added to every sample.

14.4.8 Reagent/Method Blanks

Common laboratory solvents, such as acetone, 2-butanone (MEK), and methylene chloride, may be present in the VOA blank at a concentration up to 5 times the reporting detection limit. All sample hits for those compounds will be flagged with a "B" indicating it was found in the blank. Detection of common solvents at greater concentrations or the presence of any target compounds at a concentration greater than the RDL, indicates the need to investigate the analytical system and/or water used for the blank, performing corrective action as necessary, and re-extraction/re-analysis of the blank and associated samples.

14.4.8.1 VOA - one per 12 hour per shift.

14.4.8.2 BNA - one per batch of samples extracted, not to exceed twenty.

14.5 Metals Analysis

CLP and ATI-Commercial samples required different instrument calibration criteria. CLP is run according to CLP protocol. The following describes calibration for ATI commercial samples.

14.5.1 Initial Calibration

All instruments are calibrated at the start of each run. Recalibration of instruments is performed as needed, this being indicated by the continuing calibration verification standard (ICV or CCV).

14.5.1.1 Calibration Curves

a. Cold vapor analysis of mercury requires a five point calibration.

b. The ICP is calibrated according to instrument manufacturers' recommended procedures utilizing a two point calibration, an instrument blank and one standard. Recalibration of the ICP is performed every 8 hours, or more often if the initial or continuing verification standards (ICV or CCV) or initial or continuing verification blank (ICB or CCB) indicates the need.

c. The Graphite Furnace (GF/AA) is calibrated according to instrument manufacturer's procedures utilizing a four point calibration curve for a linear curve with a correlation coefficient greater than or equal to 0.995.

14.5.1.2 Initial Calibration Verification

After calibrating the instrument,

an Initial Calibration Verification standard (ICV) is run. For ICP and GF/AA metals, the acceptable range is from 90 to 110% recovery.

14.5.2 Continuing Calibration Verification

For Metals Analysis, a Continuing Calibration Verification standard (CCV) is analyzed after every ten samples. Recalibration is indicated if the CCV differs from the established true value by >10% for the ICP and by >15% for the GF/AA and for Mercury (Hg) by AA/Cold Vapor.

14.5.3 Prep Blank Spike

A Prep Blank Spike (or Laboratory Control Sample) is analyzed for every batch of up to 20 samples. If the result is outside established mean, redigestion is indicated.

14.5.4 Matrix Spike

A matrix spike is analyzed at a frequency of 5% or one matrix spike for up to 20 samples in order to determine accuracy and/or matrix bias.

14.5.5 Duplicate Samples

A sample is analyzed in duplicate at a frequency of 5% of the batch in order to determine precision.

14.5.6 Blank Analysis

14.5.6.1 Method Blank

If the concentration of the blank is >5 times the RDL, all samples associated with the blank whose concentrations are <10 times the blank concentration, are redigested and reanalyzed along with a new blank. Samples with a concentration >10 times the blank value are reported, without correction for the blank value.

14.5.6.2 Reagent Blank

Any reagent blank result greater than the reporting detection limit (RDL) terminates the analysis until corrective action resolves the problem. For ICP metals, a negative blank value greater than 2 times the RDL requires corrective action and recalibration if necessary. In rare cases, if all corrective actions fail to resolve the problem and the blank value still hovers at 1-3 times the RDL, the analyst may run the samples, reporting all values greater than 10 times the blank value.

14.5.6.3 Surrogate Spike for ICP
Surrogate Spike (Scandium), is added to all digestions of waters and soils.

14.6 General Chemistry Analysis

14.6.1 Calibration

All instruments are calibrated daily with 3-6 point curves, depending upon instrument requirements.

14.6.2 Calibration Verification

The calibration is continuously verified throughout the run, with either a calibration standard or laboratory control standard inserted after every 10th sample.

14.6.3 Laboratory Control Sample

A laboratory control sample is analyzed at least once during each instrument run. This sample is an EPA reference standard (or second source standard) used to verify the calibration curve.

14.6.4 Blank Spike

A reagent/method blank spiked with the analyte of concern. The spike is used to verify method performance in the absence of

matrix interference. Blank spikes are run at a frequency of 5%, one per batch of up to 20 samples.

14.6.5 Matrix Spike

A matrix spike is analyzed at a frequency of 5% of the batch, indicating method performance in the presence of sample matrix. Results of the matrix spike reflects recovery from a particular sample which may or may not be relevant to other samples in the batch.

14.6.6 Duplicate Samples

A sample is analyzed in duplicate at a frequency of 5% of the batch in order to show the precision of the method.

14.6.7 Blank Analysis

If contamination exists greater than or equal to the reporting detection limit (RDL), then the problem is investigated, corrected and rerun if appropriate.

TABLE 6

RELATIVE RESPONSE FACTOR CRITERIA FOR INITIAL AND CONTINUING CALIBRATION OF VOLATILE ORGANIC COMPOUNDS (8240)

Volatile Compound	Minimum RRF	Maximum %RFD	Maximum %Diff
Bromomethane	0.100	20.5	25.0
Vinyl chloride	0.100	20.5	25.0
1,1-Dichloroethene	0.100	20.5	25.0
1,1-Dichloroethane	0.200	20.5	25.0
Chloroform	0.200	20.5	25.0
1,2-Dichloroethane	0.100	20.5	25.0
1,1,1-Trichloroethane	0.100	20.5	25.0
Carbon tetrachloride	0.100	20.5	25.0
Bromodichloromethane	0.200	20.5	25.0
cis-1,3-Dichloropropene	0.200	20.5	25.0
Trichloroethene	0.300	20.5	25.0
Dibromochloromethane	0.100	20.5	25.0
1,1,2-Trichloroethane	0.100	20.5	25.0
Benzene	0.500	20.5	25.0
trans-1,3-Dichloropropene	0.100	20.5	25.0
Bromoform	0.100	20.5	25.0
Tetrachloroethene	0.200	20.5	25.0
1,1,2,2-Tetrachloroethane	0.500	20.5	25.0
Toluene	0.400	20.5	25.0
Chlorobenzene	0.500	20.5	25.0
Ethylbenzene	0.100	20.5	25.0
Styrene	0.300	20.5	25.0
Xylenes (total)	0.300	20.5	25.0
Bromofluorobenzene	0.200	20.5	25.0

The following compounds have no Maximum %RSD, or Maximum %Difference criteria; however, these compounds <u>must</u> meet a minimum RRF Citerion of 0.010:

Acetone	1,2-Dichloropropane
2-Butanone	2-Hexanone
Carbon disulfide	Methylene chloride
Chloroethane	4-Methly-2-pentanone
Chloromethane	Toluene-d_8
1,2-Dichloroethene (total)	1,2-Dichlorethane-d_4

Note: Up to a total of 2 compounds may fail to meet the maximum %RSD (initial calibration) or maximum %Diff (continuing calibration) as long as they do not exceed 40% and the minimum RRF is treater than or equal to 0.010.

TABLE 6

RELATIVE RESPONSE FACTOR CRITERIA FOR INITIAL AND CONTINUING CALIBRATION OF SEMIVOLATILE TARGET COMPOUNDS (8270)

Semivolatile Compound	Minimum RRF	Maximum %RFD	Maximum %Diff
Phenol	0.800	20.5	25.0
bis(-2-Chloroethyl ether)	0.700	20.5	25.0
2-Chlorophenol	0.800	20.5	25.0
1,3-Dichlorobenzene	0.600	20.5	25.0
1,4-Dichlorobenzene	0.500	20.5	25.0
1,2-Dichlorobenzene	0.400	20.5	25.0
2-Methylphenol	0.700	20.5	25.0
4-Methylphenol	0.600	20.5	25.0
N-Nitroso-Di-propylamine	0.500	20.5	25.0
Hexachloroethane	0.300	20.5	25.0
Nitrobenzene	0.200	20.5	25.0
Isophorone	0.400	20.5	25.0
2-Nitrophenol	0.100	20.5	25.0
2,4-Dimethlyphenol	0.200	20.5	25.0
bis(-2-Chloroethoxy)methane	0.300	20.5	25.0
2,4-Dichlorophenol	0.200	20.5	25.0
1,,2,4-Trichlorobenzene	0.200	20.5	25.0
Naphthalene	0.700	20.5	25.0
4-Chloro-3-methyphenol	0.200	20.5	25.0
2-Methylnaphthalene	0.400	20.5	25.0
2,4,6-Trichlorophenol	0.200	20.5	25.0
2,4,5-Trichlorophenol	0.200	20.5	25.0
2-Chloronaphthalene	0.800	20.5	25.0
Acenaphthylene	1.300	20.5	25.0
2,6-Dinitrotoluene	0.200	20.5	25.0
Acenaphthene	0.800	20.5	25.0
Dibenzofuran	0.800	20.5	25.0
2,4-Dinitrotoluene	0.200	20.5	25.0
4-Chlorophenyl-phenylether	0.400	20.5	25.0
Fluorene	0.900	20.5	25.0
4-Bromophenyl-phenylether	0.100	20.5	25.0
Hexachlorobenzene	0.100	20.5	25.0
Pentachlorophenol	0.050	20.5	25.0
Phenanthrene	0.700	20.5	25.0
Anthracene	0.700	20.5	25.0
Fluoranthene	0.600	20.5	25.0
Pyrene	0.600	20.5	25.0
Benzo(a)anthracene	0.800	20.5	25.0
Crysene	0.700	20.5	25.0
Benzo(b)fluoranthene	0.700	20.5	25.0
Benzo(k)fluoranthene	0.700	20.5	25.0
Benzo(a)pyrene	0.700	20.5	25.0

TABLE 6 (continued)

RELATIVE RESPONSE FACTOR CRITERIA FOR INITIAL AND CONTINUING CALIBRATION OF VOLATILE ORGANIC COMPOUNDS (8240)

Volatile	Minimum RRF	Maximum %RFD	Maximum %Diff
Indeno(1,2,3-cd)pyrene	0.500	20.5	25.0
Dibenzo(a,h)anthracene	0.400	20.5	25.0
Benzo(g,h,i)perylene	0.500	20.5	25.0
Nitrobenzene-d_5	0.200	20.5	25.0
2-Fluorobiphenyl	0.700	20.5	25.0
Terphenyl-d_{14}	0.500	20.5	25.0
Phenol-d_5	0.800	20.5	25.0
2-Fluorophenol	0.600	20.5	25.0
2-Chlorophenol-d_5	0.800	20.5	25.0
1,2-Dichlorobenzene-d_4	0.400	20.5	25.0

The following compounds have no Maximum %RSD, or Maximum %Difference criteria; however, these compounds <u>must</u> meet a minimum RRF Citerion of 0.010:

2,2'-oxybis(1-Chloropropane
4-Chloroaniline
Hexachlorobutadiene
Hexachlorocyclopentadiene
2-Nitroaniline
Dimethylphthalate
3-Nitroaniline
2,5-Dinitrophenol
4-Nitrophenol
Diethylphthalate
4-Nitroaniline
4,6-Dinitro-2-methylphenol
N-Nitrosodiphenylamine
Di-n-butylphthalate
Butylbenzylphthalate
3,3'-Dichlorobenzidine
bis(2-Ethylhexyl)phthalate
Di-n-octylphthalate
2,4,6-Tribromophenol
Carbazole

Note: Up to a total of 4 compounds may fail to meet the maximum %RSD (initial calibration) or maximum %Diff (continuing calibration) as long as they do not exceed 40% and the minimum RRF is greater than or equal to 0.010.

15.0 CORRECTIVE ACTIONS

15.1 "Out of Control" Events

All "Out of Control" events require corrective action. An "Out of Control" (O of C) event is any condition that affects the integrity or quality of data and requires investigation and correction.

Examples of O of C events include, but are not limited to:

15.1.1 Any QC sample that does not meet acceptance criteria. These QC samples include the Reagent/Method Blank, Matrix Spike, Duplicate Sample (inorganics) or Matrix Spike Duplicate (organics), and Blank Spike.

15.1.2 Surrogate recoveries out of limits (most organic analyses and ICP metals)

15.1.3 Contaminated reagent blanks.

15.1.4 Record keeping errors, omissions, or other deviation from standard operating procedure that affects the integrity or quality of data.

15.1.5 Samples exceeding holding times, or other conditions noted on the Sample ID Form and Sample Condition Upon Receipt Checklist.

15.2 Documentation

All "Out of Control" events must be documented on an O of C Event Report (Appendix E). Corrective actions must be clearly defined and must indicate that the cause of the problem has been identified and corrected, or outline a definitive course of action for identification and resolution of the problem.

15.3 Actions

When the "Out of Control" event concerns a QC sample or instrument calibration, specific procedures are defined to correct the problem:

15.3.1 Verify the integrity of the spiking solution, laboratory control sample, or calibration standard.

15.3.2 Examine all calculations for correctness.

15.3.3 Check instrumentation and operating conditions to preclude the possibility of malfunctions or operator error.

15.3.4 Re-analyze the sample.

15.3.5 If the problem is corrected, complete the O of C Form and submit it to supervisor.

15.3.6 If these steps do not yield acceptable results, the supervisor must be notified immediately.

15.4 Responsibilities

Further responsibility for correcting "Out of Control" situations lies with the supervisor, QA Manager, and when necessary the Laboratory Manager. In general the chain of responsibility is as follows:

15.4.1 Supervisor

The supervisor is responsible for reviewing the analyst's assessment of the "Out of Control" event, and if the problem has not been corrected, exercising their best professional judgement on how to proceed. At this point, the supervisor may:

15.4.1.1 Determine that the "Out of Control" situation does not affect sample results, thus aborting the "Out of Control" process. In the unlikely event of an analyst disagreeing with the supervisor's assessment, the "Out of Control" situation should be brought to the attention of the QA Manager or Lab Manager.

15.4.1.2 Initiate further investigation of the problem.

15.4.1.3 If the results in an investigation succeed in producing acceptable results, the corrective actions should be thoroughly documented and the completed O of C form submitted to the QA Manager.

15.4.1.4 If corrective actions and investigation fail to resolve the problem, the supervisor must consult the QA Manager.

15.4.2 Quality Assurance Manager

The QA Manager is responsible for reviewing the situation and working with the personnel involved to identify and resolve the problem at its source. Utilizing professional judgement and staff technical expertise, the QA Manager will:

15.4.2.1 Review the O of C event Form for completeness.

15.4.2.2 Recommend further investigation or corrective plans.

15.4.2.3 Authorize the release of the data.

15.4.2.4 Consult laboratory manager.

15.4.3 Laboratory Manager

If all corrective actions have failed to produce acceptable results, investigation has not identified the source of the problem, and the technical nature of the situation requires greater expertise, the QA Manager, supervisor, and laboratory manager will review the situation in its entirety to produce a resolution.

16.0 ASSESSMENT AND UTILIZATION OF QA PROCEDURES

16.1 Acceptance Limits and Control Charts

16.1.1 Acceptance criteria for quality control samples and instrument calibration/calibration verification are summarized in Table 3 following Section 1.

16.1.2 Matrix and surrogate spike recoveries, and the RPD of duplicate samples, are monitored daily through the rigorous use of acceptance criteria. Appendix C Exhibit III provides a detailed description of the method of setting control limits. An example calculation is provided in Appendix C Exhibit II. The actual limits for representative methods may be found in Appendix C Exhibit I.

16.1.3 Control charts are generated periodically to visually assess the trend of spike recoveries. Data is retrieved from the LIMS in the form of a Lotus style datafile. Once the file has been transferred to the PC, it is used to generate control charts.

16.1.4 Control charts are routinely used in the following circumstances:

16.1.4.1 To prepare the quarterly QA report to management, charts are produced to assess the trend of spike and surrogate recoveries and to quantify adherence to procedures for utilizing control limits.

16.1.4.2 To investigate/correct recurring "Out of Control" QC results, i.e., after 3 consecutive results outside of warning limits, a chart should be produced to visually assess the current trend of results.

16.1.4.3 In compliance with specific project requirements, such as the NIRP, NEESA or CLEAN program. An example of a PC generated control chart, from LIMS data, is included in Appendix C. (Exhibit II-2)

17.0 PERSONNEL QUALIFICATIONS

ATI considers competent, well-trained personnel the key to the success of the Quality Assurance Program. As such, an extensive training and program is in place at the laboratory.

17.1 Training

The major elements of the training program includes:

17.1.1 Training plans:

The type and schedule of training required for each new or transferred employee is determined individually. A training plan is established to reflect individual as well as general training needs.

17.1.2 Training classes:

17.1.2.1 All new employees attend an introductory Quality Assurance and Safety session, and a one hour training course with the QA Manager prior to the three month review.

17.1.2.2 All sections conduct regularly scheduled training sessions specific to the needs of the section.

17.1.2.3 Audio visual training programs and open learning texts are available for use by all personnel.

17.1.2.4 Other laboratory QA and general training classes (i.e. LIMS, PC) are offered periodically.

17.2 Support Programs

Attendance at outside seminars, classes, conventions, etc. is highly encouraged. ATI participates in many of these throughout the year, including the American Chemical Society National Conference, the Pittsburgh Conference, and EPA/CLP Conferences.

17.3 "Brown Bag" Seminars

In-house seminars are presented for employees periodically (lunchtime "brown bag"). These seminars may be given by other employees or by individuals from outside the ATI organization. Various topics of interest are covered, including regulatory items, information from attendance at outside seminars, and specific analytical topics.

17.4 Library

The ATI in-house library contains current periodicals and journals pertinent to the environmental industry and analytical chemistry, as well as reference books, text books, and regulatory publications.

18.0 OTHER QUALITY CONSIDERATIONS

18.1 Communication With Clients

Effective communication between the laboratory and its clients is of critical importance to our ability to generate quality results. As mentioned in section 7.3, ATI will immediately notify a client of any problems with their samples discovered during sample verification. The same procedure applies throughout the analysis with any problems that may arise. Similarly, ATI encourages clients to contact the laboratory for technical assistance concerning any phase of analysis from sampling to data interpretation.

18.1.1 Supplemental or extraneous information about the sample, when available, will enhance the efficiency of the analysis. This type of information is always useful and maybe included on the Chain-of-Custody or telephoned to the laboratory project manager.

18.2 Communication With Regulatory Agencies

It is imperative that ATI maintain effective communication with various Federal, State and Local regulatory agencies. These agencies may or may not be clients of ATI. It is often through these channels that imminent as well as recent changes in legislation are discovered.

18.2.1 Publications and periodicals made available by Federal and State agencies and by organizations with environmental interests, are useful sources of information regarding changes in legislation.

19.0 DOCUMENT CONTROL

All Standard Operating Procedures (SOP) and Forms (FRM) are tracked and logged by either the Document Control Coordinator or Designee. Whenever an SOP or FRM is originally developed and written or revised, it is done according to ATI SOP 130, "Standard Operating Procedure for Document Identification."

19.1 Anyone may either originate or revise an SOP or FRM, subject to approval by the Group Leaders and Supervisors affected and by the Document Control Coordinator.

19.2 SOPs and FRMs are given unique ID numbers by which they may be identified. These numbers reflect the area to which the SOP or FRM applies, according to Table 7.

19.3 Original SOPs are kept in a locked file cabinet next to the Document Coordinator's desk, in the QA office.

19.3.1 SOPs are considered controlled documents. Their dispersal is managed through the Document Control Coordinator, who tracks and logs all persons with the SOP, so that upon revision, all old revisions of the SOPs may be reliably retrieved and replaced with the new revision. SOPs created or revised as of 1/93 have expiration dates, printed on the title page, one year from the latest date approved on the signature page of the SOP.

19.4 Original FRMs are kept in Data Management at a word processing center, monitored by Data Management personnel.

TABLE 7

SECTION	NUMERIC ID
SAFETY	000 - 099
GENERAL LABORATORY	100 - 199
ADMINISTRATION	200 - 299
DATA MANAGEMENT	300 - 399
EXTRACTIONS	400 - 499
GAS CHROMATOGRAPHY/MASS SPECTROSCOPY	500 - 599
GAS CHROMATOGRAPHY	600 - 699
METALS	700 - 799
GENERAL CHEMISTRY	800 - 899
SAMPLE CONTROL	900 - 999

20.0 REFERENCES

1. Handbook for Analytical Quality Control in Water and Wastewater Laboratories, US EPA 600/4-79-019, March 1979.

2. Code of Federal Regulations, 40 CFR Part 136, October 26, 1984.

3. Test Methods for Evaluating Solid Waste, US EPA SW-846, September 1986.

4. Methods for the Determination of Organic Compounds in Drinking Water, US EPA 600/4-88-039, December 1988.

5. Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, US EPA 600/4-82-057, July 1982.

6. Methods for Chemical Analysis of Water and Wastes, US EPA 600/4-79-020, March 1983.

7. Quality Assurance of Chemical Measurements, Taylor, John K.; Lewis Publishers, Inc. 1987

8. Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WPCF; 16th Edition, 1985

9. NIOSH Manual of Analytical Methods, US Department of Health, Education, and Welfare; Second Edition, 1977.

Analysis Reference Chart

General/Inorganic Chemistry

Analysis	Container	Preservative (Chill to 4°C)	Container (Chill to 4°C)	Holding Time (From Sampling Date)	
	WATER	**WATER**	**SOIL**	**WATER**	**SOIL**
Alkalinity	4 oz. Plastic	Unpreserved	N/A	14 days	N/A
Ammonia (NH_3)	4 oz. Plastic	.25 ml H_2SO_4[A]	4 oz. jar	28 days	28 days
BOD	16 oz. Plastic (Headspace Free)	Unpreserved	N/A	48 hr.	N/A
Boron	4 oz. Plastic (Plastic Only)	Unpreserved	4 oz. jar	28 days	28 days
Bromide	16 oz. Plastic	Unpreserved	8 oz. jar	28 days	28 days
Chloride	4 oz. Plastic	Unpreserved	8 oz. jar	28 days	28 days
COD	4 oz. Plastic	.25 ml H_2SO_4[A]	4 oz. jar	28 days	28 days
Color	4 oz. Plastic	Unpreserved	N/A	48 hrs	N/A
Cyanide (total and/or amenable)	4 oz. Plastic[B I]	2 ml 1.5N NaOH[C]	4 oz. jar	14 days	No Specified Time
EC (Electrical Conductivity)	4 oz. Plastic	Unpreserved	4 oz. jar	28 days	28 days
Fish Toxicity	5 x 1 Gal. Plastic	Unpreserved	4 oz. jar	48 hrs	No Specified Time
Flashpoint	8 oz. Amber Glass (Glass Only) w/Septum (Headspace Free)	Unpreserved	8 oz. jar	28 days	28 days
Fluoride	4 oz. Plastic	Unpreserved	4 oz. jar	28 days	28 days
Formaldehyde	1 L Glass	1% Methanol	4 oz. jar	28 days-Pres. 7 days-Unp.	28 days
General Minerals•General Minerals	1 L Plastic	Unpreserved			
•NO_3	4 oz. Plastic	.25 ml H_2SO_4[A]	16 oz. jar	28 days	28 days
•Metals	16 oz. Plastic	1 ml HNO_3[A]			
Gross Alpha/Beta	1 L Plastic	2 ml HNO_3[A D]	4 oz. jar	6 mos.	6 mos.
Hardness	4 oz. Plastic	Unpreserved	N/A	28 days	N/A
Hexavalent Chromium (Cr^{+6})	16 oz. Plastic	Unpreserved	4 oz. jar	24 hrs	28 days
Iodide	4 oz. Plastic	Unpreserved	4 oz. jar	24 hrs	28 days
Nitrate/Nitrite (NO_3/NO_2)	4 oz. Plastic	.25 ml H_2SO_4	4 oz. jar	28 days	28 days
•NO_2	4 oz. Plastic	Unpreserved	4 oz. jar	48 hrs	28 days
Odor	1 oz. Glass	Unpreserved	N/A	48 hrs	N/A
Oil & Grease	3 250 ml Glass (Glass Only)[B]	2 ml H_2SO_4[A]	4 oz. jar	28 days	28 days
418.1 (TPH by IR)	3 250 ml Glass (Glass Only)[B]	2 ml H_2SO_4[A]	4 oz. jar	28 days	28 days
pH	4 oz. Plastic	Unpreserved	4 oz. jar	immediately	14 days
Phenolics	4 oz. Amber Glass (Glass Only)[B]	.25 ml H_2SO_4[A]	4 oz. jar	28 days	28 days
Phosphorus•Total (P)	4 oz./8 oz. Plastic	.25 ml//5 ml H_2SO_4[A]	4 oz. jar	28 days	28 days
Phosphorus•Total (PO_4)	4 oz./8 oz. Plastic (Filtered)	Unpreserved	4 oz. jar	48 hrs	28 days
Silica	4 oz. Plastic (Plastic Only)	Unpreserved	4 oz. jar	28 days	28 days
Solids (Residue)•Total dissolved	16 oz. Plastic	Unpreserved	N/A	7 days	N/A
•Total suspended	16 oz. Plastic	Unpreserved	N/A	7 days	N/A
•Total settleable	1 L Plastic	Unpreserved	N/A	48 hrs	N/A
•Total solids	16 oz. Plastic	Unpreserved	N/A	7 days	N/A
Specific Gravity	4 oz. Plastic	Unpreserved	4 oz. jar	28 days	28 days
Sulfate	4 oz. Plastic	Unpreserved	4 oz. jar	28 days	28 days
Sulfide	4 oz. Plastic[B]	6 drops-2N Zn acetate & 8 drops 6N NaOH[E]	N/A	7 days	N/A
Sulfite	4 oz. Plastic	1 ml EDTA	N/A	28 days-Pres. 6 hrs-Unp.	N/A
Surfactants (MBAS)	1 L Plastic	Unpreserved	N/A	48 hrs	N/A
Total Coliform	8 oz. Glass or Polypropylene (Sterilized)	0.008% $Na_2S_2O_3$	N/A	6-8 hrs	N/A
TKN (Kjeldahl Nitrogen)	4 oz. Plastic	.25 ml H_2SO_4[A]	4 oz. jar	28 days	28 days
Total Organic Carbon (TOC)	4 oz. Amber Glass (Glass Only) w/Septum (Headspace Free)	.25 ml H_2SO_4[A]	4 oz. jar	28 days	28 days
Total Organic Halides (TOX)	8 oz. Amber Glass (Glass Only) w/Septum (Headspace Free)	.5 ml H_2SO_4[A]	4 oz. jar	7 days	No Specified Time
Total Radium	1 L Plastic	2 ml HNO_3[A D]	4 oz. jar	6 mos.	6 mos.
Turbidity	4 oz. Plastic	Unpreserved	N/A	48 hrs	N/A

Organic Chemistry

Analysis	Container (Glass and Teflon lined caps only)	Preservative (Chill to 4°C)	Container (Glass and Teflon lined caps only - Chill to 4°C)	Holding Time (From Sampling Date)	
	WATER	**WATER**	**SOIL**	**WATER**	**SOIL**
8010/8020	2 X VOA (Headspace free)	0.25 ml HCl[A]	4 oz. jar	14 days - Pres 7, days - Unp.	14 days until Analysis
• 8010	2 X VOA (Headspace free)	0.25 ml HCl[A]	4 oz. jar	14 days	14 days until Analysis
• 8020	2 X VOA (Headspace free)	0.25 ml HCl[A]	4 oz. jar	14 days - Pres 7, days - Unp.	14 days until Analysis
• BTXE	2 X VOA (Headspace free)	0.25 ml HCl[A]	4 oz. jar	14 days - Pres 7, days - Unp.	14 days until Analysis
Modified 8015 (TPH)	4 oz. Amber Glass[J] w/Septum (Headspace free)	0.25 ml HCL[A]	4 oz. jar	14 days until Analysis	14 days until Analysis
• Gasoline Range[F]	2 X VOA (Headspace free)	0.25 ml HCl[A]	4 oz. jar	14 days until Analysis	14 days until Analysis
• Diesel Range[G]	4 oz. Amber Glass[J] w/Septum (Headspace free)	0.25 ml HCL[A]	4 oz. jar	14 days until Extraction 40 days after Extraction until Analysis	14 days until Extraction 40 days after Extraction until Analysis
8240	2 X VOA (Headspace free)	0.25 ml HCl[A]	4 oz. jar	14 days - Pres 7, days - Unp.	14 days until Analysis
EDB	1 L Glass[B]	Unp.	8 oz. jar	28 days until Analysis	28 days until Analysis
8040	1 L Glass[B]	Unp.	4 oz. jar	7 days until Extraction 40 days after Extraction until Analysis	14 days until Extraction 40 days after Extraction until Analysis
8080	2 x 1 L Glass[B]	Unp.	4 oz. jar	7 days until Extraction 40 days after Extraction until Analysis	14 days until Extraction 40 days after Extraction until Analysis
8100/8310	1 L Amber Glass[B]	Unp.	4 oz. jar	7 days until Extraction 40 days after Extraction until Analysis	14 days until Extraction 40 days after Extraction until Analysis
8140	1 L Glass[B]	Unp.	4 oz. jar	7 days until Extraction 40 days after Extraction until Analysis	14 days until Extraction 40 days after Extraction until Analysis
8150	1 L Glass[B]	Unp.	4 oz. jar	7 days until Extraction 40 days after Extraction until Analysis	14 days until Extraction 40 days after Extraction until Analysis
Modified 619	1 L Glass[B]	Unp.	4 oz. jar	7 days until Extraction 40 days after Extraction until Analysis	14 days until Extraction 40 days after Extraction until Analysis
8270	2 x 1 L Glass[B]	Unp.	4 oz. jar	7 days until Extraction 40 days after Extraction until Analysis	14 days until Extraction 40 days after Extraction until Analysis
Modified 632	1 L Glass[B]	Unp.	4 oz. jar	7 days until Extraction 40 days after Extraction until Analysis	14 days until Extraction 40 days after Extraction until Analysis
TCLP • Volatiles (zero headspace extraction)	N/A	N/A	4 oz. jar	N/A	14 days until Extraction 14 days after Extraction until Analysis
• Non-Volatiles	N/A	N/A	16 oz. jar	N/A	14 days until TCLP Leaching[H]

Metals

Analysis	Container	Preservative	Holding Time (From Sampling Date)
WATER			
Metals (1 or more metals) • Total	16 oz. Plastic[B]	1 ml HNO_3[A]	6 mo. (28 days - Hg)
• Dissolved • Filtered Field	16 oz. Plastic[B]	1 ml HNO_3[A]	6 mo. (28 days - Hg)
• Not Filtered	16 oz. Plastic[B] (Specify "To be lab filtered")	Unpreserved	6 mo. (28 days - Hg)
• Organic Lead	8 oz. Amber Glass (Glass Only) w/Septum (Headspace free)	Unpreserved Chill to 4°C	14 days until Analysis[M]
• Hexavalent Chromium (Cr^{+6})	16 oz. Plastic	Unpreserved	24 hrs.
SOIL			
Metals (1 or more metals) • Total	4 oz. jar		6 mos.
• Soluble			
• EP Toxicity	8 oz. jar		6 mos.
• WET	8 oz. jar		6 mos.
• TCLP (see also Organic Chemistry)	8 oz. jar		6 mos.
• Hexavalent Chromium (Cr^{+6})	4 oz. jar		28 days
• Organic Lead	4 oz. jar	Chill to 4°C	14 days until Analysis[M]

Notes

- *Fill all containers as much as possible. (Consult laboratory for minimum volume required.)*
- *Holding time = the samples must be analyzed within the required time frame.*
- *Most tests require samples to remain chilled at 4°C after sampling.*

A. *Typical volume needed to bring the pH < 2.*

B. *Additional volumes may be required. (Consult laboratory for recommendations.)*

C. *Typical volume needed to birng the pH > 12.*

D. *Sample does not need to be chilled.*

E. *Typical volume needed to bring the pH > 9.*

F. *Applicable to all hydrocarbons in the Gasoline hydrocarbon range.*

G. *Applicable to all hydrocarbons in the Diesel hydrocarbon range.*

H. *Laboratory recommended holding time.*

I. *In the presence of residual Chlorine, add 0.6 grams ascorbic acid.*

J. *2 x VOA (Headspace Free) may be used if higher TPH values are acceptable. Consult laboratory for recommendations.*

- *VOA = 40 ml vial w/septum*
- *4 oz. jar holds approx. 100 - 150 grams*

8 oz. jar holds approx. 300 - 400 grams

16 oz. jar holds approx. 600 - 800 grams

AnalyticalTechnologies, Inc.
5550 MOREHOUSE DRIVE
SAN DIEGO, CA 92121-1709
(619) 458-9141

Chain of Custody

DATE_____ PAGE_____ OF_____

PROJECT MANAGER:
COMPANY:
ADDRESS:

BILL TO:
COMPANY:
ADDRESS:

SAMPLERS: (Signature) _____ ( ) - PHONE NUMBER

SAMPLE ID	SAMPLE DATE	TIME	MATRIX	LAB ID

Recommended Quantity and Preservative (Provide triple volume on QC Samples)

Petroleum Hydrocarbons 418.1	Oil and Grease 413.2	Gasoline (MOD 8015/DOHS)	Diesel (MOD 8015/DOHS)	Gasoline/BTXE (MOD 8015/8020) Maximum Contamination Level of Gasoline: 2ppm (water), 50ppm (Soil)	MOD 8015 (Unknown)	BTXE (8020)	Chlorinated Hydrocarbons (8010)	Aromatic Hydrocarbons (8020)	Chlorinated/Aromatic Hydrocarbons (8010/8020)	Organic Pb		Pesticides/PCB (8080)	Base/NEU/Acid Cmpds GC/MS (8270)	Volatile Cmpds GC/MS (8240)	Polynuclear Aromatic (8310)	CCR Metals	Priority Pollutant Metals								Number of Containers
1L (H_2SO_4)/100g	1L (H_2SO_4)/100g	4 oz (HCl)/50g	4 oz (HCl)/50g	2X40ml (HCl)/50g	4 oz (HCl)/50g	2X40ml (HCl)/50g	2X40ml (HCl)/50g	2X40ml (HCl)/50g	2X40ml (HCl)/50g	500ml/50g		1L/50g	1L/100g	2X40ml (HCl)/100g	1L/100g	500ml/100g	500ml/100g								

PROJECT INFORMATION	SAMPLE RECEIPT	
PROJECT NUMBER:	TOTAL NUMBER OF CONTAINERS	
PROJECT NAME:	CHAIN OF CUSTODY SEALS Y/N/NA	
PURCHASE ORDER NUMBER:	SEALS INTACT? Y/N/NA	
VIA:	RECEIVED GOOD COND./COLD	
TAT: ☐24HR ☐48HRS ☐72HRS ☐1WK ☐2WK	LAB NUMBER	

SAMPLE DISPOSAL INSTRUCTIONS

☐ ATI Disposal @ $5.00 each ☐ Return ☐ Pickup

Comments:

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature: Time:	Signature: Time:	Signature: Time:
Printed Name: Date:	Printed Name: Date:	Printed Name: Date:
Company:	Company:	Company:
RECEIVED BY: 1.	**RECEIVED BY: 2.**	**RECEIVED BY: (LAB) 3.**
Signature: Time:	Signature: Time:	Signature: Time:
Printed Name: Date:	Printed Name: Date:	Printed Name: Date:
Company:	Company:	Analytical Technologies, Inc.

DISTRIBUTION: White, Canary - ANALYTICAL TECHNOLOGIES, INC. • Pink - ORIGINATOR

ACCESSION #: _____ INITIALS: _____

SAMPLE CONDITION UPON RECEIPT CHECKLIST
(FOR RE-ACCESSIONS, COMPLETE #7 THRU #9)

1	Does this project require special handling according to NEESA Levels C, D, AFOEHL or CLP protocols? If yes, complete a) thru c) a) Cooler temperature _____ b) pH sample aliquoted: yes / no / n/a c) LOT #'s: _____	YES	NO
2	Are custody seals present on cooler?	YES	NO
	If yes, are seals intact?	YES	NO
3	Are custody seals present on sample containers?	YES	NO
	If yes, are seals intact?	YES	NO
4	Is there a Chain-Of-Custody (COC)*?	YES	NO
5	Is the COC* complete? Relinquished: yes/no Requested analysis: yes/no	YES	NO
6	Is the COC* in agreement with the samples received? # Samples: yes/no Sample ID's: yes/no Matrix: yes/no # containers: yes/no	YES	NO
7	Are the samples preserved correctly?	YES	NO
8	Is there enough sample for all the requested analyses?	YES	NO
9	Are all samples within holding times for the requested analyses?	YES	NO
10	Were the samples received cold?	YES	NO
11	Were all sample containers received intact (ie. not broken, leaking, etc.)?	YES	NO
12	Are samples requiring no headspace, headspace free? N/A	YES	NO
13	Are there special comments on the Chain of Custody which require client contact?	YES	N/A
14	If yes, was ATI Project Manager notified?	YES	NO

Describe "no" items: _____

_____

_____

_____

Was client contacted? yes / no

If yes, Date: _____ Name of Person contacted: _____

Describe actions taken or client instructions: _____

_____

_____

_____

*Or other representative documents, letters, and/or shipping memos

SAMPLE CUSTODY LOG

ACCESSION #	SAMPLE (#-#)	ANALYST (1st Name, Initials)	ANALYSIS	CONT./ PRES.	LOCATION		OUT		IN		SAMPLE CUSTO-DIAN
					Storage	Lab	Date	Time	Date	Time	

ATIFRM922(9/91)

Effective 2/1/93

INORGANICS/GENERAL CHEMISTRY ACCEPTANCE LIMITS
Matrix Spike, Blank Spike and Duplicate***

FOR VARIOUS METHODS

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS	BLANK SPIKE CONTROL LIMITS
Chloride (Cl)	85-122	90-113
Fluoride (F)	69-123	83-114
Total Cyanide (CN)	80-120	89-113
Nitrate (NO_3 as N)	75-121	87-110
Nitrate/Nitrite as N	70-118	84-112
Sulfates (SO_4)	72-124	91-122
Sulfides (S)	67-130	84-118
Orthophosphate	84-119	84-119**
Ammonia (NH_3)	88-107	88-107
Total Kjeldahl Nitrogen (TKN)	59-136	84-112
Total Organic Carbon (TOC)	63-129	80-118
Total Organic Halide (TOX)	66-119	80-110
Total Petroleum Hydrocarbons (IR)	42-133	73-111
Oil & Grease (IR)	56-124	79-116
Oil & Grease (Grav.)	35-147	35-147**
Hexavalent Chromium (Cr_6)	78-126	90-114
Formaldehyde	48-98*	48-98**
Total Phenols	87-107	87-107
630	52-137*	52-137**
Surfactants (MBAS)	57-138	57-138**
Hydrazine	76-123*	76-123**
Silica	76-125	76-125**

* Insufficient data to recalculate limits. Data from 4/89.
** Insufficient data to calculate limits. Use Matrix Spike limits.
*** **Relative Percent Difference Limits:** 67% for samples <10 times the RDL;
20% for samples >10 times the RDL.

Effective 2/1/93

INORGANICS/GENERAL CHEMISTRY ACCEPTANCE LIMITS
Matrix Spike, Blank Spike and Duplicate***

FOR VARIOUS METHODS

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	BLANK SPIKE CONTROL LIMITS
Chloride (Cl)	80-122	90-110
Fluoride (F)	57-136	57-136**
Total Cyanide (CN)	49-132	76-113
Nitrate (NO_3 as N)	48-146	80-127
Sulfates (SO_4)	81-124	88-120
Sulfides (S)	63-130	78-119
Ammonia (NH_3)	47-146	91-124
Total Kjeldahl Nitrogen (TKN)	31-165	82-115
Total Organic Carbon (TOC)	33-148	72-125
Total Organic Halide (TOX)	55-144	78-120
Total Petroleum Hydrocarbons (IR)	70-133	85-122
Total Phosphate	86-111*	86-111**
Oil & Grease (Grav.)	40-134	40-134**
Hexavalent Chromium (Cr_6)	42-110	84-118
Formaldehyde	82-103*	82-103**
Total Phenols	60-121	79-109
630	20-156*	20-156**

* Insufficient data to recalculate limits. Data from 4/89.
** Insufficient data to calculate limits. Use Matrix Spike limits.
*** **Relative Percent Difference Limits:** 67% for samples <10 times the RDL;
20% for samples >10 times the RDL.

Effective 2/1/93

INORGANICS ACCEPTANCE LIMITS
Matrix Spike, Blank Spike and Duplicate**

METHOD: AA & ICAP

NAME: TRACE METALS

MATRIX: WATER

PARAMETER		MATRIX SPIKE CONTROL LIMITS	BLANK SPIKE CONTROL LIMITS
Silver	Ag	72-118	74-118
Aluminum	Al	75-115	77-113
Arsenic	As	69-126	78-122
Boron	B	71-121	71-124
Barium	Ba	78-114	84-113
Beryllium	Be	78-113	89-110
Calcium	Ca	74-119	85-112
Cadmium	Cd	76-123	76-123
Cobalt	Co	73-114	88-110
Chromium (total)	Cr	75-110	85-109
Copper	Cu	82-110	87-109
Iron	Fe	78-115	88-109
Mercury	Hg	68-128	80-119
Potassium	K	81-116	81-114
Magnesium	Mg	75-121	89-110
Manganese	Mn	73-118	78-118
Molybdenum	Mo	75-112	87-107
Sodium	Na	66-127	74-123
Nickel	Ni	75-111	86-110
Lead	Pb	63-131	77-124
Antimony (GF/AA)	Sb	67-116	67-116*
Antimony (ICAP)	Sb	77-110	88-104
Selenium	Se	63-132	63-132
Tin	Sn	75-122	84-117
Strontium	Sr	77-117	90-109
Thallium	Tl	54-140	62-137
Vanadium	V	77-111	86-109
Zinc	Zn	79-118	89-116
Organic Lead	OPb	63-135	65-132

* Insufficient data to calculate limits. Use Matrix Spike limits.
** **Relative Percent Difference Limits:** 67% for samples <10 times the RDL; 20% for samples >10 times the RDL.

Effective 2/1/93

INORGANICS ACCEPTANCE LIMITS
Matrix Spike, Blank Spike and Duplicate**

METHOD: AA & ICAP

NAME: TRACE METALS

MATRIX: SOIL

PARAMETER		MATRIX SPIKE CONTROL LIMITS	BLANK SPIKE CONTROL LIMITS
Silver	Ag	62-113	73-109
Aluminum	Al	67-131	76-117
Arsenic	As	61-120	75-117
Boron	B	53-125	64-122
Barium	Ba	60-127	86-107
Beryllium	Be	75-113	85-108
Calcium	Ca	66-143	74-118
Cadmium	Cd	70-119	77-114
Cobalt	Co	64-114	64-114
Chromium (total)	Cr	60-122	81-107
Copper	Cu	69-116	82-108
Iron	Fe	58-130	74-116
Mercury	Hg	61-137	78-123
Potassium	K	65-129	74-115
Magnesium	Mg	71-126	78-112
Manganese	Mn	63-128	81-111
Molybdenum	Mo	56-113	85-105
Sodium	Na	71-130	77-116
Nickel	Ni	61-121	82-107
Lead	Pb	63-119	81-112
Antimony	Sb	15-104	80-104
Selenium	Se	45-132	67-126
Tin	Sn	59-140	59-140*
Strontium	Sr	78-122	78-122*
Thallium	Tl	61-129	61-120
Vanadium	V	66-113	84-107
Zinc	Zn	59-123	80-110
Organic Lead	OPb	53-109	53-109

* Insufficient data to calculate limits. Use Matrix Spike limits.
** Relative Percent Difference Limits: 67% for samples <10 times the RDL;
20% for samples >10 times the RDL.

Effective 2/1/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 504

NAME: EDB & DBCP

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Ethylene Dibromide (EDB)	39-113	22	39-113*
Dibromochloropropane (DBCP)	34-143	19	50-140

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Ethylene Dibromide (EDB)	31-155	31	31-120*
Dibromochloropropane (DBCP)	35-125	39	35-102*

* Blank Spike limits adjusted to Matrix Spike limits.

Effective 2/1/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 619

NAME: TRIAZINE PESTICIDES

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Prometon	46-140	24	75-137
Atrazine	47-139	28	81-125
Ametryn	48-136	24	80-131

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Prometon	13-147	33	13-133*
Atrazine	57-162	21	57-134*
Ametryn	37-154	23	37-133*

* Blank Spike limits adjusted to be within Matrix Spike limits

Effective 2/1/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 632

NAME: CARBAMATES AND UREA PESTICIDES

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Bromacil	48-130	43	58-130*
Carbaryl	41-122	25	50-122*
Linuron	48-125	35	66-118
Neburon	34-134	26	59-124

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Bromacil	53-150	34	60-145
Carbaryl	58-153	31	66-146
Linuron	60-151	24	63-151*
Neburon	61-150	30	69-144

* Blank Spike limits adjusted to be within Matrix Spike limits.

Effective 2/10/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 8015 Modified

NAME: TOTAL PETROLEUM HYDROCARBONS

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Fuel Hydrocarbons	60-104	15	60-104*
Surrogate			
bis-2-ethylhexylphthalate	49-126		

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Fuel Hydrocarbons	72-114	14	72-114*
Surrogate			
bis-2-ethylhexylphthalate	71-125		

* Blank Spike limits adjusted to be within Matrix Spike limits.

Effective 2/1/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 8020

NAME: BTXE (Benzene, Toluene, Xylene, Ethylbenzene)

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Benzene	77-123	16	85-116
Toluene	79-121	13	86-116
Surrogate			
Trifluorotoluene	65-134		

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Benzene	69-117	20	83-117*
Toluene	69-120	19	86-120*
Surrogate			
Trifluorotoluene	77-125		

* Blank Spike limits adjusted to be within Matrix Spike limits.

Effective 4/1/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 8021

NAME: PURGEABLE HALOCARBONS AND AROMATICS

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Benzene	80-120	15	80-120
Chlorobenzene	80-125	9	80-125*
Chloroform	80-125	~~14~~ 19 LM 4/1/93	80-120
1,1-Dichloroethene	50-130	20	70-125
Tetrachloroethene	85-120	16	85-120*
Toluene	85-125	15	85-120*
Trichloroethene	85-130	14	85-120*

Surrogate

Bromofluorobenzene

BFB (ELCD)	60-139
BFB (PID)	79-134

* Blank Spike limits adjusted to be within Matrix Spike limits.

Effective 2/1/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 8021

NAME: PURGEABLE HALOCARBONS AND AROMATICS

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Benzene	65-125	15	85-125
Chlorobenzene	65-120	18	75-120*
Chloroform	65-120	18	75-120*
1,1-Dichloroethene	40-115	27	50-115*
Tetrachloroethene	65-120	16	75-120*
Toluene	60-130	16	85-130
Trichloroethene	70-120	15	75-120*

Surrogate

Bromofluorobenzene

BFB (ELCD)	57-139
BFB (PID)	75-136

* Blank Spike limits adjusted to be within Matrix Spike limits.

Effective 2/1/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 8040

NAME: PHENOLS

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS*	RPD	BLANK SPIKE CONTROL LIMITS
2-Chlorophenol	29-126	15	**
2,4-Dichlorophenol	44-119	18	**
2-Nitrophenol	43-117	16	**
Pentachlorophenol	38-128	29	**
2,4,6-Trichlorophenol	53-119	19	**

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS*	RPD	BLANK SPIKE CONTROL LIMITS
2-Chlorophenol	24-131	15	**
2,4-Dichlorophenol	39-124	18	**
2-Nitrophenol	38-122	16	**
Pentachlorophenol	33-133	29	**
2,4,6-Trichlorophenol	41-128	19	**

* Insufficient data to recalculate limits. Data from 4/89 adjusted to meet SW-846 EPA Method 8040 limits.

** No separate limits available. Use Matrix Spike limits.

Effective 2/1/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 8080

NAME: ORGANOCHLORINE PESTICIDES & PCB's

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Aldrin	33-134	29	54-128
gamma-BHC	51-136	22	51-136*
4,4'-DDT	29-150	28	51-150*
Dieldrin	49-145	22	60-138
Endrin	63-146	24	68-141
Heptachlor	35-124	30	47-124*
Surrogate			
Dibutylchlorendate (DBC)	20-150		

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Aldrin	44-148	24	44-143*
gamma-BHC	44-127	30	47-116
4,4'-DDT	42-143	23	50-138
Dieldrin	54-142	24	69-134
Endrin	56-138	20	58-132
Heptachlor	45-120	22	49-107
Surrogate			
Dibutylchlorendate (DBC)	30-144		

* Blank Spike limits adjusted to be within Matrix Spike limits.

Effective 2/1/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 8080

NAME: PCB's Only

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
PCB 1260	36-139	30	36-139*
Surrogate			
TCMX	21-137		

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
PCB 1260	55-130	30	67-126
Surrogate			
TCMX	40-139		

MATRIX: OIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
PCB 1260	30-139	16	62-131
Surrogate			
TCMX	15-126		

* Insufficient data to calculate acceptance limits (<20 points). Use Matrix Spike limits.

Effective 2/1/93

ORGANICS ACCEPTANCE LIMITS*

METHOD: 8140

NAME: ORGANOPHOSPHOROUS PESTICIDES

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Diazinon	50-139	27	50-139**
Ethyl Parathion	48-140	29	48-140**
Guthion	73-140	31	73-140**
Methyl Parathion	42-147	23	42-147**

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Diazinon	34-140	30	34-138**
Ethion	45-147	29	45-147*
Ethyl Parathion	45-147	29	45-145**
Guthion	25-150	30	50-133
Methyl Parathion	47-142	30	47-137**

* Insufficient data to calculate limits. Use Matrix Spike limits.

** Blank Spike limits adjusted to be within Matrix Spike limits.

Effective 2/1/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 8150

NAME: HERBICIDES

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
2,4,5-T	43-127	21	43-124
2,4,5-TP	42-122	22	42-122*
2,4-D	41-135	24	41-130*
Dinoseb	29-145	33	29-143*

Surrogate

Pentachlorophenol	17-110

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
2,4,5-T	32-108	37	34-108*
2,4,5-TP	31-104	34	31-104*
2,4-D	31-121	31	39-121*
Dinoseb	20-139	49	20-139*

Surrogate

Pentachlorophenol	20-108

* Blank Spike limits adjusted to be within Matrix Spike limits.

Effective ~~2/1/93~~ 5/27/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 8310

NAME: POLYNUCLEAR AROMATIC HYDROCARBONS

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Acenaphthylene	26-97	34	27-97*
Phenanthrene	36-116	25	46-115
Pyrene	30-129	27	42-129*
Benzo(k)fluoranthene	23-127	27	38-127*
Dibenzo(a,h)anthracene	24-127	27	39-127*
Surrogate			
2-Chloroanthracene	~~22-95~~ 34-125 LM 6/1/93		

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
Acenaphthylene	21-119	34	21-106*
Phenanthrene	25-136	28	26-122
Pyrene	35-137	31	35-126*
Benzo(k)fluoranthene	37-128	29	37-125*
Dibenzo(a,h)anthracene	36-141	27	36-133*
Surrogate			
2-Chloroanthracene	~~17-112~~ 43-123 LM 6/1/93		

* Blank Spike limits adjusted to be within Matrix Spike limits.

Effective 2/1/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 8240

NAME: VOLATILE ORGANICS ANALYSIS BY GC/MS

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
1,1-Dichloroethene	55-134	17	55-133
Trichloroethene	81-120	11	81-120
Chlorobenzene	87-123	12	88-123
Toluene	84-121	11	84-121
Benzene	84-121	12	84-121*
Surrogates			
1,2-Dichloroethane-D_4	77-123		
Bromofluorobenzene	84-111		
Toluene-D_8	93-112		

* Blank Spike limits adjusted to be within Matrix Spike limits.

Effective 2/1/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 8240

NAME: VOLATILE ORGANICS ANALYSIS BY GC/MS

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
1,1-Dichloroethene	40-142	19	51-141
Trichloroethene	50-136	21	73-126
Chlorobenzene	50-145	19	81-129
Toluene	66-124	21	81-124*
Benzene	62-124	21	79-124*
Surrogates			
1,2-Dichloroethane-D_4	60-119		
Bromofluorobenzene	55-125		
Toluene-D_8	70-120		

* Blank Spike limits adjusted to be within Matrix Spike limits.

Effective 2/1/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 8270

NAME: SEMI-VOLATILE ORGANICS ANALYSIS BY GC/MS

MATRIX: WATER

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTRO LIMITS
1,2,4-Trichlorobenzene	40-111	30	40-111
Acenaphthene	42-115	25	42-115
2,4-Dinitrotoluene	20-112	39	30-112
Pyrene	21-143	36	38-143
n-Nitroso-di-n-Propylamine	27-91	34	27-91
1,4-Dichlorobenzene	37-103	30	37-103
Pentachlorophenol	19-128	46	28-128
Phenol	34-98	55	34-98
2-Chlorophenol	34-105	50	34-105
4-Chloro-3-Methylphenol	24-119	35	35-117
4-Nitrophenol	13-145	41	13-145
Surrogates			
Terphenyl	14-135		
2-Fluorophenol	12-121		
Phenol-D_6	11-129		
Nitrobenzene-D_5	31-119		
2-Fluorobiphenyl	33-121		
2,4,6-Tribromophenol	25-134		

Effective 2/1/93

ORGANICS ACCEPTANCE LIMITS

METHOD: 8270

NAME: SEMI-VOLATILE ORGANICS ANALYSIS BY GC/MS

MATRIX: SOIL

PARAMETER	MATRIX SPIKE CONTROL LIMITS	RPD	BLANK SPIKE CONTROL LIMITS
1,2,4-Trichlorobenzene	21-123	33	42-101
Acenaphthene	30-131	29	37-118
2,4-Dinitrotoluene	20-130	47	35-118
Pyrene	38-137	36	49-128
n-Nitroso-di-n-Propylamine	26-124	35	31-122
1,4-Dichlorobenzene	29-114	30	29-114
Pentachlorophenol	16-155	47	38-137
Phenol	23-120	34	29-111
2-Chlorophenol	25-116	36	28-113
4-Chloro-3-Methylphenol	33-124	29	33-121
4-Nitrophenol	21-134	40	38-128

Surrogates

Terphenyl	21-143
2-Fluorophenol	19-119
Phenol-D_6	22-117
Nitrobenzene-D_5	23-127
2-Fluorobiphenyl	20-132
2,4,6-Tribromophenol	29-133

9-DEC-92

ORGANIC MSMSD RECOVERY LIMITS CALCULATION

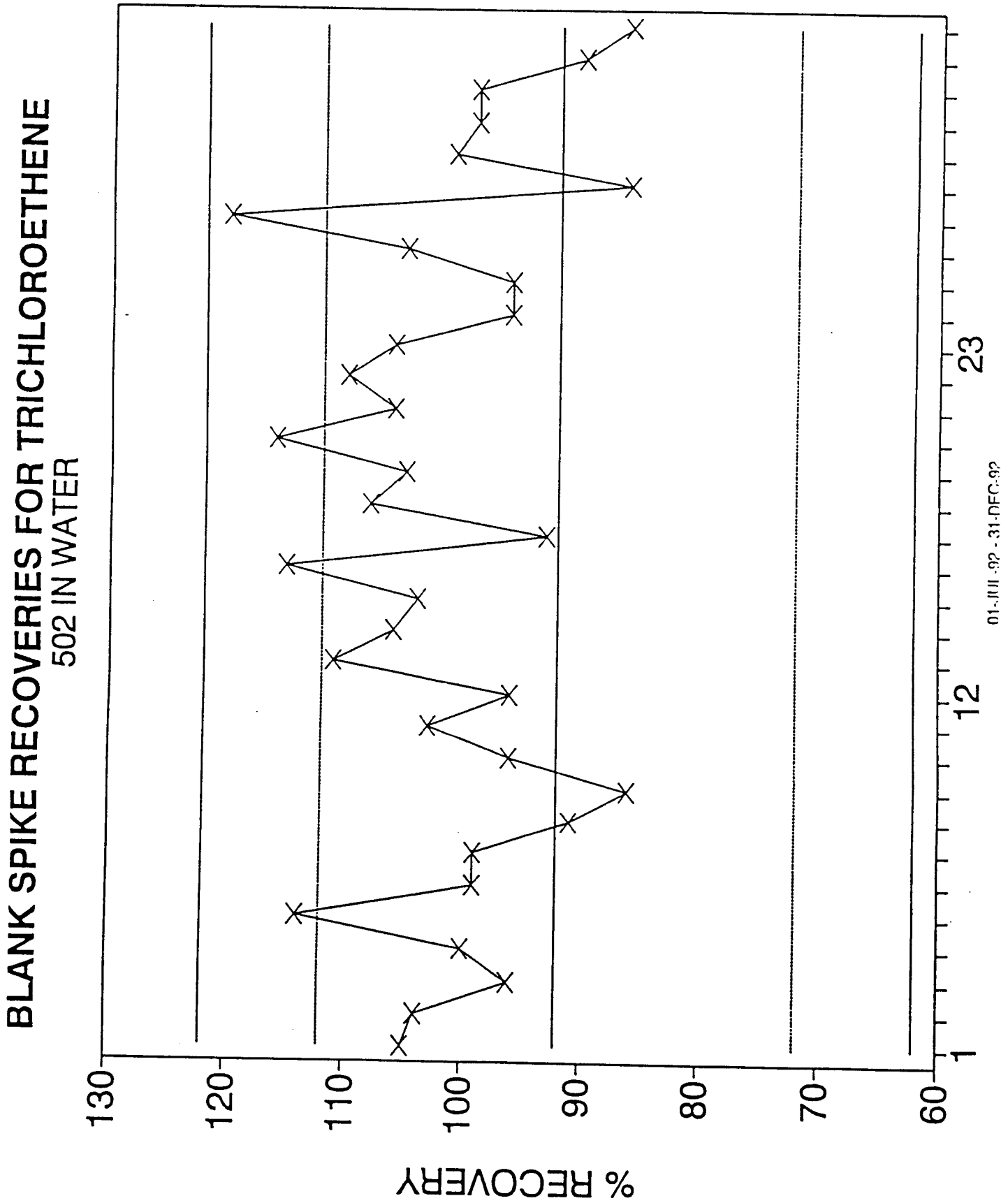
Parameter: GAMMA-BHC (LINDANE)
Version : 0
Msmsd's Analyzed From 30-SEP-90 to 30-SEP-92

Method Code: 8080
Matrix Cat : AQ

Seq	Msmsd Id	Date Analyzed	Recov	Rpd	Dup Recov	Exclude Flag
1	11000	22-FEB-91	110	9	120	
2	11327	03-MAR-91	98	3	95	
3	11633	08-MAR-91	85	0	85	
4	13006	16-APR-91	127	0	127	
5	13228	21-APR-91	100	10	91	
6	13229	21-APR-91	91	7	85	
7	13355	21-APR-91	81	4	77	
8	13842	15-MAY-91	105	3	100	
9	14187	14-MAY-91	N/A*K	7	N/A*K	*
10	14587	21-MAY-91	100	5	95	
11	14747	21-MAY-91	89	6	95	
12	15032	21-MAY-91	80	12	90	
13	15898	01-JUN-91	95	0	95	
14	15907	15-JUN-91	90	11	100	
15	16112	10-JUN-91	95	15	110	
16	18867	24-JUL-91	90	11	100	
17	21818	20-SEP-91	96	0	96	
18	21995	18-SEP-91	75	40*G	50	*
19	21996	18-SEP-91	90	5	95	
20	22254	01-OCT-91	155*F	18	130*F	*
21	22625	04-OCT-91	115	4	120	
22	23170	11-OCT-91	84	6	89	
23	23431	19-OCT-91	95	18	79	
24	23906	27-OCT-91	86	12	76	
25	25537	22-NOV-91	119	17	100	
26	25661	27-NOV-91	68	4	64	
27	25714	28-NOV-91	70	6	74	
28	26996	28-DEC-91	91	5	87	
29	27066	31-DEC-91	83	0	83	
30	27068	27-DEC-91	91	10	83	
31	29511	14-FEB-92	89	13	79	
32	34073	29-MAY-92	80	6	85	
33	35863	11-JUL-92	89	0	89	
34	37219	10-AUG-92	125	8	115	

Average Recovery : 93.32
Total number of sample: 62
Stddev Recovery : 14.11
Total number of sample: 61
Lower Warning Limit : 65.10
Upper Warning Limit : 121.54
Lower Control Limit : 50.99
Upper Control Limit : 135.65

Average RPD : 6.77
Total number of sample: 31
Stddev RPD : 5.14
Total number of sample: 30
Lower Warning Limit : -3.51
Upper Warning Limit : 17.05
Lower Control Limit : -8.65
Upper Control Limit : 22.19


BLANK SPIKE RECOVERIES FOR TRICHLOROETHENE
502 IN WATER
% RECOVERY
130
120
110
100
90
80
70
60
1
12
23
01-JUL-92 - 31-DEC-92

DATE 06-JAN-93

BLANK SPIKE RECOVERIES FOR TRICHLOROETHENE
502 IN WATER

	BS ID	DATE EXTRACTED	DATE ANALYZED	%REC	UCL	UWL	AVG	LWL	LCL
1	B26272		07/07/92	105	122	112	92	72	62
2	B26633		07/08/92	104	122	112	92	72	62
3	B26634		07/09/92	96	122	112	92	72	62
4	B27846		08/20/92	100	122	112	92	72	62
5	B27863		08/21/92	114	122	112	92	72	62
6	B27882		08/24/92	99	122	112	92	72	62
[illegible]	B27890		08/24/92	99	122	112	92	72	62
8	M37847		08/25/92	91	122	112	92	72	62
9	B27891		08/25/92	86	122	112	92	72	62
10	M37847		08/25/92	96	122	112	92	72	62
11	B29107		10/06/92	103	122	112	92	72	62
12	B29109		10/06/92	96	122	112	92	72	62
13	B29106		10/07/92	111	122	112	92	72	62
14	B29108		10/07/92	106	122	112	92	72	62
15	B29712		10/27/92	104	122	112	92	72	62
16	B29728		10/28/92	115	122	112	92	72	62
17	B29729		10/29/92	93	122	112	92	72	62
18	B29764		10/29/92	108	122	112	92	72	62
19	M40714		10/30/92	105	122	112	92	72	62
20	B29804		10/30/92	116	122	112	92	72	62
21	B29807		10/30/92	106	122	112	92	72	62
22	M40714		10/30/92	110	122	112	92	72	62
23	B29812		11/02/92	106	122	112	92	72	62
24	B29813		11/02/92	96	122	112	92	72	62
25	B30336		11/20/92	96	122	112	92	72	62
26	M41376		11/21/92	105	122	112	92	72	62
27	M41376		11/21/92	120	122	112	92	72	62
28	B31617		12/24/92	86	122	112	92	72	62
29	B31649		12/24/92	101	122	112	92	72	62

DATE 06-JAN-93

BLANK SPIKE RECOVERIES FOR TRICHLOROETHENE
502 IN WATER

	BS ID	DATE EXTRACTED	DATE ANALYZED	%REC	UCL	UWL	AVG	LWL	LCL
30	B31616		12/28/92	99	122	112	92	72	62
31	B31650		12/28/92	99	122	112	92	72	62
32	B31689		12/29/92	90	122	112	92	72	62
33	B31681		12/31/92	86	122	112	92	72	62

ESTABLISHMENT AND UTILIZATION OF ACCEPTANCE LIMITS FOR QUALITY CONTROL SAMPLES STANDARD OPERATING PROCEDURE

1.0 SCOPE AND APPLICATION

1.1 Scope

The purpose of this procedure is to establish and provide a method to utilize the acceptance limits for quality control samples.

1.2 Application

This procedure shall be applicable to all laboratory analyses that have quality control samples.

2.0 DISCUSSION/COMMENTS

This procedure establishes the requirements and procedures for calculating and utilizing the acceptance limits.

3.0 DEFINITIONS

The terms "Quality Control Samples", "Warning Limits, and "Control Limits" shall be defined as follows:

3.1 Quality Control Samples

Quality Control samples are samples that are analyzed on a regular basis for the purpose of demonstrating that the method is operating in a state of statistical control. These include, but are not limited to, the following:

Matrix Spikes
Surrogate Spikes
EPA QC Check Samples
Laboratory Control Samples
Blank Spikes
Reagent Blanks

3.2 Warning Limits

Warning limits represent the 95% confidence interval and are equal to the average value for the control sample percent recovery $\pm$ 2 standard deviations. Exceeding these limits is a warning that the analytical system may be approaching an "Out of Control" condition. No formal action is taken for this event.

3.3 Control Limits

Control limits represent the 99% confidence interval and are equal to the average value of the control sample percent recovery $\pm$3 standard deviations. Exceeding these limits indicates that the analytical system is "Out of Control". This situation must be investigated and appropriate action taken. Actions range from filling out an "Out of Control" form and explaining the situation (matrix interference) to halting the analysis until the problem can be solved.

4.0 PROCEDURE

4.1 Establishing Limits For Percent Recovery

4.1.1 Warning limits and Control limits for percent recovery are established through statistical analysis of actual QC sample results. Limits are set for each parameter of each method, separately for Blank Spike and Matrix Spike samples.

4.1.2 The average value ($\bar{x}$) and the standard deviation (s) for each data set is calculated. The limits for Percent Recovery are set as follows:

Warning = $\bar{x} + 2s$ = 95.5% confidence limit

Control = $\bar{x} + 3s$ = 99.7% confidence limit

Where $$\bar{x} = \frac{x(1) + x(2) + x(3) + \ldots + x(n)}{n}$$

where $\bar{x}$ = average percent recovery
x = individual spike sample recovery
n = total number of results in set

and $$s = \sqrt{\frac{\Sigma(x - x)^2}{n-1}}$$

4.1.3 The minimum number of results to be used in statistical analysis is 20. Limits will generally be calculated on a data set of at least 30 results. Limits shall be updated yearly using the last 100 points or one year of data, whichever is less. Data gathered over longer time periods may be used for those analyses that do not have 20 data points in one year. Exceptions to the above may occur at the discretion of the QA manager. Deviations will be documented.

4.2 Establishing Limits for Relative Percent Difference (RPD)

4.2.1 The upper control limit for RPDs is established through separate statistical analysis of matrix spike/matrix spike duplicate results and blank spike/blank spike duplicate results, if enough data exists. The lower control limit for RPDs is always zero (ie. no difference between duplicate samples).

4.2.2 The average (x) and standard deviation (s) for each set of organic RPD data is calculated as in Section 4.1.2; where x is the individual RPD value for each pair of samples, and x is the average RPD value for n number of pairs of control samples. The upper control limit for the RPD is set as follows:

$$\text{RPD Limit} = \bar{x} + 3s$$

4.3 Utilization of Acceptance Limits

QC sample results must fall within the established control limits ($\pm 3s$) for each parameter. Results that fall outside established control limits are considered "Out of Control." These results must be carefully examined for possible sources of error in the analysis or justified as a matrix bias effect. They must be documented and appropriate corrective action taken.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Documentation and corrective action procedures can be found in SOP ATI-SD 117, Out of Control Events.

PAGE ____ OF 100

NAME OF STOCK TO BE PREPARED:				
ANALYST:			NUMBER:	
SOLVENT:			DATE:	
PARENT	PURITY	WEIGHT USED (g)	FINAL VOLUME (ml)	FINAL CONCENTRATE (µg/ml)
COMMENTS:				
VERIFIED:		REVIEWED BY:		DATE:

NAME OF STOCK TO BE PREPARED:				
ANALYST:			NUMBER:	
SOLVENT:			DATE:	
PARENT	PURITY	WEIGHT USED (g)	FINAL VOLUME (ml)	FINAL CONCENTRATE (µg/ml)
COMMENTS:				
VERIFIED:		REVIEWED BY:		DATE:

NAME OF STOCK TO BE PREPARED:				
ANALYST:			NUMBER:	
SOLVENT:			DATE:	
PARENT	PURITY	WEIGHT USED (g)	FINAL VOLUME (ml)	FINAL CONCENTRATE (µg/ml)
COMMENTS:				
VERIFIED:		REVIEWED BY:		DATE:

ATIFRM806 (6/91)

OUT OF CONTROL QC/EVENT REPORT

DATE OCCURED:	SECTION: GENERAL CHEMISTRY OUT OF CONTROL #:
ANALYTICAL METHOD:	SAMPLE ID: MATRIX:
DATE REPORTED:	BY:

CLIENT: PROJECT NAME: PROJ. MGR.:

O/C RESULT:

CONTROL LIMITS:

PROBABLE CAUSE:

CORRECTIVE ACTION TAKEN: RE-EXTRACT/DIGEST YES_____ NO_____

DID CORRECTIVE ACTION YIELD ACCEPTABLE RESULTS? YES_____ NO_____

FURTHER CORRECTIVE ACTION REQUIRED:

I.D OF SAMPLES ASSOCIATED WITH OUT OF CONTROL QC/EVENT:

COMMENTS:

GEN. CHEM. SUPERVISOR:	DATE:	INITIALS:
PROJECT MANAGER:	DATE:	INITIALS:
QC MANAGER:	DATE:	INITIALS:

ATIFRM815(10/92)

LABORATORY EQUIPMENT

GAS CHROMATOGRAPHS

HEWLETT PACKARD

1. HP 5890 Series II GC with one Flame Ionization Detector, an HP 7673A Autosampler (7673A tower, 18596B rack, and 7673A controller) and an HP 3366 Series II Integrator. (Ext.)

	Serial Numbers
GC	3203A40720
Autosampler	
tower	3208A29851
rack	3208A27798
controller	3208A28355
Integrator	3029P20372

2. HP 5890 GC with two Flame Ionization Detectors and an HP 7673AA Autosampler (two 7673AA towers, 18596A rack, and 7673AA controller). (Fuels)

	Serial Numbers
GC	2623A08238
Autosampler	
tower #1	2704A06080
tower #2	2843A11346
rack	2718A04883
controller	2720A07212

3. HP 5890 Series II GC with two Flame Ionization Detectors and an HP 7673AA Autosampler (two 7673A towers, 18596A rack, and 7673AA controller). (Fuels)

	Serial Numbers
GC	2921A24637
Autosampler	
tower #1	2932A14320
tower #2	2932A14318
rack	2933A11520
controller	2929A15557

4. HP 5890 Series II GC with two Flame Ionization Detectors and an HP 7673A Autosampler (two 7673A towers, 185968 rack and 7673A controller). (Fuels)

	Serial Numbers
GC	2950A26161
Autosampler	
tower #1	3004A20605
tower #2	2932A14318
rack	2942A20608
controller	2941A20276

GAS CHROMATOGRAPHS (Continued)

HEWLETT PACKARD (Cont'd.)

5. HP 5890 GC with two Flame Ionization Detectors and an HP 7673A Autosampler (7673AA tower, 2718A rack, and 7673A controller). (Misc.)

	Serial Numbers
GC	2536A05761
Autosampler	
tower	2704A07075
rack	2718A09166
controller	2929A15676

6. HP 5880A GC with two HP 19233 15 millicurie Electron Capture Detectors and an HP 7671A Autosampler. (Pest.)

	Serial Numbers
GC	2417A06224
ECD #1	S10822
ECD #2	S9905
Autosampler	2446A09417

7. HP 5890 GC with two HP 19233 15 millicurie Electron Capture Detectors and an HP 7673AA Autosampler (7673AA tower, 7673AA rack, and 7673AA controller). (Pest.)

	Serial Numbers
GC	2843A19724
ECD #1	M 2060
ECD #2	L 5343
Autosampler	
tower	2843A11342
rack	2718A09094
controller	2847A12656

8. HP 5890 Series II GC with two HP 19233 15 millicurie Electron Capture Detectors and an HP 7673AA Autosampler (7673AA tower, 18596A rack, and 7673AA controller). (Pest.)

	Serial Numbers
GC	2921A24618
ECD #1	F 2472
ECD #2	F 2448
Autosampler	
tower	2936A14363
rack	2933A11251
controller	2929A15485

GAS CHROMATOGRAPHS (Continued)

HEWLETT PACKARD (Cont'd.)

9. HP 5890 Series II GC with Dual Electron Capture Detectors and an HP 7673A Autosampler (7673A tower, 18593B tower, and 7673A controller). (Pest.)

	Serial Numbers
GC	3033A33399
ECD 1	F1071
ECD 2	F1072
Autosampler	
tower	3104A24850
rack	3106A23939
controller	3104A24204

10. HP 5890 Series II GC with Dual Nitrogen Phosphorous Detectors and an HP 7673A Autosampler (7673A tower, model 18596B rack, and a 7673A controller). (Pest.)

	Serial Numbers
GC	3108A34106
Autosampler	
tower	3104A24860
rack	3106A24294
Controller	3104A24733

11. HP 5890 Series II GC with a Flame Ionization Detector and an OIC 4430 Photoionization Detector, and a Tekmar LSC 2000/ALS 2016 Purge and Trap device. (VOAB)

	Serial Numbers
GC	2921A24604
PID	89-298A
LSC 2000	92259004
ALS 2016	92282009

12. HP 5890 Series II GC with a Flame Ionization Detector, an OIC 4430 Photoionization Detector, and a Tekmar LSC 2000/ALS 2016 Purge and Trap device. (VOAB)

	Serial Numbers
GC	3140A38292
PID	91-1127
LSC 2000	90297021
ALS 2016	902829017

GAS CHROMATOGRAPHS (Continued)

HEWLETT PACKARD (Cont'd.)

13. HP 5890 GC with an OIC 4420 Electrolytic Conductivity Detector and an HNU PI-52 Photoionization Detector. Also with a Tekmar LSC 2000/ALS 2016 Purge and Trap device. (VOA10)

	Serial Numbers
GC	2728A12881
ELCD	2720A70405
PID	2701A27028
LSC 2000	89209009
ALS 2016	91249014

14. HP 5890 GC with an OIC 4420 Electrolytic Conductivity Detector and an OIC 4430 Photoionization Detector, and a Tekmar LSC 2000/ALS 2016 Purge and Trap device. (VOA10)

	Serial Numbers
GC	2950A2875
ELCD	90-083
PID	90-557
LSC 2000	90073038
ALS 2016	90066033

15. HP 5890 GC with an OIC 4420 Electrolytic Conductivity Detector and an OIC 4430 Photoionization Detector, and a Tekmar ALS/LSC-2 Purge and Trap device. (VOA10)

	Serial Numbers
GC	2950A27584
ELCD	90-052
PID	90-515
LSC-2	90157008
ALS	90169025

VARIAN

1. Varian 3700 GC with a Thermionic Specific Detector and two Flame Photometric Detectors, and a Leap Technologies CTCA 200S Autosampler. (Pest.)

	Serial Numbers
GC	93322922-13
Autosampler	12103

GAS CHROMATOGRAPHS (Continued)

VARIAN (Cont'd.)

2. Varian 3700 GC with a Flame Ionization Detector and a Tracor model 703 Photoionization Detector, and a Tekmar LSC-2/ALS Purge and Trap. (VOAB)

	Serial Numbers
GC	93642927-13
PID	861314
LSC-2	87201007
ALS	690

3. Varian 3700 GC with a Flame Ionization Detector, a Thermal Conductivity Detector and a Varian 8 millicurie Electron Capture Detector, and a Varian 8000 Autosampler. (Misc.)

	Serial Numbers
GC	69160447-13
ECD	2839
Autosampler	9612020C86-04

4. Varian 3400 GC with a Flame Ionization Detector and an Electron Capture Detector, a Varian 8000 Autosampler, and two HP 3396A Integrators. (Prep)

	Serial Numbers
GC	9331
ECD	A7748
FID	A2900
Autosampler	17080385-04
Integrator #1	2841P0740
Integrator #2	2841P5785

HIGH PERFORMANCE LIQUID CHROMATOGRAPHS

PERKIN-ELMER

1. Series 4 Gradient LC with a Model 550 Gradient Controller, a Perkin-Elmer LC-15B Fixed Wavelength UV Detector, a Fiatron CH-460 column oven with a TC-50 Controller, and a Perkin-Elmer ISS-100 Autosampler. (Misc.)

	Serial Numbers
LC	003735
LC Controller	522944
Column Heater	C-U901003
TC-50	FL901018
LC-15B	49334
Autosampler	0729656

HIGH PERFORMANCE LIQUID CHROMATOGRAPHS (Continued)

PERKIN-ELMER (Cont'd.)

2. Series 10 Isocratic LC with a Perkin-Elmer LC-15B Fixed Wavelength UV Detector, Shimdazu RF-535 Fluorescence Detector and a Perkin-Elmer LC-600 Autosampler. (Misc.)

	Serial Numbers
LC	43158
LC-15B	47632
Autosampler	2726-783

WATERS

1. Model 600 Multisolvent Delivery System LC with a Waters 600E System Controller, a Waters 484 Tunable Absorbance UV Detector, a Waters 470 Scanning Fluorescence Detector and a Waters 712 Ingredient Sample Processor (WISP). (Misc.)

	Serial Numbers
LC	600PF1251
UV Detector	484-000170
Fluor. Detector	06078RP
WISP	712-005150
Controller	600EPA670

GEL PERMEATION CHROMATOGRAPHS

WATERS

1. HPLC chromatograph consisting of a Waters 501 High Performance pump, a Waters 717 Autosampler, a Waters 440 Absorbance Detector, a Waters Fraction Collector and two custom steel GPC prep columns (19 x 300 and 19 x 150) with a Waters 746 Data Module. (Ext.)

	Serial Numbers
Pump	SDS/206792
Absorbance Detector	06118
Fraction Collector	100360
Data Module	079/76S-100117
Autosampler	717-000255

2. HPLC chromatograph consisting of a Waters 501 High Performance pump, a Waters 717 Autosampler, a Waters 440 Absorbance Detector, a Waters Fraction Collector and two custom steel GPC prep columns (19 x 300 and 19 x 150) with a Waters 746 Data Module. (Ext.)

	Serial Numbers
Pump	SDS/208147
Absorbance Detector	441-004774
Fraction Collector	WFC-40122
Data Module	112/765-102959
Autosampler	717-002010

GAS CHROMATOGRAPH/MASS SPECTROMETERS

FINNIGAN

1. Finnigan 5100B GC/MS with a Leap Technologies CTC-A200S Autosampler and a Printronix printer. (Designated M3)

	Serial Numbers
GC/MS	13313-0984
Autosampler	1621/89
Printer	A5900

2. Finnigan Incos 50 MS with an HP 5890 GC, a Tekmar LSC 2000/ALS 2016 Purge and Trap device and automatic sample heater, and a Data General Computer with color monitor and a Printronix Printer for data handling. (Designated M1)

	Serial Numbers
MS	IN396
GC	2750A18626
Computer	
E8712-N	U0068295
E6336	C1218393
E6267-A	U0068416
E6270	Q5132029
E6261-2	Y4A009661
Printer	M46544
LSC 2000	88298004
ALS 2016	89003019
Heater	90169047

HEWLETT PACKARD

1. HP 5970 MSD with an HP 5890 Series II GC, HP 2397A Controller, and a Tekmar LSC 2000/ALS 2016 Purge and Trap device with automatic sample heater, and an HP 59824 Scanning Interface, a 670H Processor, and 9144 sixteen Track Tape Drive for data handling. (Designated M2)

	Serial Numbers
MSD	3004A12757
GC	3033A30661
LSC 2000	90073039
ALS 2016	90080027
Sample Heater	91011002
Controller	2924Y01120
Monitor	9011J34270

GAS CHROMATOGRAPH/MASS SPECTROMETERS (Continued)

HEWLETT PACKARD (Cont'd.)

2. HP 5970 MSD with an HP 5890 Series II GC. An HP 7673A Autosampler (HP 3033A tower, 7673A rack, and 7673A contoller), and an HP 59824 Scanning Interface, a 670H Processor, and 9144 sixteen Track Tape Drive for data handling. (Designated M4)

	Serial Numbers
MSD	3034A12808
GC	3033A30833
Autosampler	
tower	3120A27372
rack	3032A22503
controller	3032A22798
Monitor	9017J35346

3. HP 5971 MSD with an HP 5890 Series II GC, and a Tekmar LSC 2000/ALS 2016 Purge and Trap device with sample heater, and an HP Vectra 386/25 with HP color monitor and HP printer for data handling. (Designated M5)

	Serial Numbers
MSD	3118A02568
GC	3126A36674
LSC 2000	91227007
ALS 2016	91253028
Sample Heater	91261008
Controller	2924Y01478
System	3132A47514
Computer	3125A10225
Monitor	9104K17138

4. HP 5971 MSD with an HP 5890 Series II GC, and an HP 7673A Autosampler (7673A tower, 7673A rack, and a 7673A controller), and an HP Vectra 386/25 Computer with an HP color monitor and an HP printer for data handling. (Designated M6)

	Serial Numbers
MSD	3188A02952
GC	3022A29270
Autosampler	
tower	3033A23187
rack	3131A25862
controller	3113A26315
System	3143A48016
Computer	3137A12394
Monitor	9121J27916

TOTAL ORGANIC CARBON ANALYZERS

DOHRMANN

1. Dohrmann Carbon Analyzer including a DC-80 Reaction Module, a DC-80 Electronics Module and a ASM-1 Auto-Sampler and a Horiba PIR-2000 Infrared Detector.

	Serial Numbers
Reaction Module	HD1338
Electronics Module	HD1355
Auto-Sampler	HD1681
Detector	706038

ROSEMOUNT ANALYTICAL, INC.

1. Dohrmann Total Organic Carbon Analyzer DC-190 with autosampler.

	Serial Numbers
DC-190	9201004

TOTAL ORGANIC HALIDE ANALYZERS

XERTEX

	Serial Numbers
1. Dohrmann MC-1	HD1310
2. Dohrmann MC-1	HD1855

MITSUBISHI

1. MCI Tox 10 Organic Halogen Analyzer (Sulfur, Chlorine Analyzer) with MCI Microcoulometer, and Mitsubishi TXA02 Sample Preparater.

	Serial Numbers
TOX 10	43F32331
Microcoulometer	43C32331
Sample Preparater	75A20551

AUTO-ANALYZERS

SKALAR

1. Skalar 5120 Autoanalyzer with two UV/VIS Detectors and a 187 Autosampler. Also two micro Distillation units and a 1070 Detector Controller.

	Serial Numbers
Skalar	162
Autosampler	187
Detector Controller	249

AUTO-ANALYZERS (Continued)

TECHNICON

1. Technicon AutoAnalyzer II AA with a Technicon S.C. Colorimeter UV Detector which uses interchangeable filters, autosampler, a Clindus PUMP III Peristaltic Pump, a Strip Chart Recorder, and four analytical cartridges (manifolds) 1-Phenol, 2-Cyanide, 3-Sulfate, 4-Ammonia, TKN, Nitrate, Nitrite, Chloride, Silica and ortho-Phosphate.

	Serial Numbers
AA II	
Peristaltic Pump	AT220REP
Detector	GS2676
Recorder	502A427
Cartridges (manifolds)	
1	TC60117
2	TC60219
3	TC60174
4	TC60159
Autosampler	171-AOF7-07 N

pH METERS

BECKMAN

		Serial Numbers
1.	Beckman Phi 21	014022
2.	Beckman Phi 71	0089212
3.	Beckman Phi 11	0223262
4.	Beckman Phi 11	0222631

HACH

		Serial Number
1.	Hach 43800	871002307

ORION RESEARCH

		Serial Number
1.	Orion 611	61863

TURBIDITY METER

MONITEX

		Serial Number
1.	Nephelometer 21P1	L-2177

CONDUCTIVITY TESTERS

FISHER

		Serial Number
1.	Fisher model 09-328, Digital Conductivity Meter	022149

CONDUCTIVITY TESTERS (Continued)

VWR

		Serial Number
1.	VWR Conductivity Meter	A10911

YSI

		Serial Number
1.	YSI Conductance Meter, Model 32	988

FLASH POINT TESTERS

FISHER/TAG

		Serial Numbers
1.	Fisher/Tag Penskey-Martens (Closed Cup)	1594
2.	Fisher/Tag Cleveland (Open Cup)	932

INFRARED SPECTROPHOTOMETERS

NICOLET

1. Nicolet IR/42 Fourier Transform Infrared Spectrophotometer with a DELL System 220 Computer, Tatung CM-1495 Color Monitor and an IBM 5182001 Color Printer.

	Serial Numbers
FT/IR	8900531
Computer	286125021224
Monitor	71490677
Printer	030243

2. Nicolet 205 Fourier Transform Infrared Spectrophotometer with a Dell System 220 Computer, Tatung CM-1495 Color Monitor, and an HP Color Plotter, C.Itoh C310 Color Printer.

	Serial Numbers
FT/IR	AAC9200744
Computer	286125021224
Monitor	71490677
Plotter	2929A43071
Printer	R 126828

UV/VIS SPECTROPHOTOMETERS

UVIKON

		Serial Number
1.	Uvikon 810 UV/VIS Spectrophotometer	18-1980

BAUSCH & LOMB

		Serial Number
1.	Spectrophotometer-20	_____

ION SPECIFIC ELECTRODES

ORION

		Serial Numbers
1.	Iodide (I-)	94-55
2.	Perchlorate (ClO4-)	93-81
3.	Cyanide (CN-)	94-06
4.	Oxygen (O2)	97-08-99

CORNING

		Serial Numbers
1.	Chloride (Cl-)	476126
2.	Flouride (F-)	476042
3.	Sulfide (S-)	476139

OTHER ELECTRODES, INCLUDING DISSOLVED OXYGEN

ORION

		Serial Numbers
1.	Redox	96-78
2.	Dissolved Oxygen, model 970899	0065344

WATER PURIFICATION SYSTEMS

CULLIGAN

1. Culligan Deionization System, with two parallel setups consisting of five tanks each (in series) and particulate filters.

BARNSTEAD

1. Sybron/Barnstead Nanopure II, water filtration system with a Sybron/Barnstead resistivity meter.

	Serial Numbers
Filtration system	8206008
Resistivity meter	82-07-017

INDUCTIVELY COUPLED ARGON PLASMA ATOMIC EMISSION SPECTROMETERS

THERMO JARRELL ASH

1. Thermo Jarrel Ash ICAP 61 Model 95970 including Auto-Sampler, with an IBM PS/2 8550 Computer, an IBM 8513 Color Monitor, and an IBM Proprinter II for data handling.

	Serial Numbers
ICAP	42882
Auto-Sampler	278E8 B028
IBM PS/2	72-8284074

GRAPHITE FURNACE/ATOMIC ABSORPTION SPECTROMETERS

PERKIN-ELMER

1. Perkin-Elmer 3030 Atomic Absorption Spectrophotometer with a HGA-400 Graphite Furnace (including programmer), an AS-40 Auto-Sampler (including controller), an EDL Power Supply and a Perkin-Elmer PR-100 Printer.

	Serial Numbers
AA	123655
Graphite Furnace	2699
Programmer	3860
Auto-Sampler	7515
Controller	4646
Power Supply	101282
Printer	A 10831

2. Perkin-Elmer 5100PC Atomic Absorption Spectrophotometer with a HGA-600 Graphite Furnace (including programmer), a AS-60 Auto-Sampler, an EDL System 2 Power Supply, a Digital 316SX Data System and an Epson LR-850 Printer. (Designated PE 5100)

	Serial Numbers
AA	142572
HGA-600 Furnace	6997
Controller	5452
Auto-Sampler	8257
Data System	TC00063926
Printer	OTF1017696
Monitor	TC02208639
Power Supply	421291

GRAPHITE FURNACE/ATOMIC ABSORPTION SPECTROMETERS (Continued)

PERKIN-ELMER (Cont'd.)

3. Perkin-Elmer 5100PC Atomic Absorption Spectrophotometer with a HGA-600 Graphite Furnace (including programmer), a AS-60 Auto-Sampler, an EDL System 2 Power Supply, a Digital 316SX Data System and an EPSON LQ-870 Printer. (Designated PE 5100X)

	Serial Numbers
AA	144110
HGA-600 Furnace	7052
Controller	5579
Auto-Sampler	8365
Data System	TC00072092
Printer	4OU1002823
Monitor	TC00063926
Power Supply	420223

COLD VAPOR MERCURY ANALYZER

PERKIN-ELMER

1. Perkin-Elmer 2380 Atomic Absorption Spectrophotometer with a special attachment for mercury analysis using the cold vapor technique.

	Serial Number
AA	130403

AA LAMPS

HOLLOW CATHODE LAMPS

1.	Ag	2.	Al	3.	Ba	4.	Be
5.	Ca-Mg	6.	Cd	7.	Cr	8.	Cu
9.	Fe	10.	Hg	11.	Mn	12.	Na-K
13.	Pb	14.	Pt	15.	Sb	16.	Si
17.	Tl						

ELECTRODELESS DISCHARGE LAMPS

1.	As	2.	Cd	3.	Cs	4.	Pb
5.	Sb	6.	Se	7.	Sn	8.	Tl

ELECTRODELESS DISCHARGE LAMPS SYSTEM 2

1.	As	2.	Cd	3.	Pb	4.	Se
5.	Tl						

ICP LINES ON THE THERMO-JARREL ASH ICAP 61

ELEMENT	WAVELENGTH	ELEMENT	WAVELENGTH
Ag	328.1	Mg	383.2
Al	308.2	Mn	257.6
As	193.4	Mo	207.0
B	249.7	Na	589.0
Ba	493.4	Na	330.2
Be	313.0	Ni	231.6
Ca	393.3	P	214.9
Ca	370.6	Pb	220.3
Cd	226.5	Sb	206.8
Co	228.7	Se	196.0
Cr	267.7	Si	288.2
Cu	324.8	Sn	190.0
Fe	259.9	Sr	421.6
Fe	271.4	Ti	334.9
K	766.5	Tl	377.6
Li	670.8	V	292.4
Mg	279.5	Zn	213.9

MUFFLE FURNACES

THERMOLYNE

		Serial Number
1.	Thermolyne 1500 Muffle Furnace	32701201

CERAMIC FIBER FABRICATION, INC.

		Serial Number
1.	Model CSE.BX.8.0.SPL	503

KILN

CRESS

		Serial Number
1.	Model FX-31P	8309

ROTATORS

ASSOCIATED DESIGN

		Serial Number
1.	12 Vessel	3740-12-BRE

TURNER LABORATORIES

Five rotators manufactured by Turner Laboratories.

EXTRACTION VESSELS

ASSOCIATED DESIGN

Eighteen extraction vessels 3745 ZHE SLO\FLO

REFRIGERATED RECIRCULATORS

LAUDA

		Serial Numbers
1.	UKT 3000	M02033-T16A
2.	RMT 6	N12001-T15A
3.	RMT 6	N05049-T15A

VWR

		Serial Number
1.	Model 1176	915319

CENTRIFUGE

BECKMAN

		Serial Number
1.	Beckman TJ-6	13126

VACUUM EVAPORATOR

BUCHI

		Serial Number
1.	Buchi 011	1143616

KUDERNA-DANISH EVAPORATORS

60 Total, Capable of running 24 at one time

EVAPORATORS

ORGANOMATION

		Serial Numbers
1.	S-EVAP 120	10728
2.	S-EVAP 120	8027
3.	S-EVAP 120	7973
4.	N-EVAP 115	5694
5.	N-EVAP 115	9227
6.	N-EVAP 112	3484

SONICATORS

HEAT SYSTEMS

		Serial Numbers
1.	Model W-385	G8975
2.	Model W-385	_____
3.	Model W-375	_____

BRANSON

		Serial Number
1.	Model 350	RD30102A

SONICS & MATERIALS VIBRA CELL

		Serial Number
1.	Model VC 600-2 (with dual horn)	14111

SONICATOR CONVERTORS

BRANSON

		Serial Number
1.	Model unable to read	unable to read

ULTRASONICS

		Serial Number
1.	Model C3	C2098

OTHER

		Serial Numbers
1.	Model CV17	V02031
2.	Model CV17	V02027

SONICATOR BATHS

BRANSON

		Serial Numbers
1.	Model 1200	none
2.	Model 5200	none
3.	Model 5200	none

LIQUID-LIQUID EXTRACTORS

Minimum of 42.

SHAKERS

LABLINE

		Serial Number
1.	Orbit 3520	1086-0309

SHAKERS (Continued)

GLAS-COL

		Serial Numbers
1.	Glas-Col Funnel Shaker	253099
2.	Model RD350, Rotary	253165
3.	Model RD350, Rotary	252492

EBERBACH

		Serial Numbers
1.	Reciprocating	none
2.	Reciprocating	none

ANALYTICAL BALANCES (TOP LOADERS)

METTLER

		Serial Numbers
1.	Model AE 160	SV00986
2.	Model AC 100	B09643

SARTORIUS

		Serial Number
4.	Model R300S	40060017

OTHER BALANCES (TOP LOADERS)

METTLER

		Serial Numbers
1.	Model PM 600	F08873
2.	Model PE 360	C78692
3.	Model PE 2000	B16555
4.	Model PM 2500	K38337
5.	Model PM 400	L66654
6.	Model BasBal	L78761

SARTORIUS

		Serial Number
1.	Model E1200S	3605005

OVENS

LAB LINE INSTRUMENT

		Serial Number
1.	Model L-C 3511	0587-0049

BLUE M

		Serial Number
1.	Model OV-500C-2	OV3-19610

OVENS (Continued)

VWR

		Serial Numbers
1.	Model 1330G	1330787
2.	Model 1300U	0904290
3.	Model 1645D	_____

BAXTER SCIENTIFIC PRODUCTS

		Serial Number
1.	Model DX-31	182018

FISCHER

		Serial Number
1.	Model 230D	182018

INCUBATOR

FISCHER

		Serial Number
1.	Model 146, Low Temperature	1059

DATA SYSTEMS (COMPUTER AND SOFTWARE)

SUN MICROSYSTEMS

1. Sun 3/60 Workstation with a 247 Processor, a 511 Hard Disk/Tape Drive unit and a HM-4119-S-AA-O Color Graphics Monitor. Along with SunOS (Berkeley 4.3 Unix) and Oracle software.

	Serial Numbers
Model 247	921F0472
511	911H0027
HM-4119-S-AA-O	911AR0133

2. Sun Sparcserver 390, 861 with two Hard Disk Drives, a Tape drive, and a Xylogics Annex II, AX2T-AB.

	Serial Numbers
Sparcserver	005E0591
Annex II	005192408

PERSONAL COMPUTERS

Numerous IBM compatible Personal Computers with various hardware and software.

Numerous Laser Printers, Dot Matrix Printers and Plotters.

APPENDIX F - 2

West Coast Analytical Services - Quality Assurance Manual

QUALITY ASSURANCE MANUAL

West Coast Analytical Services
9840 Alburtis Avenue
Santa Fe Springs, CA 90670
July, 1993

Approved by: 8-18-93
D.J. Northington, Ph.D.
President

Rex Morris, Ph.D.
Quality Assurance Coordinator

N:\WS7\DOC\QAM1993

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- Appendix D Requirements for Special Programs

Revision 3/88
- Section 3.2 Chain of Custody
- Figure 3.2 Chain of Custody Form

Revision 2/89
- Minor revisions and updating

Revision 3/90
- Minor revisions and updating

Revision 1/91
- Minor revisions and updating

Revision 9/91
- Section 1.0 Paragraph added on Quality objectives
- Section 2.5 Confidentiality
- Section 5.7 Data Packages, Data Review, and Audit

Revision 1/92
- Section 5.6 Corrective Action
- Appendix B General Revisions and Updating
  - Annual Statistics Update
  - Refrigerators changed from 4-8 to 2-6 ^{o}C
  - Five Place Balance calibration changed to 2.0000 $\pm$ 0.00009 g
  - Table 1. QC Frequency (new Table)
  - Table 2. Out of Control (new table)

Revision 7/93

- Figure 2-1 Updated Organizational Chart
- Appendix E Job Descriptions added
- Appendix B Minor Updating

1. Introduction

West Coast Analytical Service, Inc. is an independent analytical laboratory providing state-of-the-art instrumental analytical chemistry to both industry and government. We presently specialize in trace analyses using GC, GCMS, FTIR, LCMS, IC, HPLC, and ICPMS techniques. Services include environmental, priority pollutant, and pesticide analysis, industrial hygiene analyses, contaminant identification, gas composition and trace impurity determinations, polymer and coating identifications, product compositions, and quality control.

The owners, managers, and staff at WCAS consider quality of work to be a prerequisite in serving our clients' needs. We are dedicated to providing the highest quality analytical services that we can. For that reason we have a formal QA program, we are certified and accredited by outside agencies, and we participate in both required and voluntary proficiency evaluation programs.

The Quality Assurance Manual (QAM) describes the procedures that are followed to monitor the quality of our work.

Chapter 2: Describes the organization, floor plan, services offered, and the source of analytical procedures used in our work.

Chapter 3: Describes the procedures that are used to log, track, store samples, analytical data, and reports.

Chapter 4: Lists laboratory equipment.

Chapter 5: Describes the procedures used to monitor the precision and accuracy of data as well as the operational guidelines used in performing the analyses.

2. Description of the Company

2.1 Organizational Structure

The Laboratory is currently divided into five groups: (1) GCMS, (2) GC, (3) Inorganics, (4) Ion Chromatography and Wet Chemistry and (5) Sample Preparation. Support groups include accounting, secretarial, and janitorial services. An Organizational Chart appears in Figure 2.1.

Group Leaders are responsible for technical and administrative management of small groups of two to five people specializing in a type of instrumental analysis or chemistry. The Group Leaders assign work to individual members of the group, organize the work efforts, review data packages, and help solve analytical problems. In some cases, the Group Leader is assisted with these duties by senior technical members of the group.

An Organics Manager aids in coordinating the work effort between GC, GCMS, and the extraction lab. This manager also performs many of the same duties as a Group Leader in reviewing data packages, etc.

The Group Leaders and Organics Manager report to the Technical Director and the Lab Director. The Technical Director is responsible for the technical aspects of the lab including setting up new methods, solving analytical problems, and specifying methods. The Lab Director is responsible for administration.

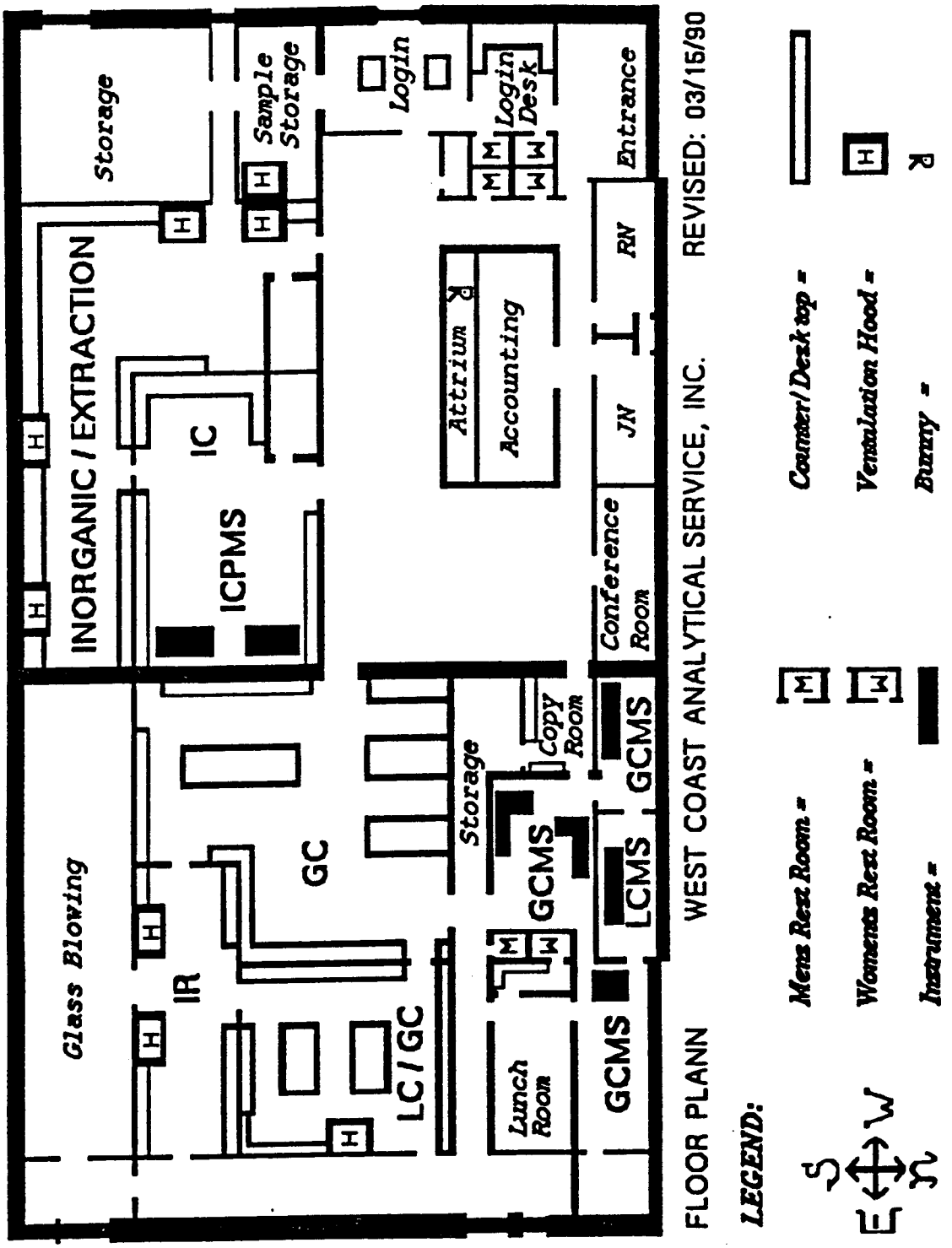
Both directors report directly to the President, as does the QA Coordinator. The President assists the Technical Director in the technical aspects of the operation. The President also acts as the QA Officer. The QA Coordinator's responsibilities are described further in Section 5.1. The President is responsible for setting and monitoring all Quality standards and updating the QAM.

2.2 Floor Plan

A new floor plan is given in Figure 2.2. The building is approximately 16,500 square feet (110' x 150'), including 1300 for GCMS, 1600 for GC and LC, 750 for ICPMS, 250 for IC/LC, 600 for Inorganic Prep, 1000 for Organic Extraction, 500 for IR, and 1000 square feet for Log-In/Sample Receipt. The remaining space is primarily office and storage space.

Figure 2-1. Organization Chart

Figure 2-2. Floor Plan



2.3 List of Services offered according to general classification.

a. Liquid Chromatography-Mass Spectrometry +EI, +CI, -CI, quadrupole sector 2000 amu range, thermospray, and particle beam interface.

b. Gas Chromatography-Mass Spectrometry (GCMS) positive ion electron impact and chemical ionization, quadrupole mass filter, capillary GCMS.

Environmental Analysis
EPA Priority Pollutant Analysis
Contaminant Analysis
Composition of Organic Mixtures
Pyrolysis GCMS
Organic Molecular Structure Determination
Solvent Composition
Industrial Hygiene Analyses
Air Pollution Analyses
Forensic Chemistry
Plastic and Coatings Analysis
Food and Flavor Analysis
Pharmaceuticals Analysis
Molecular Weight Determination (800)
Deformulation Analysis
Reaction Products

c. Gas Chromatography (GC)-packed and capillary GC with FID, TC, EC, Hall, thermionic N/P, and photo ionization (PID) detection.

Quantitative Analysis
Natural Gas and LPG Analysis
Environmental Analysis
EPA Priority Pollutant Analysis
Contaminant and Solvent Composition
Pesticide Residues
Deformulation
Industrial Hygiene Analyses
Pharmaceuticals Analyses
Combustion Products Analyses
Quality Control

d. Liquid Chromatography (LC) with variable UV/VIS and fluorescence detection.

Carbamate and Urea Pesticides
Pharmaceuticals
Polymer Additives
Environmental Analysis

e. Infrared Spectroscopy-Fourier Transform (FTIR)

Identifications of Plastics, Polymers and Coatings
Organic Structure Determination
Deformulation
Surfactant Identification
Quality Control
Oil and Grease

f. Inorganic

Trace Metals (ICPMS)
Anions (Selective Electrode)
Anions, Cations, Speciation (Ion Chromatography)

g. Other

WET Chemical Analysis
Consulting

h. Outside Laboratory Services

Elemental Analyses (CHNSX)
Nuclear Magnetic Resonance (NMR)
Emission Spectroscopy (ES)
Surface Analyses (SEM, ESCA, etc.)
Microbiological Analyses
Asbestos

2.4 Procedures

Routine methods are documented in WCAS Standard Operating Procedures (SOP) Manual. SOP's are revised periodically as needed; revision dates and summary of changes are documented in the preface to each SOP. The date revised and authorization by the Technical Director is also documented in the preface.

Where applicable the following documents are used to determine analytical procedures for testing.

a. American Society for Testing and Materials: Annual Standards. (ASTM)

b. U.S. Environmental Protection Agency: Manuals: EPA 600, SW846, etc.

c. American Public Health Association, American Water Works Association, Water Pollution Control Federation: Standard Methods for the Examination of Water and Wastewater.

d. American Pharmaceutical Association: National Formulary XIII. (NF)

e. The United States pharmacopeial Convention, Inc.: The Pharmacopeia of the United States of America (USP).

f. FDA Pesticide Analytical Manual.

g. The Association of Official Analytical Chemists: Official Methods of Analysis of the Association of Official Analytical Chemists.

h. California Air Resources Board and Air Quality Management Districts manuals.

i. State of California: LUFT Manual.

j. Military Specifications: (MIL-SPEC)

k. NIOSH and OSHA Manuals of Analytical Methods.

l. Other government specifications.

2.5 Confidentiality

Often during the course of business, we are privileged to data or information that is considered confidential or proprietary to our cli Such information includes results of their tests, origin of their sam the fact that we are working with them, any procedures or processes t they conduct or investigate, any information about them or their busi our own laboratory procedures, and clients. All such information mus kept strictly confidential. The information should only be discussed with people designated as technical contacts or purchasing agents for the particular project or corporate officers for the clients company. The information should not be discussed with anyone else, even people within a client's company not designated as a contact, without writte permission from the client.

Often we are contacted by government agencies or consultants hired by our clients. Without express permission, we may only discuss the tests generally such as procedures or QC limits, and then only if it is obvious from the conversation that they have a copy of the report. Any discussion of the origin of the samples, test results, or analytical problems requires written permission. Permission by the designated contact may be granted by phone if it is followed in writing.

3. Operational Procedures

3.1 Sample Receipt

Samples are received in the log-in area, where lab personnel are responsible for logging in the samples under the direction of the Sample Coordinator/Log-In Supervisor.

3.2 Chain of Custody

For all samples potentially involved in litigation (most environmental samples), Chain of Custody procedures are to be followed. All environmental samples delivered to the lab should have Chain of Custody records similar to Figure 3.2. This is necessary to preserve the security of samples. Samples are considered secure for evidentiary purposes if they are in your possession, within view, or in a secured area. The laboratory is considered secure because access during working hours is monitored and the laboratory is locked and armed with alarms (audible and silent) during non-working hours. The Chain of Custody record, Figure 3.2, is therefore used to document the change in possession from sampling, delivery, and receipt by the laboratory.

Each sample should be clearly identifiable. The condition of the sample/container and the presence/absence of custody seals should be noted. Signatures of parties changing custody as well as date and time should be documented on the form. Clients may have forms of their own. Use our form (Figure 3.2) if the client does not have such a form.

3.3 Sample Log-In: The Master Log

A Master Job Log is maintained at the log-in desk. The following information is put in the log to initiate a job.

1. Initials of person receiving/logging in the job.
2. Date received.
3. How samples were delivered to the laboratory, i.e., Customer (designating the sample as having been delivered by an employee of the client) or specific agent (U.S. Mail, UPS, Fed Exp., etc.)
4. Assigned job number (number stamp is used).

Figure 3.1 Job envelope

QUOTED TAT _____ Job No. _____

Date Rec'd _____

Company _____	P.O. No. _____
Address _____	Proj. Name _____
	Date Sampled _____
	Retainer $_____
Technical Contact _____	Check No. _____
Phone _____ FAX _____	Credit Apprv'd _____

WEST COAST ANALYTICAL SERVICE, INC.
[illegible]

GROUP	NO.	ANALYSIS DESCRIPTION	PRICE/SAMPLE	EXTENSION
GCMS				
GC				
IC				
ICPMS				
IR				
LC gsc				
LCMS				
MISC/ WET				
O/S Lab				

TOTAL INVOICE AMT $_____

Samples in Fridge No. _____ On dry shelf _____ Air bag area _____

SAMPLE DESCRIPTION/NOTES:

Report date _____ Disposition _____

Chain of Custody copy with invoice [ ] Invoice date _____

A/P instructions enclosed [ ] Invoice no. _____

Additional notes/phone conversations:

CHAIN OF CUSTODY RECORD

COMPANY _____
ADDRESS _____
_____
PHONE NO. _____ FAX _____
MAIL REPORT TO: _____

PROJECT MANAGER _____
PROJECT NAME _____
PROJECT NO. _____
PURCHASE ORDER NO. _____

WEST COAST ANALYTICAL SERVICE, INC.
9840 Alburtis Avenue
Santa Fe Springs, CA 90670
(310) 948-2225 Fax (310) 948-5850

COMMENTS:

If sample is liquid & has sediment or particulate should we:
_____ test filtrate only?
_____ mix sample by shaking?
_____ test particulate only?

If sample is multi-phased, should we:
_____ test each phase separately?
_____ test only ONE phase? Which phase?
_____ mix all phases by shaking, if possible?

Sample I.D. #	Date Sampled	Time Sampled	Preservative	MATRIX: soil	MATRIX: water	MATRIX: air	MATRIX: other	# of containers	8015 Modified Gas Diesel	Total Petroleum Hydrocarbons 418.1	Halo. Volatiles 601/8010	Aromatic Volatiles 602/8020	Volatile Organics 624/8240	Semi-Volatile Org 625/8270	Chlor Pest/PCB 608/8080	Herbicides 615/8150	CAM (17) Metals	TCLP Metals	STLC Metals	Hex Chrome EPA 218.6	CARB 425/Total & Hex Chrome	CARB 436 Multi-metals						RUSH	Remarks

Relinquished by:	Company	Date/Time	Received by:	Company	Date/Time
Relinquished by:	Company	Date/Time	Received by:	Company	Date/Time
Relinquished by:	Company	Date/Time	Received by:	Company	Date/Time

NOTE: Samples are discarded 30 days after date of final report.

White Copy - WCAS • Yellow - Report • Pink - Client

WCAS Job No. _____

Figure 3.2 Chain of Custody

5. Customer's company name.

6. Number of samples and description of work requested.

7. Name of individual to whom work is assigned.

8. Invoice date.

9. Invoice No.

10. Disposition of samples after the analyses are completed, i.e., consumed in test, stored, returned to customer via, etc.

11. "Remarks" column for any other special entries. The same information is put into a computerized data base for job tracking.

3.4 The Job Envelope, Job Number, and Distribution.

Concurrent with entering the above information into the Master Log, a job envelope is prepared which will ultimately contain all information, data, and results connected with this job. The job envelope, as shown in Figure 3.1, has space on the face of the envelope for the following information:

1. Job number.

2. Customer name and address.

3. Date and time sample was received.

4. Technical Contact - to whom the report will be addressed.

5. Phone number of Technical Contact.

6. Purchase order number.

7. Report date.

8. Invoice number and date.

9. Disposition of the sample.

10. Entries for number and types of analyses & charges.

11. Space to indicate if quote and P.O. are enclosed.

A sequential job number corresponding to the entry number in the Master Log is placed on the job envelope and on each of the sample containers associated with this job. All subsequent reference to the sample is made first by this job number, and then by the customer identification. After checking in the samples, logging the job, preparing the job envelope and tagging the samples, the samples are placed in the appropriate storage location and the job envelope is placed in the lab in the numerical job file.

The jobs are assigned, at the time of the log-in, to the group or groups that will be responsible for performing the work. The individual to whom the job is assigned will then check the samples and make sure that all the information necessary for job completion is present. He/she contacts the customer when necessary to complete this information.

Once the job information is placed in the Master Log, similar information is entered into the WCAS Job Tracking computer network.

Designated Group Leaders schedule work for their groups and assign members of their groups to various jobs. Analysts frequently print out a listing of outstanding jobs from the Job Tracking computer network.

The analysts, performing the actual analysis, log the analytical runs into a log book specific to the instrument or area of work. For example, each chromatograph has a book used to log each productive injection (standards, calibrations, blanks, samples, etc.). These books are used to log the following information about the analytical run:

1. Instrument log run number.
2. Job number.
3. Customer.
4. Sample Identification.
5. Date.
6. Analysts name.
7. Other pertinent information.

Similar books are used for all instruments. Special lab notebooks are used to document sample preparation.

After work is complete, the results and report are assembled by the analyst and checked by the Group Leader. The rough draft of

the report, data, and job envelope are passed on to the typist.

In many cases, analysts prepare the report drafts using programs on computers attached to the network. The analyst can enter a complete status and the file name of the draft report into the Job Tracking network described in Section 3.6.

Samples are put into storage or returned to the customer via the Sample Coordinator. The final report and invoice are prepared by the lab secretaries. The reports are reviewed and signed by the a Senior Chemist (or higher), Technical Director, and/or President.

3.6 Job Tracking

From the WCAS Job Tracking computer network, periodic outstanding job lists are prepared and reviewed with each group. An end-of-the-month reconciliation is done between the WCAS Job Tracking computer network and the Master Log Book. Sample result files for the final report are integrated into this data base. A hierarchy of security measures is password protected. Only certain staff members are allowed access to make changes, corrections, or approve reports.

3.7 Storage of completed samples, reports, data and job envelopes.

Samples are returned to the customer or stored for up to 30 days. If it becomes necessary to dispose of the samples because the client cannot take them back, samples containing hazardous materials or having hazardous characteristics are disposed according to the Hazardous Waste SOP. Reports are filed alphabetically according to customer name. Job envelopes are filed numerically. Data Packages are filed by analysis and instrument, chronologically. Hard copies of such information are kept on site for 2 years, and may be kept for an unspecified time off site. Data for jobs known to be involved in litigation are kept in a separate file until we are notified otherwise by the attorney, or for seven years for an in-active file.

4. Laboratory Equipment Summary

4.1 Organic Analysis: GC, GCMS, LC, LCMS, FTIR

Equipment	Number	Mfg/Model	Accessories
GCMS (Gas Chromatography-Mass Spectrometer)	4	Finn 5100 (3/85) Finn 4500 (9/86) VG Trio 1 (6/89) VG Trio 1000 (5/91)	+/-EI & +/-CI Capillary HP Autosampler-7673 Gas Sampling
GC/LC/MS (GC-Liquid Chromatography-MS)	1	Extrel ELQ 400 (7/88)	Thermospray ThermaBeam Waters 600MS LC Programmable UV/Vis
GC *	13	Varian 3700 (6) 6000 (1) 6500 (1) 3400 (4) Hewlett Packard 5890	FID(7), TCD, ECD(9), N/P Thermionic Detector(2), Hall Detector(4), Photo-ionization Dtr.(5) Autosamplers (8) Gas Sampler
Purge and Trap	10	Tekmar LSC 3 (3) LSC 2 (2) LSC 2000 (5)	Fritted and Needle Sparge ALS 2050 ALS 2016 (4)
FTIR (Fourier Transform Infrared Spectrometer)	1	Nicolet 44	ATR, Gas and Liquid Cells
LC	3	Dionex 2010 Spectra Physics Waters 600MS	Variable UV/VIS Fluorescence Scanning UV/VIS Post Column Reactor

* GCid#8 (Varian 3400, 7/87) is the primary CLP-Pest GC and GCid#2 (Varian 3700, 4/84) is the back-up.
All GCMSs and the GC/LC/MS will be used for CLP work; installation dates are in parentheses.

4.2 Inorganics Analysis: ICPMS, IC, etc.

Equipment	Number	Mfg/Model	Accessories
ICPMS Inductively Coupled Plasma/ Mass Spectrometry	2	VG Instruments PQ2TurboPlus Fisons/VG PQ2 Turbo STE	Autosampler (3) HP Plotter Peristaltic Pump (4) Flow Injection Pump Hydride Generator Corrosion Resistant Nebulization Sys. (2)
Mercury Analyzer	1	Jerome Cold Vapor/Gold Film Analyzer Model 511	
Ion Chromatography	2	Dionex 2010i	Auto Sampler (2) Conductance Detector Variable UV/Vis Det.
Ph Meter	2	Altex 70 Orion 720A Orion 520A	Selective Ion Electrodes Cyanide Fluoride
UV/VIS Spectrophotometer		Sequoia Turner 340	
Grinder/Pulverizer		Spex 8000	
Tissue Grinder			
Microwave Digestion Sys.		CEM Corp. MDS-2000	Pressure/Temp. Probe Open Vessel Carousel
Specific Conductance		Markson	
BOD		Hach	DO Meter, VWR Incubator
Reacti-Term Evap.	2	Pierce	
Programmable Hot Plate/ Block Digester		PMC 730 (2)	
Turbidometer		Hach 2100A	
COD Reactor		Hach	
Micro-Distillation		Lachat	

4.3 Other Equipment

Equipment	Number	Mfg/Model	Accessories
Sonifier	2	Branson 350(1) Branson 250(1)	Ultrasonic Cell Disrupter
Muffle Furnace	1	Thermolyne Type 48000	
Ovens	5	Scientific Products(2) Pacific Combustion VWR Convection(2)	
Pyrolysis Unit	1	CDS Pyroprobe 100/382	Extended Pyroprobe
Oscilloscope	3	BK 1522(1) Tektronix 2235(1)	
Electronic Balance	11	Mettler AE100 Sartorious 1265MP Sartorious 1202MP Sartorious L310 5 Ohaus Metler AE240 (semi-micro) Metler PJ3000	
Dew Point	1	Alnor 7000	
Flash Point	1	GCA Closed Cup	
Centrifuge	1	IEC/UV	
Steam Baths	2	Boekle	
Rotary Evaporator	2	Yamato	
Rotory Extractors for WET, EPTox, and TCLP	3	Anal. Testing (2) Other (1)	ZHE (18)
Pressure Filter	1	Millipore	
Chillers, Recirc.	9	Neslab (6) VWR (3)	

4.4 Computers and Data Systems

Equipment	Mfg/Model	Accessories
Instrument Data Systems:	Finnigan Incos (4)	70 MB disks Tape Streamers
	Varian 654 (2) Spectra Physics (3) Dionex (4)	30 MB Hard Disk
	Fisons Lab-Base (2)	210/340 MB H.D. w/ Jumbo 120 MB Tape Drive
Computer Network Operating System	Novell Netware Version 3.11	
Network Electronics	SMC Elite 3512TP 10Base-T Concentrators (2) SMC Elite16 10Base-T EtherCard Plus (30)	
Workstations	assorted 286 and 386 PCs (30)	
File Server	Dell 486/ME, 16MB RAM, 650MB H.D.	
Network Printers	HP LaserJet 2686D, HP LaserJet IIID	

5. Laboratory Quality Control

The quality control program consists of both internal and external checks on precision and accuracy of analytical results. The responsibility for maintaining the program rests with the President and the QA Coordinator.

5.1 Quality Assurance Coordinator

In 1988 the staff position of Quality Assurance Coordinator was created to aid in maintaining the Quality Control Program. The mission of the QA coordinator, who reports directly to the President, is to develop and maintain a QA database for recording data on duplicates, spikes, and laboratory control standards. Periodically he will revise QC limits based upon historical data, create summaries of data on control charts for group leaders and the Technical Director, aid in revising the QA Manual and setting QA policies, and work with each group to facilitate the collection and reporting of QA data. He is also responsible for performing periodic data package audits.

5.2 Internal Quality Control

A hard bound log book is maintained for each instrument (Section 3.4). This log book is used to document the analysis of each sample, standard, and blank. The log book is also used to record calibration and maintenance information. These logs are reviewed periodically by the Technical Director.

Duplicate and spiked samples as well as standards and blanks are logged separately into the log book. Generally, 5% of the incoming samples are split and analyzed in duplicate (including sample preparation) to yield data on the precision of the analysis. These same samples are also analyzed as matrix spikes for determining accuracy. This is described in more detail in Section 5.4. Method Blanks are prepared and analyzed with each batch of samples. Standard Reference Materials are routinely used as Laboratory Control Standards (LCS).

In the statistical analysis of data for precision and accuracy, warning and control limits are set using 2 and 3 standard deviations (S.D., n-1) respectively. The use of data outside of warning limits is at the discretion of the Group Leader. If the data shows that the error may cause an erroneous conclusion because of its nearness to a critical or regulatory limit, the source of error should be corrected and the analysis repeated. The use of data outside control limits shall be at the discretion

of the Technical Director depending on the needs of the client. Precision and accuracy data from duplicates and spikes and data from laboratory control standards are archived in a QC database written in D-Base III. Control Charts are plotted for up to 20 of the latest data points. QC limits are taken from the last 100 data points after discarding points outside 2 SD.

When large numbers of samples are analyzed, a standard is repeated frequently. In cases where sample preparation is required, prep data for each job is recorded in a special laboratory workbook or worksheet. This book has duplicate pages so that the original is kept in the workbook while a carbon copy is placed in the job envelope when the analyses are completed. Worksheets are placed in the job envelope.

More specific information on the Quality Control Programs can be found in Standard Operation Procedures (SOPs) and Methods.

5.3 External Quality Control Programs

The laboratory participates in:

California Department of Health Services
- Environmental Laboratory Accreditation Program (ELAP) (formerly the Approved Water and Hazardous Waste Testing programs)

Environmental Protection Agency (EPA)PE programs
- Water Supply (WS)
- Water Pollution (WP)

National Institute of Occupational Safety and Health (NIOSH)
- Proficiency in Analytical Testing (PAT) program administered through the American Industrial Hygiene Association (AIHA)

U.S. Geological Society

5.4 Precision and Accuracy in Quality Control

As a general QC procedure replicate analyses are performed for determining precision and spiked samples are analyzed to determine accuracy. Warning limits are set at 2 S.D. (95% Confidence limits) while control limits are set at 3 S.D. (99% Confidence limits). Standards are routinely repeated during analysis to ensure instrument calibration.

Precision is the measure of the repeatability of an analysis. It is determined by replicate analysis and can be expressed as the relative percent difference (RPD) of a set of duplicate results.

$$RPD = | X1 - X2 | * 100 / \bar{X}$$

where X1 and X2 are the results for the duplicates

$\bar{X}$ is the mean of the two results

Accuracy is a measure of the nearness of a result or the mean of a set of results to the true value. It can be expressed as recovery from a spiked sample. After the sample has been analyzed in duplicate to determine a mean concentration, the sample is spiked to approximately double the mean concentration and reanalyzed. Recovery is then calculated as;

$$\% \text{ Recovery} = (S - \bar{X}) * 100 / T$$

where S = analytical value determined after spiking

$\bar{X}$ = analytical value before spiking

T = theoretical value of spike

An example of how precision and accuracy data are used is as follows: A set of 15 water samples are submitted for routine analysis for organochlorine pesticides. One sample from this set is selected for duplicate analysis. Two aliquots of this sample are analyzed. The results of this set of duplicates are compared to previous laboratory data which shows that the relative standard deviation for past replicates of this approximate concentration is 6%. If the RPD of the duplicates is larger than 12% (within 2 S.D.), the set of results are suspect. The method and results are critically reviewed to determine if a problem encountered must be corrected. The sample which has been analyzed in duplicate is then spiked with the parameters of interest to double the concentrations. Previous laboratory data has shown that mean recovery of organochlorine pesticides from this type of sample is 95% with a standard deviation of 5%. The warning limits are therefore 85 - 105%. The recovery of this particular sample is therefore used to judge the validity of the set of results as

outlined above. If precision or accuracy measurements are outside of the warning limits, the group leader must be notified and the analytical problem corrected. This set of samples can then be repeated. If any QC parameter is outside of the Control Limits, ± 3 SD, the Technical Director must be notified.

The analysts are directly responsible for quality control during analysis. Many data reduction schemes involve Lotus 123 spreadsheets. Each of these incorporates forms for documenting QC results from duplicates, spikes, and LCS samples. The forms compare the experimental results with warning and control limits, and flag the results if they are outside these limits. These forms feed data into the QC data base. Group Leaders and other supervisors review these forms in the data packages. The analysts are responsible for alerting their supervisors of outliers, finding and correcting the problems, and reanalyzing samples if necessary. In this way the QC program identifies and corrects analytical problems as they arise. This type of program is in contrast to programs that only have review of QC results by parties not involved in the analysis. The latter types of programs suffer from a delay in alerting lab personnel to QC problems.

Quality Control charts are useful in indicating trends or problems which may be developing. Periodically the QA Coordinator will print control charts from the data base.

5.5 Control Charts

Control charts are useful in following trends in analytical precision and accuracy and identifying problem occurrences. In general, a parameter of known value is measured periodically during a sample set, and its measured value is compared with its theoretical value. From a number of such measurements, a standard deviation (SD) can be calculated. Acceptance windows for this measurement can then be set, typically at 2 SD. Data can then be plotted on a graph with the measured value on the Y-axis and the sample sequence on the X-axis. The acceptance or warning limits are shown in the graph as dotted lines extending from the Y-axis representing the X ± 2SD, when X is the mean of several measurements.

As an example, the following data set was taken from the analysis of 100 charcoal tubes for benzene. One sample out of every 10 was spiked with 10ug benzene and the percent recovery calculated.

Sample	Benzene % Recovery
A	103
B	96
C	98
D	100
E	107
F	101
G	98
H	102
I	105
J	101

The mean and standard deviation were calculated and found to be:

$$\bar{X} = 101.1$$
$$SD = 3.35$$

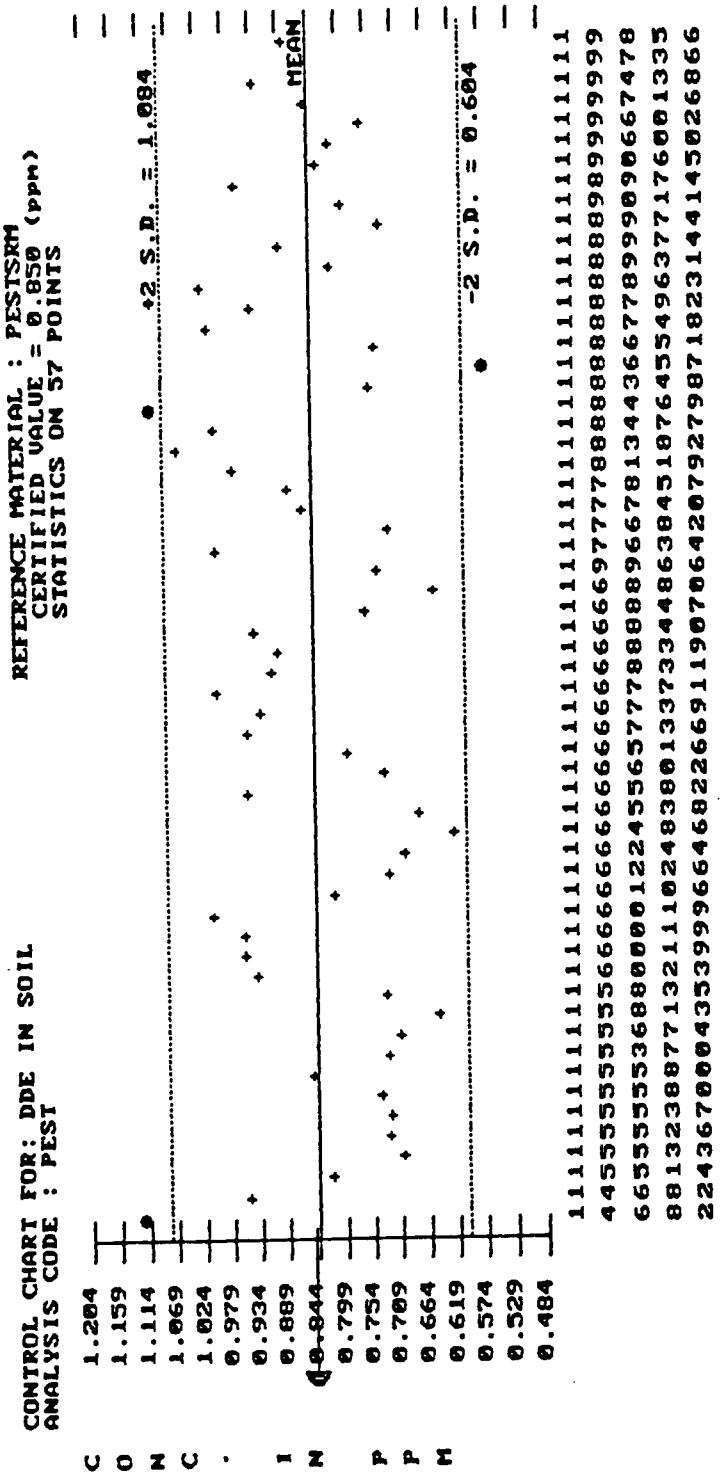
This data can then be used to prepare a graph showing the measurements and how they compare to the warning limits ($\pm$ 2/SD). If any of the data fall outside the warning limits, this would mean that the analytical data may have abnormally large errors, and that some of the samples may need to be re-analyzed. The warning limits determined by this set of 10 spikes can then be used to judge the acceptance of future spiked samples by adding their results to the graph. When significantly more data is gathered, the control limits should be recalculated based on all data.

Periodically the QA Coordinator generates control charts and reviews the QA data base. An example is shown in Fig. 5.3.

5.6 Corrective Action

SOPs and Appendix B outline specific corrective action steps and policies. Whenever an out of control situation has been detected, the analyst should notify his supervisor and together try to find and solve the problem which caused the situation. After fixing it, the analyst should continue with the corrective action steps to bring the analysis back in control. Usually this means re-preparing and/or re-analyzing the samples. When sample or time limitations (Rush work) preclude correcting the situation, discuss it with the Technical Director and notify the client by phone, and flag the out of control data.

Figure 5.3 Control Chart



5.7 Laboratory Control Standards (Reference Materials)

WCAS uses standard reference materials from NBS, EPA, and other sources to check the accuracy of analysis. Some of the reference materials used are listed in Table 5.2. These materials are used to routinely check analysis using control limits from previous data.

Table 5.2 Standard Reference Materials

NBS 1643b	Trace Metals in Water
NBS 1645	River Sediment (for Trace Metals)
NBS 1646	Estuarine Sediment (for Trace Metals)
NBS 1084	Wear-Metals in Lubricating Oil
NBS 1583	Chlorinated Pesticides
NBS 1633	Coal Fly Ash (for Trace Metals)
NBS 2713	Lead in Reference Fuel
NBS 4350	River Sediment (Trace Metals)
NBS 679	Brick Clay (Trace Metals)
NBS 4354	Lake Sediment (Trace Metals)
NBS 2704	Buffalo River Sediment (Trace Metals)
NBS 1572	Citrus Leaves
NBS 1577a	Bovine Liver
NBS 1549	Non-Fat Milk Powder
NBS 981-3	Lead Isotopes
EPA	WP and WS samples
EPA	Trace Metals in Fish
EPA	PCBs in Oil
USGS	Trace Metals and others
WCAS	Volatile Organics
WCAS	Volatile Organics in Gas
WCAS	Herbicides
WCAS	Semi-Volatiles
DORM-1	Dogfish Muscle from Canadian Ref. for trace metals and methylmercury

5.8 Data Packages, Data Review, and Audits

Raw data is assembled with QC summaries into data packages by the analysts. A face page summarizing the contents of the data package and any problems is signed by the analyst and a supervisor after the data has been reviewed. This package contains the face page, a copy of the instrument run log, QC summaries such as internal standard recovery, calibration, LCS, duplicate and spike results, blanks, raw data, and QA Action Forms. The

data packages are then filed by instrument, date, and analysis type.

At least 1% of all data packages undergo an independent audit by the QA Coordinator. Periodic audits are also conducted by the President and the Technical Director. The QA Coordinator submits the summary of his data package audits to the President for his review on a monthly basis. The President then will initiate any corrective action required to comply with Quality Standards, generally involving the Technical Director, Group Leader, and analysts.

Forms for the data package Signature Page, QA Action Form, and Audit Summary are at the end of Appendix B. The Quality Assurance system of QC procedures, preset QC limits, review of data packages, and approval of reports is designed to catch errors and problems prior to data being reported to clients. However, when corrective action affects previously reported data, the client is notified in writing describing the problem and resolution.

APPENDIX

Appendix A	Resumes: Jim Bonde Isabelle Gundran Craig Hechanova B. Michael Hovanec Jeff Jordan Rex Morris Todd Munoz Dewey Northington Ramona L. Northington Bettina Oelke Noemi Portillo Greg Shaw Michael Shelton Shelley Stuart
Appendix B	SOP for Quality Control
Appendix C	SOP for Legal and Forensic Jobs
Appendix D	Requirements for Special Programs
Appendix E	Job Descriptions

RESUME

JAMES E. BONDE
Senior Chemist

EDUCATION
B.S., Biochemistry, 1973, California State University - Fullerton, Fullerton, CA.

EMPLOYMENT HISTORY

Senior Chemist 1984-Present	West Coast Analytical Service, Inc., Santa Fe Springs, CA. Responsible for GC analysis.
Analytical Chemist 1980-1984	It Analytical Service, Cerritos, CA. Responsible for GC analysis.
Chemist 1979-1980	Humko Products, Buena Park, CA. Responsible for chemical testing of various food products using classical wet chemical methods and gas chromatography.
Food Inspector 1976-1979	United States Department of Agriculture, Long Beach, CA. Responsible for inspection of meat products, sanitation and quality control of various food processing plants.
Manager 1973-1976	Bradbury-Robb, Los Angeles, CA. Responsible for sales, purchasing, and shipping/ receiving.

Mr. Bonde has expertise in the GC and GCMS analysis of a variety of different sample types, including environmental samples, gases, and industrial hygiene samples using various specific detectors with packed and capillary columns. He has also developed methods for analyzing a variety of samples by GC.

ADDITIONAL TRAINING

Varian Liquid Chromatography, Varian Inc., 1989.

James Bonde
Signature

2-24-93
Date

JB
Initials

RESUME

ISABELLE GUNDRAN
Chemist

EDUCATION
B.S., Chemistry, 1973, National University, Manila, Philippines.

EMPLOYMENT HISTORY

Chemist 1989-Present	West Coast Analytical Service, Inc. Santa Fe Springs, CA. Responsible for performing 601/602 analysis, drinking water, and gas analysis.
1986-1989	Responsible for FTIR, wet chemistry, and inorganic analyses.
Chemist 1977-1986	Oil Well Research, Inc. Responsible for AA, GC, IR analyses of wastewater, oil and gas samples.

ADDITIONAL TRAINING

Chromatography, WCAS, 1989.

Isabelle G. Gundran — Signature

2-24-93 — Date

I.E.G. — Initials

RESUME

CRAIG HECHANOVA
Analytical Chemist

EDUCATION
B.A., Chemistry, 1984, University of California, Santa Barbara, CA.

EMPLOYMENT HISTORY

Analytical Chemist 1991-Present	West Coast Analytical Service, Inc. Santa Fe Springs, CA. Responsible for ICPMS sample preparation and analysis.
1989-1990	GC Group Leader responsible for supervising GC group.
1988-1989	Responsible for GC analyses by EPA methods 601,602, and 608.
Chemist 1985-1988	IT Corporation, Cerritos, CA., Responsible for preparation and analysis of solid and liquid samples for trace organics by GC using EPA methods 608 and 8080, primarily for analysis of pesticides by PCB's.

Mr. Hechanova is an Analytical Chemist with expertise in preparation of solid and liquid environmental and industrial samples for minor and trace organic constituents as well as a variety of physical and chemical properties. His analytical laboratory expertise includes GC, column chromatography, titrations and sample preparations according to CLP and EPA methods.

ADDITIONAL TRAINING

Chromatography, WCAS, 1989.

ICP-Mass Spectrometry SI-8,9,10, Plasma Spec Winter Conference, 1992.

Craig Hechanova
Signature

2/23/93
Date

CH
Initials

RESUME

B. MICHAEL HOVANEC
Senior Staff Chemist
Project Manager

EDUCATION
B.A., Chemistry, 1975, University of California - Riverside, Riverside, CA., Major emphasis in analytical instrumentation. Certificate in Hazardous Materials Management, 1990, University of California - Irvine, Irvine, CA.

EMPLOYMENT HISTORY

Senior Staff Chemist	West Coast Analytical Service, Inc. Santa Fe Springs, CA.
1992-Present	Project Manager ICPMS and Air Toxics
1990-1993	Group Leader ICPMS
1989-1990	LCMS Research responsible for Particle Beam and Thermospray Methods Development.
1986-1989	Group Leader inorganic section: ICPMS, AA, IC and wet chemistry.
Sr. Analytical Chemist/Engineer 1980-1986	Rockwell International (Semiconductor Products Division), Newport Beach, CA. Provided technical support to various internal divisions in the areas of semiconductor problem solving, Space Shuttle tile adhesion system modification and characterization, environmental methods development and implementation, as well as laboratory design and equipment purchase.
Sr. Chemist Group Leader 1978-1980	West Coast Technical Service, Inc. (Division of IT Corporation), Cerritos, CA. Responsible for the mass spec group. Analyzed microcircuit cavities, high purity gases, and polymer off-gassing.
Chemist 1977-1978	Lever Bros., City of Commerce, CA. Responsible for monitoring the manufacture of detergents, edible oils and margarines.
Jr. Chemist 1976-1977	Industrial Polymers, Inc., Cucamonga, CA. Responsible for formulation of various isocyanate polymers and hybrids.

B. Michael Hovanec — Signature

2/23/93 — Date

BMH — Initials

Mr. Hovanec has seventeen years of analytical experience in the areas of trace metals, polymers, semiconductor materials, light sensitive organics, and ultra pure water systems. His analytical chemistry background includes GCMS, GC, LC, LCMS, MS, Thermal Analysis, AA, ICP, ICPMS, IR/FTIR, IC, UV/VIS and SEM/EDAX. He is an expert in GCMS, ICPMS, and LCMS analysis. He has extensive electronics experience in maintaining and trouble shooting many systems at the component level. Mr. Hovanec's current research interests are in ICPMS and Hyphenated ICPMS techniques.

ADDITIONAL TRAINING

ICP-Mass Spectrometry I,II,III, Plasma Spec Winter Conference, 1987.

Lab Application of 1-2-3 etc: Beyond the Basics, ACS Short Course, 1988.

VG Instruments ICPMS PlasmaQuad Electronics Maintenance Course, 1988.

Finnigan MAT Institute, INCOS 50 GC/MS Data Systems Course, 1989.

ICP-Mass Spectrometry SI-8,9,10, Plasma Spec Winter Conference, 1992.

PRESENTATIONS AND PUBLICATIONS

D.J. Northington & B.M. Hovanec, "ICPMS Analysis of Reference Materials," Rocky Mountain Conference, 1987.

D.J. Northington & B.M. Hovanec, "Analysis of Environmental Reference Materials using ICPMS," Winter Conference on Plasma Spectrochemistry, 1988.

B.M. Hovanec, "Particle Beam LCMS in Environmental Analysis," Fifth Annual Hazardous Material Management Conference/West, HAZMAT/West, 1989.

D.J. Northington, B.M. Hovanec, & M. Shelton, "Particle Beam LCMS in Environmental Analysis," 28th ACS Pacific Conference, Pasadena, CA., 1989.

D.J. Northington, B.M. Hovanec, & M. Shelton, "Finnigan INCOS Data System," WCAS, 1989.

D.J. Northington, B.M. Hovanec, & M. Shelton, "Particle Beam LCMS in Environmental Analysis," Am. Environmental Lab, 10/90, 34-41 (1990).

B.M. Hovanec, "Hazardous Substance Chemistry," California State University, Long Beach, University Extension Services, Instructor 1992-Present.

RESUME

JEFF JORDAN
Chemist

EDUCATION
B.S., Microbiology, 1984, California State University - Long Beach, Long Beach, CA.

EMPLOYMENT HISTORY

Chemist 1988-Present	West Coast Analytical Service, Inc. Santa Fe Springs, CA. Responsible for analyzing samples using IC and HPLC including Anions, Cations, and Hexavalent Chromium, Carbamate Pesticides, etc.
Analyst 1986-1988	Applied Microbiological Services, Inc., Signal Hill, CA. Performed various microbiological and chemical testes on ultra-pure and city water including Direct Epifluorescent Microscopy, Ion Chromatography and Total Organic Carbon.
Quality Control Microbiologist 1985-1986	Gregg Foods, Garden Grove, CA. Performed standard microbiological tests for all products produced.
Laboratory Technician 1984-1985	Allergan Pharmacuetical, Inc. Irvine, CA. Assisted in chronic and sub-actue research and development studies related to eye and skin care products.

Mr. Jordan is an expert in the analysis of organic and inorganic anions as well as hexavalent chromium using ion chromatography. His experience also includes numerous LC analyses, including carbamates, aldehydes, glyphosate, PAH's, TDI, MDI, Diquat and acrylamide; as well as an extensive number of wet chemistry techniques relating to the analysis of water and soil.

ADDITIONAL TRAINING

Chromatography, WCAS, 1989.

Jeff Jordan
Signature

2/24/93
Date

JJ
Initials

RESUME

REX MORRIS, Ph.D.
Quality Assurance Coordinator

EDUCATION
Ph.D., Analytical Chemistry, 1977, Iowa State University, Ames, IA.
M.S., Organic Chemistry, 1971, Oklahoma State University, Stillwater , OK.
B.S., Chemistry, 1969, Oklahoma State University, Stillwater, OK.

EMPLOYMENT HISTORY

Quality Assurance Coordinator 1993-Present	West Coast Analytical Service, Inc. Santa Fe Springs, CA. Develops and maintains a QA database for recording data duplicates, spikes, and laboratory controls and standards. Works with the technical director in revising the QA Manual and setting QA policies. Works with analytical groups to insure the collection and reporting of QA data. Performs QA audits on data packages.
Senior Staff Chemist 1991-1993	Responsible for trace metals analysis using ICPMS.
Research Associate 1977-1991	UNOCAL Science and Technology Research Center., Brea, CA. Responsible for the Thermal Analysis Unit operations including DSC, TMA, TGA, DTA, HP-DSC, HP-TGA and TGA/MS, Network LAN administrator, instrument repair, computer interfacing, methods development in NMR, ESR, UV/VIS, FTIR, Raman and MS.

Dr. Morris is an expert in thermal analysis, many spectrochemical fields, as well as mini and PC computer systems and LAN's. He has worked in such diverse fields as environmental analysis, catalysts, polymers, agricultural chemicals, lubricants, fuels, coal, ceramics, oil shale and oil field problems. He is experienced in instrument repair as well as instrument interfacing with computers and computer networking.

Signature	4/8/93 Date	Initials

RESUME

TODD P. MUNOZ
Chemist

EDUCATION
B.A., Biology, 1991, California State University - Fullerton, Fullerton, CA.

EMPLOYMENT HISTORY

Chemist 1992-present	West Coast Analytical Service, Inc. Santa Fe Springs, CA. Resonsible for ICPMS sample preparation.
Chemical Analyst 1990-1992	Golden West Refining Company. Santa Fe Springs, CA. Organized and managed chemical analysis of wastewater, read and interpreted results, led certification process for mercaptans in wastewater.

Mr. Munoz is an analytical chemist with experience in preparation of solid and liquid environmental and industrial samples for minor and trace organic consitituents as well as a variety of physical and chemical properties. His analytical laboratory expertise includes mercury analysis by cold vapor/gold film absorption and sample prep for ICPMS using microwave digestion, traditional acid digestions and leaching methods. Additionally, Mr. Munoz is experienced in the analysis of wastewater using traditional wet chemistry and spectrophotometric methods.

Todd Munoz
Signature

3-9-93
Date

TM
Initials

RESUME

DEWEY J. NORTHINGTON, Ph.D.
President

EDUCATION
Ph.D. Organic Chemistry, 1970, University of Florida, Gainesville, FL.
B.S., Chemistry, 1967, Louisiana State University, Baton Rouge, LA.

EMPLOYMENT HISTORY

President/ Technical Dir. 1984-Present	West Coast Analytical Service, Inc. Santa Fe Springs, CA. Responsible for operation of the laboratory.
Technical Dir. 1974-1984	IT Analytical Services, (previously West Coast Technical Service, Inc.) Cerritos, CA. Responsible for directing the laboratory, quality control, safety, contracts and proposals.
Sr. Research Scientist 1972-1974	Carnation Company, Van Nuys, CA. Responsible for basic and applied research in food, flavor, and analytical chemistry, developing GC, LC, and GCMS techniques.
Postdoctoral Fellow 1971	Syva Research Institute, Palo Alto, CA. Conducts basic research in organic photochemistry, exploring the chemistry of photochemically sensitive protective groups.

Dr. Northington is an expert in trace organic analyses, especially GCMS, GC, LC, MS, MNR, ICPMS, and IR. His experience extends from AA, emission, X-Ray analyses, surface analysis techniques, and computers, to lab automation. For several years he has been directing work done under contract with EPA. These programs include GCMS, GC, LC, ICPMS, and AA analysis of soil, water, wastewater, chemical wastes, and other environmental samples, methods development and validation, and quality control. He also has experience in the fields of industrial hygiene, chemistry, landfill gas recovery, pesticides, hazardous wastes, and air and water pollution. He is responsible for the QA program and certification of the laboratory by AIHA, California DOHS, and others.

Dr. Northington's current research interests include ICPMS and LCMS.

DJNorthington	2-23-93	JN
Signature	Date	Initials

ADDITIONAL TRAINING

Finnigan INCOS GCMS Data System, Finnigan Corp., 1977.

Statistical Approach to Industrial Hygiene Sampling and Analysis, American Industrial Hygiene Association (AIHA), 1978.

VG PlasmaQuad Operators Course, VG Elemental, 1981.

Liquid Chromatography-Mass Spectromety, American Chemical Society (ACS), 1988.

PUBLICATIONS AND PRESENTATIONS (since 1987)

D.J. Northington & B. M. Hovanec, "ICPMS Analysis of Reference Materials," Rocky Mountain Conference, 1987.

D.J. Northington, "Inductively Coupled Plasma-Mass Spectrometry for the Analysis of Metals on Membrane Filters," Am. Ind. Hyg. Assoc. J., 48, 977-979 (1987).

D.J. Northington, "Chromatography," WCAS, 1989.

M. Shelton, & D.J. Northington, "Determining Total Organic Lead in Waters and Soils by ICPMS," ACS Pacific Conference, Pasadena, 1989.

D.J. Northington, B.M. Hovanec, & M. Shelton, "Finnigan INCOS Data System," WCAS, 1989.

D.J. Northington, "Particle Beam LCMS Analysis of Pesticides," California Dept. of Food and Agriculture Conference, 1989.

D.J. Northington, B.M. Hovanec, & M. Shelton, "Particle Beam LCMS in Environmental Analysis," Am. Environmental Lab, 10/90, 34-41 (1990).

D.J. Northington, "Introduction to ICPMS," Environmental Tutorial, ALEX Conference, November 1992.

D.J. Northington, "Hazardous Substance Chemistry," California State University , Long Beach, University Extension Services, Instructor 1992-Present.

D.J. Northington & Ken Reich, "Arsenic in Groundwater by ICPMS," submitted to Environmental Science and Technology, January 1993.

ADDITIONAL TRAINING-TECHNICAL

LCMS, ACS, 1988.

Chromatography, WCAS, 1989.

Organic Chemistry, Hazmacon, 1989.

Hazardous Substance Chemistry, WCAS, 1993.

RESUME

RAMONA LEE NORTHINGTON
CFO/Laboratory Director

EDUCATION
B.S., Accounting, 1979, California State University - Dominguez Hills, Dominguez Hills, CA.

EMPLOYMENT HISTORY

Laboratory Director 1986-Present	West Coast Analytical Service, Inc. Santa Fe Springs, CA. Responsible for financial controls, accounting policies and procedures, marketing, and administrative practises of the lab.
Controller 1984-1986	Responsible for financial and accounting administration.
Controller 1983-1986	Goodwin Company, Garden Grove, CA. Responsible for finaincial, accounting and office administration, including extensive cost accounting system.
Senior Accountant	Enyedi & Calloway, Certified Public Account ants (now known as McGinnes, Knechtel and McIntyre) Pasadena, CA. Responsible for 45 write-up clients through tax returns and two audit clients.
Office Manager	West Coast Technical Service, Inc. Cerritos, CA. Responbile for accounting and administration.

As an accountant and administrator, Ms. Northington has experience in the chemical manufacturing and testing laboratory industries. She is currently a Board Member of the American Council of Independent Laboratories (ACIL) and the Association of California Testing Laboratories (actLABS). She served as co-chairperson for the ACIL Environmental Section from 1987-1991.

Ramona Lee Northington	3-1-93	RN
Signature	Date	Initials

ADDITIONAL TRAINING-TECHNICAL

LCMS, ACS, 1988.

Chromatography, WCAS, 1989.

Organic Chemistry, Hazmacon, 1989.

Hazardous Substance Chemistry, WCAS, 1993.

RESUME

BETTINA OELKE
Senior Chemist

EDUCATION
B.S., Chemistry, 1985, University of California, Irvine, CA.

EMPLOYMENT HISTORY

Senior Chemist 1992-Present	West Coast Analytical Service, Inc. Santa Fe Springs, CA. ICPMS Group Leader responsible for trace metals analysis.
1990-1992	Chemist in GCMS performing volatile and semi-volatile organics analyses.
1990	Chemist in GC group performing 601/602, herbicide, and pesticide analyses.
1988-1990	Responsible for ICPMS analysis.
Product Specialist 1985-1988	Applied Research Laboratories, Brea, CA. Responsible for providing technical support to customers, sales representatives and field service concerning AA, ICP-AES and DCP-AES.
Chemist Product Specialist 1985-1986	Beckman Instruments, Brea, CA. Performed applications studies for customers using DCP-AES. Generated technical literature.
Chemist 1985	Beckman Instruments, Irvine, CA. Implemented applications for designing optical emission accessories for DCP-AES.

Ms. Oelke has over seven years experience in the area of inorganic analysis. She is also proficient in performing many other types of analyses including the EPA methods for pesticides, herbicides, VOA's and BNA's in water, air, hazardous wastes, and drinking water.

ADDITIONAL TRAINING

ICPMS Theory Short Course, Plasma Winter Conference, 1988.

Mass Spectral Interpretation, Finnigan MAT Institute, 1990.

Bettina Oelke
Signature

2-24-93
Date

B.O.
Initials

RESUME

NOEMI PORTILLO
Chemist

EDUCATION
B.S., Chemistry, 1992, University of California, Los Angeles, Los Angeles, CA.

EMPLOYMENT HISTORY

Chemist 1992-Present	West Coast Analytical Service, Inc. Santa Fe Springs, CA. Responsible for wet chemical and spectrophotometric methods of analysis.
Laboratory Assistant 1988-1992	Dept. of Physiology, UCLA, Los Angeles, CA. Prepared assays and buffers, performed experiments on animal tissue to determine muscle architecture and effects of spaceflight, computed data.

Noemi M. Portillo — Signature

3/9/93 — Date

N.M.P. — Initials

RESUME

GREG R. SHAW
Senior Chemist

EDUCATION
M.S., Chemistry, 1987, California State University - Long Beach, Long Beach, CA.
B.S., Chemistry, 1982, San Diego State University, San Diego, CA.

EMPLOYMENT HISTORY

Chemist	West Coast Analytical Service, Inc. Santa Fe Springs, CA.
1992-Present	GCMS Group Leader.
1987-1992	Responsible for GCMS analyses.
Graduate Assistant 1986-1987	California State University - Long Beach, Long, Beach, CA. Thesis research "Kinetics and Mechanism of Hg(II) Halide Promoted Hydrolysis of Benzaldehyde O-Ethyl S-Phenyl Acetal."
Research Associate 1984-1986	Molecular Ecology Institute, CSULB. Responsible for PAH analysis of marine sediments and fauna.

Mr. Shaw is proficient at preparing and analyzing environmental samples using a variety of techniques, including HPLC, GC, and GCMS.

ADDITIONAL TRAINING

Finnigan INCOS Data System, WCAS, 1989.

Advanced Data System Techniques for the Triol, VG Instruments, 1990.

PUBLICATIONS AND PRESENTATIONS

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Signature	3.2.93 Date	GRS Initials

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RESUME

MICHAEL J. SHELTON
Senior Staff Chemist
Technical Director

EDUCATION
B.S., Chemistry, 1982, University of California, Irvine, CA.

EMPLOYMENT HISTORY

Senior Staff Chemist	West Coast Analytical Service, Inc., Santa Fe Springs, CA.
1990-Present	Technical Director.
1989-1990	Group Leader ICPMS and Inorganic.
1987-1989	Group Leader GCMS.
1985-1987	Responsible for GCMS analyses.
Senior Chemist 1982-1985	IT Analytical Service, Cerritos, CA. Responsible for GCMS, primarily commercial and non-routine problems.
Lab Assistant 1980-1981	UC Irvine, Irvine, CA.

Mr. Shelton is an expert in GCMS and LCMS, mass spectral interpretation, and applications to non-routine sample types and problems. He has several years experience in EPA CLP protocols. Mr. Shelton is also knowledgeable in FTIR, GC, LC, IC, ICPMS, and wet chemical analysis. His research interests are new mass spectrometry techniques.

ADDITIONAL TRAINING

Mass Spectral Interpretation, Finnigan Institute, 1984.
Electronics for MS, ASMS Short Course, 1987.
LCMS, ACS Short Course, 1988.
Thermospray LCMS, Vestec Corp., 1989.
Supercritical Fluid Extraction, ACS Short Course, 1992.

Signature

2-23-93
Date

Initials

PUBLICATIONS AND PRESENTATIONS

M. Shelton & D.J. Northington, "Organic Lead by ICPMS," Pacific Conference, Oct. 1989.

D.J. Northington, M. Shelton, & B.M. Hovanec, "Finnigan INCOS Data Systems," WCAS, 1989.

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M. Shelton & D.J. Northington, "Aromatic Sulfonic Acids in Water by GCMS", FACSS, 1991.

D.J. Northington, M. Shelton, & M. Hovanec, "Hazardous Substance Chemistry," California State University, Long Beach, University Extension Services, Instructor 1992-Present.

RESUME

SHELLEY D. STUART
Senior Chemist
Organics Manager

EDUCATION
B.A., Chemistry, 1984, Indiana University of Pennsylvania.

EMPLOYMENT HISTORY

Senior Chemist 1990-Present	West Coast Analytical Service, Inc. Santa Fe Springs, CA. Organics Manager responsible for scheduling the workload, training, and quality control of data for GC, GCMS, IR and wet chemistry departments.
1989-1990	Group Leader GCMS.
1986-1989	Group Leader GC and FTIR
1984-1986	Responsible for routine GC, IC and FTIR analysis.
Intern 1983	Philadelphia Police Department, Philadelphia, PA. Responsible for IR and GC analysis of forensic samples such as fire debris, blood and stains, hair, etc.

Mrs. Stuart performs many GC, GCMS, FTIR, HPLC, and IC analyses. She is experienced with the EPA methods for pesticides, herbicides, anions, cations, carbamates, VOA's and BNA's in water, soil, and hazardous wastes. She is also familiar with industrial hygiene and air analysis using GC and GCMS.

ADDITIONAL TRAINING

Maintaining and Troubleshooting Chromatographic Systems, ACS Short Course, 1986.

Capillary Gas Chromatography: Techniques and Problem Solving, ACS Short Course, 1988.

Basic course in Ion Chromatography, Dionex, 1988.

Finnigan INCOS Data System, WCAS, 1989.

PC/IR Training Course, Nicolet Instrument Corporation, 1989.

Environmental Compliance for Laboratories, Association of Bay Area Governments, 1992.

Shelley Stuart	2/24/93	SS
Signature	Date	Initials

PUBLICATIONS AND PRESENTATIONS

S. Stuart, Safety Meetings for WCAS Employees, on a bimonthly basis, WCAS, 1993.

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Introduction

Quality is a prerequisite in all of our work. This policy outlines the use of warning and control limits for Quality Control results. These warning and control limits are used for analyses when not superseded by contractual obligations such as the EPA/CLP contract. There are three types of limits described in the following pages. Where limited number of data points (<20) are available, the limits are expressed as Guidelines. When data exceed these Guidelines, notify your supervisor. Where sufficient data has been obtained (>20 points), notify your Group Leader whenever Warning Limits (2 S.D., 95% Confidence) have been exceeded. Notify the Technical Director whenever Control Limits have been exceeded (3 S.D., 99% Confidence).

The various QA parameters are described below. The frequency that each of these are performed is dictated by SOPs, but general guidelines on frequency are outlined in Table 1.

1. Precision and Accuracy

   a) At least one sample in each batch of 20 analyses will be spiked in duplicate with representative analytes to determine % recovery and relative percent difference. Alternatively, 1 duplicate and 1 spike may be performed in each batch of 20 analyses.

   b) In cases where surrogates or internal standards are used in routine analyses such as VOA, BNA, and Pesticides (608), duplicate spikes need only be performed on one sample out of every 20 even if only small batches are processed at a time.

   c) In some cases, spiked samples are not appropriate, (gas analysis, high level [%] analysis, etc.). Whenever possible, other types of quality control data should be generated to assure a quality result.

Table 1. QC Frequency

Unless precluded by agency, program, or contractual obligations, follow the guidelines below to determine the frequency of analysis for blanks, standards, spikes, and LCS.

I. Whenever sample batches are large (20+) or frequent (daily)

A. analyze a blank with each sample preparative batch,

B. see SOP for initial and continuing calibration frequency,

C. MS and MSD every 20 samples (or Dup/MS),

D. an LCS at least once with every initial calibration

II. Less than 20 samples, more than one per week

A. initial calibration and LCS at least one per month

B. continuing calibration at least daily within SOP guidelines of initial calibration

C. blank with each preparative batch

D. Dup/MS or MS/MSD once per week or 5 - 10 % of samples

III. Less than 20 samples, less than one per week

A. initial calibration and LCS at least once per month

B. continuing calibration at least daily within SOP guidelines of initial calibration

C. blank with each preparative batch

D. Dup/MS or MS/MSD once per month or 5 - 10 % of samples

IV. Less than 20 samples, less than one per month

Full QC with every batch. Price should reflect blank, calibration, LCS, MS and MSD.

2. Instrument Calibration

Instrument calibration must be performed frequently for quantitative analysis.

Calibration should be performed with a frequency which will assure that the response factors are at least as reproducible as the analytical error for the method or the client's needs. For example; for an external standard GC method, 2 sigma variations are usually ± 15%. Calibrations should be repeated as frequently as necessary to ensure that the response changes less than 15%. Some methods are more or less reproducible than this and the frequency of calibration may vary from every few minutes to a minimum of one per day.

Initial multipoint calibration must meet specifications set in the SOP. Usually this means that the linearity coefficient (R^2) is greater than 0.995 or the RSD of response factors is less than 10 - 20%. Continuing calibration must then agree with initial within 5 - 20% (see SOPs for individual guidelines).

Calibration standards should be initialed by preparer, dated, and serialized.

3. Method Blanks

Method blanks must be generated with every analysis. These must include a blank taken through any sample preparation, clean-up, and analysis stage. Use the same guidelines for the frequency of blanks as in #1 above. Whenever contamination is found in blanks, notify your supervisor. Blank contamination must be generally less than agency reporting limits or less than five times WCAS reporting limits.

4. QC Limits

QC limits apply to data which are greater than 20 x detection limits. At less than 20 x detection limits, errors may exceed QC limits.

Whenever QC data is outside warning limits; (1) notify your supervisor, (2) try to determine the cause of the error and correct the problem, and (3) repeat analysis of samples if necessary to ensure quality data. Note, the first thing you should do is to notify your supervisor. The use of data outside warning limits (2 S.D.) is at the discretion of the Group Leader. The use of data

outside of Control Limits (3 S.D.) is at the discretion of the Technical Director.

5. Log Book

A log book must be kept with each instrument to document chronologically which samples were analyzed and instrument maintenance performed. The Technical Director will periodically review these notebooks.

6. Source and Preparation of Standards

Calibration standards are prepared from reagents of documented purity or grades. Each stock solution and calibration standard shall be documented in a standards log-book including the manufacturer of the chemical, lot #, and purity. The weight and/or volume of each component in the standard should be documented. Each solution made in this way is given a unique serial number. Each person preparing a standard shall initial and date the entry in the log book.

7. Good Laboratory Practices

To prevent contamination of samples and extracts either use virgin containers that have been shown free from contamination or follow SOP procedures for cleaning (see SOP Manual-Glassware Cleaning).

8. Laboratory Control Standards (LCS)

LCS are samples from NTIS (formerly NBS), EPA, USGS, or other sources which mimic real sample matrixes with known concentrations of analytes. These are used with each sample set must meet additional QC limits. There may be two types of LCS: (1) Initial Calibration Verification (ICV or CCV) where the LCS is simply injected or (2) where the sample goes through the extraction process.

9. Corrective Action

Table 2 defines out of control situations for various analytical parameters (blank, standards, LCS, and MS/MSD). It also lists corrective action steps required to bring the analysis back under control.

10. Additional Policies

Other policies and information can be found in the Quality Assurance Manual or individual method SOP's.

Table 2. Out of Control Situations

In each case notify your supervisor and try to correct the problem before proceeding. Additional corrective action steps may be outlined in SOPs. If corrective action is precluded by sample or time limitations (rush work), (a) notify your supervisor, (b) notify the client, and (c) flag the results on the report. Choose from the corrective action options listed below the ones that best suit the situation.

Analytical Parameter	Out of Control	Corrective Action Options
Blank	a) > Agency Required Reporting Limits (DLR) b) > 5X WCAS Reporting Limits c) $MeCl_2$ in VOAs by GCMS Water > 10 ppb Soil > 50 ppb d) Phthalate in BNAs by GCMS Water > 8 ppb Soil > 100 ppb	Reprep and reanalyze samples, if possible
Initial Calibration	a) $R^2 < 0.995$ * b) Resp Factor > 20% RSD * (see SOP for limits.)	a) For rarely observed analytes, proceed if analyte not detected b) Repeat bad points until initial calibration meets specs.
Continuing Calibration	Calculated amount in standard > 10-20% error (see SOP)	a) Repeat continuing calibration, or b) Repeat initial calibration
Lab Control Standards	See QAM, Appendix B	1) repeat LCS 2) repeat initial calibration and LCS analysis
Surrogate	See QAM, Appendix B	1) if surrogate not obscured by matrix a) re-inject sample b) re-prep. sample c) dilute and

		2) if surrogate is obscured by matrix or corrective action fails, flag data

Table 2. Out of Control Situations (cont'd)

MS/MSD	See QAM, Appendix B	a) If calibration and blanks are prepared as a sample (VOAs, MBAS, etc.), flag data as matrix problem. When a calibration standard is prepared as a sample, this may be reported as additional QC as a spiked blank. b) If calibration stds are not prepared as a sample but sample prep is simple, run a spiked blank (or a prepared LCS). c) Re-prepare samples, MS/MSD, and a spiked blank. If sample MS/MSD continues out of control but the blanks and spiked blanks are in control, report as a matrix problem and flag the data.

QUALITY CONTROL LIMITS FOR GC

VOLATILE ORGANICS IN DRINKING WATER, EPA METHOD 502.2

Analyte	N	MATRIX SPIKE PERCENT RECOVERY Quality Control Limits Warning	Control
1,1-Dichloroethylene	18	36 - 123	15 - 144*
Benzene	52	57 - 140	36 - 160
Chlorobenzene	22	82 - 123	72 - 133
Trichloroethylene	50	66 - 116	53 - 128
Toluene	20	67 - 121	54 - 134
1,1-Dichloroethane	30	62 - 123	47 - 138
1,2-Dichloroethane	30	58 - 122	42 - 138
1,4-Dichlorobenzene	30	63 - 119	50 - 134
1,1,1-Trichloroethane	30	69 - 132	53 - 147
Carbon Tetrachloride	30	77 - 155	59 - 175
Dibromochloromethane	30	64 - 126	49 - 142
Bromoform	22	54 - 130	35 - 150
Bromodichloromethane	30	69 - 103	61 - 112
Chloroform	30	56 - 110	43 - 123
Vinyl Chloride	26	67 - 133	50 - 150

	MATRIX SPIKE RELATIVE PERCENT DIFFERENCE Quality Control Limits
All Analytes	< 25%

* Updated 4/93

Laboratory Control Standard Results: 502 SRM

Analyte	N	Ideal Value	Lower Warning Limit	Upper Warning Limit	Lower Control Limit	Upper Control Limit
1,1,1-TCA	26	0.50	0.33	0.57	0.27	0.63
1,1-DCE	26	0.50	0.33	0.60	0.26	0.67
1,2-DCA	26	0.50	0.34	0.46	0.31	0.50
1,4-DCB	26	0.50	0.29	0.61	0.21	0.69
Benzene	26	0.50	0.38	0.58	0.33	0.63
CHBr3	24	0.50	0.33	0.67	0.25	0.75
CCl4	26	0.50	0.36	0.65	0.29	0.72
CHBr2Cl	25	0.50	0.33	0.61	0.25	0.69
CHBrCl2	25	0.50	0.30	0.56	0.23	0.62
CHCl3	26	0.50	0.21	0.63	0.11	0.73
TCE	26	0.50	0.35	0.59	0.29	0.65
VCM	24	0.50	0.33	0.67	0.25	0.75

QUALITY CONTROL LIMITS FOR GC

VOLATILE ORGANICS, EPA METHOD 601/602 (8021)

	Surrogate % Recovery			
	Water		Soil	
Bromofluorobenzene	Warning	Control	Warning	Control
Hall Detector	84-119	75-128	71-126	58-138
PID	90-106	86-110	82-110	75-117

Repeat the analysis if the surrogate is outside of control limits.

SOIL

		RPD MATRIX SPIKES Quality Control Limits	
Analyte	N	Warning	Control
1,1-DCE	83	< 24	< 36
BENZENE	100	< 21	< 31
CHLOROBENZENE	100	< 16	< 25
TCE	83	< 22	< 34
TOLUENE	100	< 16	< 25

WATER

		RPD MATRIX SPIKES Quality Control Limits	
Analyte	N	Warning	Control
1,1-DCE	78	< 37	< 55
BENZENE	100	< 26	< 39
CHLOROBENZENE	100	< 12	< 18
TCE	78	< 15	< 22
TOLUENE	68	< 12	< 18

VOLATILE ORGANICS, EPA METHOD 601/602 (8021), cont'd

SOIL

Analyte	N	MATRIX SPIKE PERCENT RECOVERY Quality Control Limits Warning	Control
1,1-DCE	100	41 - 141	16 - 166
BENZENE	100	60 - 152	36 - 175
CHLOROBENZENE	100	66 - 127	52 - 140
TCE	100	64 - 123	50 - 138
TOLUENE	100	58 - 136	39 - 152

WATER

Analyte	N	MATRIX SPIKE PERCENT RECOVERY Quality Control Limits Warning	Control
1,1-DCE	100	42 - 140	18 - 163
BENZENE	100	60 - 153	36 - 175
CHLOROBENZENE	100	80 - 125	69 - 136
TCE	100	70 - 126	55 - 140
TOLUENE	100	61 - 121	46 - 136*

* Updated 4/93

VOLATILE ORGANICS, EPA METHOD 601/602 (8021), cont'd

Laboratory Control Standard Results: 601/602 SRM

Analyte	N	Cert Value	Lower Control Limit	Lower Warning Limit	Upper Warning Limit	Upper Control Limit
1,1,2-TCA	100	81.2	51	63	111	123
1,2-DCA	100	59.5	30	38	70	77
1,2-DCB	100	28.1	14	17	32	35
Bromoform	100	21.4	6	11	28	32
CCl_4	100	48.0	24	30	55	62
$CHBrCl_2$	100	66.5	27	36	74	83
Ethylbenzene	100	100.8	61	73	122	134

TOTAL PETROLEUM HYDROCARBONS , EPA METHOD 8015

Surrogate for Water Macro-extraction	% Recovery
Tetradecane	65-135%

RPD MATRIX SPIKES
Quality Control Limits

SOIL

Analyte	N	Warning Limits	Control Limits
DIESEL FUEL	100	< 11	< 17
GASOLINE	100	< 9	< 14

WATER

Analyte	N	Warning Limits	Control Limits
DIESEL FUEL	36	< 17	< 25
GASOLINE	27	< 17	< 25

MATRIX SPIKES
PERCENT RECOVERY
Quality Control Limits

SOIL

Analyte	N	Warning	Control
DIESEL FUEL	100	85 - 115	77 - 122*
GASOLINE	100	88 - 110	82 - 116*

WATER

Analyte	N	Warning	Control
DIESEL FUEL	100	61 - 111	49 - 123*
GASOLINE	100	52 - 133	32 - 153*

* Updated 4/93

VOLATILE ORGANICS IN AIR by GC (CALDERON ANALYSIS)

GAS

Analyte	N	SAMPLE RPD Quality Control Limits Warning	Control
1,1,1-TCA	35	< 38	< 57
BENZENE	24	< 52	< 78
CARBON TET	16	< 15	< 23
CHLOROFORM	8	< 41	< 61
PCE	22	< 37	< 55
TCE	24	< 43	< 64

MAJOR FIXED GASES by GC

GAS Analyte	N	RPD Quality Control Limits Warning	Control
CO_2	59	< 11	< 17*
CH_4	63	< 7	< 11*
N_2	66	< 5	< 8*
O_2	62	< 5	< 8*

SRM: NGPA GAS STANDARD

ANALYTE	N	MEAN VALUE	EXPECTED VALUE	Quality Control Limits Warning Limits	Control Limits
CO	37	0.47	0.50	0.34 - 0.59	0.28 - 0.65*
CH_4	37	1.98	2.00	1.70 - 2.30	1.60 - 2.40*
N_2	37	78.3	77.0	75.5 - 80.6	74.3 - 81.8*
O_2	37	19.3	20.5	17.9 - 20.8	17.2 - 21.5*

* Updated 4/93

POLYCHLORINATED BIPHENYLS by GC

SOIL AND WATER		3 S.D. (99 %) Limits Matrix Spike
Analyte	N	% RECOVERY
1254	45	54 - 158
1260	45	59 - 130

ORGANOCHLORINE PESTICIDES by GC, EPA 608 (8080)

Surrogate	% Recovery Control Limits Soil	Water
Tetrachloro-m-xylene	60 - 150	33 - 101
Decachlorobiphenyl	60 - 150	49 - 136

SOIL

Analyte	N	RPD Matrix Spikes Quality Control Limits Warning	Control
ALDRIN	81	< 14	< 21
DDT	79	< 23	< 34
DIELDRIN	80	< 21	< 32
ENDRIN	84	< 15	< 22
HEPTACHLOR	80	< 14	< 21
LINDANE	82	< 13	< 19

WATER

Analyte	N	RPD Matrix Spikes Quality Control Limits Warning	Control
ALDRIN	41	< 20	< 29
DDT	41	< 17	< 26
DIELDRIN	41	< 21	< 31
ENDRIN	37	< 16	< 25
HEPTACHLOR	40	< 21	< 32
LINDANE	41	< 15	< 22

ORGANOCHLORINE PESTICIDES by GC, EPA 608 (8080), cont'd

SOIL

Analyte	N	MATRIX SPIKES PERCENT RECOVERY Quality Control Limits Warning	Control
ALDRIN	100	76 - 118	67 - 129
4,4-DDT	100	59 - 149	42 - 160
DIELDRIN	100	62 - 131	45 - 147
ENDRIN	100	78 - 132	65 - 145*
HEPTACHLOR	100	75 - 121	62 - 134
LINDANE	100	77 - 124	65 - 135*

WATER

Analyte	N	MATRIX SPIKES PERCENT RECOVERY Quality Control Limits Warning	Control
ALDRIN	83	64 - 110	52 - 122*
4,4-DDT	83	68 - 133	52 - 149*
DIELDRIN	81	73 - 122	60 - 135*
ENDRIN	81	68 - 131	53 - 147*
HEPTACHLOR	81	67 - 114	55 - 124*
LINDANE	83	71 - 124	58 - 137*

* Updated 4/93

SRM1583

Analyte	N	Cert Value	Lower Control Limit	Lower Warning Limit	Upper Warning Limit	Upper Control Limit
ALDRIN	100	0.59	0.31	0.35	0.66[1]	0.69[1]*
D-BHC	100	0.53	0.35	0.40	0.60	0.65 *
DDE	100	0.85	0.62	0.69	0.99	1.07 *
DDT	100	1.31	0.87	0.99	1.45	1.57 *
LINDANE	100	0.77	0.56	0.62	0.87	0.94 *

1. These limits were widened from the mean to allow for the certified value +10% and +15% warning and control limits.

* Updated 4/93

CHLORINATED HERBICIDE ANALYSIS by EPA 615/8150

SOIL AND WATER

Surrogate 2,4-DCAA

	Warning Limits	Control Limits
SOIL	48 - 122	29 - 141
WATER	42 - 104	26 - 119

SOIL AND WATER	#	MATRIX SPIKE RPD Q.C. Limits	
Analyte	N	Warning	Control
2,4,5-T	67	< 40	< 61
DICAMBA	69	< 26	< 41
DINOSEB	62	< 40	< 60
SILVEX	68	< 27	< 42

SOIL AND WATER		MATRIX SPIKE PERCENT RECOVERY 3 S.D. (99 %) Limits	
Analyte	N	Warning	Control
2,4,5-T	94	27 - 133	0 - 160
DICAMBA	100	44 - 131	23 - 152
DINOSEB	100	22 - 126	0 - 152
SILVEX	100	52 - 105	39 - 118

HERBICIDE SRM (Methyl esters in Organic Matrix)

Analyte	N	Cert. Value	Lower Control Limit	Lower Warning Limit	Upper Warning Limit	Upper Control Limit
2,4-D	96	1.00	0.32	0.50	1.22	1.41
SILVEX	94	0.100	0.037	0.053	0.120	0.137

ORGANOPHOSPHOROUS PESTICIDES (EPA 614, 622, 8140)

SURROGATE - Triphenylphosphate

Percent Recovery Guidelines 38 - 146

Analyte	N	Spike RPD Guidelines
Phorate	8	< 27
Disulfoton	8	< 27
Dimethoate	6	< 195
Methyl Parathion	8	< 51
Parathion	8	< 58

Analyte	N	Percent Recovery Guidelines
Phorate	11	23 - 139
Disulfoton	17	14 - 150
Dimethoate	17	0 - 103
Methyl Parathion	13	13 - 169
Parathion	16	55 - 127

QUALITY CONTROL FOR IR ANALYSIS

HYDROCARBONS by EPA METHODS 418.1 and 413.2 (INFRARED ANALYSIS)

SOIL and WATER

Analyte	N	RPD Matrix Spikes QC Limits: Warning Limits	RPD Matrix Spikes QC Limits: Control Limits
DIESEL FUEL	100	< 10	< 15

SOIL

Analyte	N	Matrix Spikes Percent Recovery Quality Control Limits: Warning Limits	Matrix Spikes Percent Recovery Quality Control Limits: Control Limits
DIESEL FUEL	100	81 - 105	75 - 111

WATER

Analyte	N	Matrix Spikes Percent Recovery Quality Control Limits: Warning Limits	Matrix Spikes Percent Recovery Quality Control Limits: Control Limits
DIESEL FUEL	100	86 - 104	80 - 109

QUALITY CONTROL LIMITS FOR GCMS

BNA in DRINKING WATER by EPA 525.1

WATER

Surrogate	% Recovery Control Limits
2-Fluorobiphenyl	34 - 120
2,4,6-Tribromophenol	42 - 119
Terphenyl - d_{14}	27 - 111

WATER

Analyte	N	MATRIX SPIKES PERCENT RECOVERY Control Limits
Acenaphthalene	12	35 - 125
Butylbenzylphthalate	12	35 - 125
Dimethylphthalate	12	35 - 125
Di-N-butylphthalate	12	35 - 125
Pentachlorophenol	12	0 - 215
Phenanthrene	12	35 - 125
Pyrene	12	34 - 166

WATER

Analyte	N	RPD MATRIX SPIKES Control Limits
Acenaphthalene	6	< 25
Butylbenzylphthalate	6	< 25
Dimethylphthalate	6	< 25
Di-N-butylphthalate	6	< 25
Pentachlorophenol	6	< 43
Phenanthrene	6	< 25
Pyrene	6	< 20

(cont'd) QUALITY CONTROL LIMITS FOR GCMS

BNA SRM for Drinking Waters by EPA 525.1

WATER

Analyte	N	Cert Value	Warning Limits	Control Limits
2,4,6-Trichlorophenol	15	5	3.3 - 6.3	2.5 - 7.1 *
Benzo(GHI)Perylene	15	4	2.3 - 5.8	1.5 - 6.7 *
Butylbenzylphthalate	15	3	1.6 - 4.4	0.92 - 5.1 *
Fluorene	15	2	1.6 - 2.5	1.4 - 2.7 *
Dimethyl Phthalate	15	1	0.83 - 1.2	0.74 - 1.3 *
Phenanthrene	15	4	3.2 - 4.6	2.9 - 5.0 *

* Updated 4/93

(cont'd) QUALITY CONTROL LIMITS FOR GCMS

BNA EXTRACTABLES by EPA METHOD 625 (8270)

Surrogate	% Recovery Water Warning	Water Control	Soil Warning	Soil Control
Phenol-d_5	39-119	19-139	33-113	24-113
2-Fluorophenol	34-130	21-154	30-121	25-121
Nitrobenzene-d_5	45-114	35-114	39-119	23-120
2-Fluorobiphenyl	46-114	43-116	38-115	30-115
2,4,6-Tribromophenol	29-113	10-123	26-118	19-122
p-Terphenyl-d_{14}	61-129	44-141	37-137	18-137

Repeat the analysis if 2 or more are outside of the control limits.

SOIL

Analyte	N	RPD MATRIX SPIKES Quality Control Limits Warning	Control
1,2,4-Trichlorobenzene	100	< 17	< 25
1,4-Dichlorobenzene	100	< 15	< 23
2,4-Dinitrotoluene	99	< 19	< 29
2-Chlorophenol	100	< 16	< 24
4-Chloro-3-methylphenol	100	< 19	< 29
4-Nitrophenol	97	< 15	< 24
Acenaphthene	100	< 17	< 26
Pentachlorophenol	88	< 23	< 36
N-Nitroso Di-N-propylamine	99	< 20	< 30
Phenol	98	< 18	< 27
Pyrene	100	< 25	< 37

BNA EXTRACTABLES by EPA METHOD 625 (8270), cont'd

WATER

Analyte	N	RPD MATRIX SPIKES Quality Control Limits Warning	Control
1,2,4-Trichlorobenzene	100	< 21	< 31
1,4-Dichlorobenzene	100	< 23	< 34
2,4-Dinitrotoluene	100	< 11	< 18
2-Chlorophenol	100	< 10	< 17
4-Chloro-3-methylphenol	100	< 12	< 20
4-Nitrophenol	100	< 25	< 38
Acenaphthene	100	< 10	< 17
Pentachlorophenol	100	< 24	< 36
N-Nitroso Di-N-Propylamine	100	< 14	< 24
Phenol	100	< 13	< 21
Pyrene	100	< 19	< 29

BNA EXTRACTABLES by EPA METHOD 625 (8270), cont'd

SOIL

Analyte	N	MATRIX SPIKES PERCENT RECOVERY Quality Control Limits Warning	Contro
1,2,4-Trichlorobenzene	100	58 - 113	44 - 12
1,4-Dichlorobenzene	100	55 - 100	44 - 11
2,4-Dinitrotoluene	100	51 - 115	35 - 13
2-Chlorophenol	100	64 - 110	52 - 12
4-Chloro-3-methylphenol	100	56 - 116	42 - 13
4-Nitrophenol	100	22 - 146	0 - 17
Acenaphthene	100	62 - 114	49 - 12
Pentachlorophenol	100	38 - 159	8 - 18
N-Nitroso Di-N-propylamine	100	40 - 120	21 - 13
Phenol	100	55 - 104	43 - 11
Pyrene	100	55 - 144	33 - 16

BNA EXTRACTABLES by EPA METHOD 625 (8270), cont'd

WATER

Analyte	N	MATRIX SPIKES PERCENT RECOVERY Quality Control Limits Warning	Control
1,2,4-Trichlorobenzene	100	43 - 87	32 - 98
1,4-Dichlorobenzene	100	41 - 75	32 - 84
2,4-Dinitrotoluene	100	51 - 109	36 - 124
2-Chlorophenol	100	60 - 114	46 - 128
4-Chloro-3-methylphenol	100	51 - 96	38 - 110
4-Nitrophenol	100	25 - 103	6 - 123
Acenaphthene	100	54 - 114	39 - 129
Pentachlorophenol	100	20 - 176	0 - 215
N-Nitroso Di-n-propylamine	100	47 - 96	35 - 108
Phenol	100	55 - 100	42 - 113
Pyrene	100	56 - 144	34 - 166

BNA SRM

Analyte	N	Actual Value	Warning Limits	Control Limits
1,2-Dichlorobenzene	100	20	16.4 - 25.0	14.2 - 27.1
2,4,6-Trichlorophenol	100	100	59.7 - 122.9	44.0 - 138.6
2,4-Dimethylphenol	100	100	81.9 - 123.7	71.5 - 134.1
Benzo(GHI)Perylene	100	80	55.1 - 96.1	44.9 - 106.3
Bis(2-Chloroethyl)ether	100	40	32.3 - 52.7	27.2 - 57.8
Butylbenzylphthalate	100	60	44.3 - 74.8	36.6 - 82.5
Fluorene	97	40	29.2 - 52.8	23.4 - 58.7
Hexacloroethane	100	80	64.0 - 108.1	53.0 - 119.1
Isophorone	100	20	14.4 - 31.2	10.2 - 35.4
2-Methylnaphthalene	100	20	14.9 - 23.5	12.8 - 25.6
Dimethyl Phthalate	83	40	30.4 - 49.1	25.7 - 53.8
Naphthalene	100	40	32.9 - 48.0	29.1 - 51.8
Nitrobenzene	97	80	66.7 - 95.1	59.6 - 102.2
p-Cresol	100	100	76.9 - 141.8	60.7 - 158.1
Phenanthrene	100	80	53.0 - 86.7	44.6 - 95.2

VOLATILE ORGANICS in DRINKING WATERS by EPA METHOD 524.2

Surrogate	% Recovery Control Limits Water	Soil
1,2-Dichloroethane-d_4	81 - 109	74 - 116
Toluene-d_8	72 - 124	59 - 137
Bromofluorobenzene	73 - 117	62 - 128

Repeat the analysis if 2 or more of the surrogates are out of control limits.

WATER

Analyte	N	RPD MATRIX SPIKES Quality Control Limits Warning	Control
Benzene	15	< 7.7	< 11.7
Bromodichloromethane	15	< 7.8	< 11.7
Bromoform	15	< 9.0	< 12.9
Carbon Tetrachloride	15	< 8.9	< 13.4
Chloroform	15	< 6.9	< 10.5
Dibromochloromethane	15	< 9.9	< 14.5
1,4-Dichlorobenzene	15	< 7.3	< 12.0
1,2-Dichloroethane	15	< 5.9	< 9.3
1,1-Dichloroethylene	15	< 8.9	< 13.2
Trichloroethane	15	< 6.9	< 10.3
Trichloroethylene	15	< 8.6	< 12.8
Vinyl Chloride	15	< 10.4	< 16.2

VOLATILE ORGANICS in DRINKING WATERS by EPA METHOD 524.2, cont'd

WATER

Analyte	N	PERCENT RECOVERY MATRIX SPIKE Quality Control Limits Warning	Control
Benzene	32	70 - 110	60 - 120
Bromodichloromethane	32	77 - 109	69 - 117
Bromoform	32	62 - 97	54 - 105
Carbon Tetrachloride	32	71 - 115	60 - 126
Chloroform	32	74 - 110	65 - 119
Dibromochloromethane	32	63 - 127	47 - 144
1,4-Dichlorobenzene	32	72 - 122	59 - 134
1,2-Dichloroethane	32	64 - 123	49 - 138
1,1-Dichloroethylene	32	65 - 113	53 - 125
Trichloroethane	32	79 - 107	72 - 114
Trichloroethylene	32	57 - 119	41 - 134
Vinyl Chloride	32	45 - 141	20 - 165

VOA SRM

Analyte	Actual Value	Percent Recovery Quality Control Limits
All Analytes	5.0	3.5 - 6.5

VOLATILE ORGANICS by EPA METHOD 624 (8240)

Surrogate	% Recovery Control Limits Water	Soil
1,2-Dichloroethane-d_4	76-114	77-125
Toluene-d_8	88-110	84-114
Bromofluorobenzene	86-115	74-121

Repeat the analysis if 2 or more of the surrogates are out of control limits.

SOIL

Analyte	N	RPD MATRIX SPIKES Quality Control Limits Warning	Control
1,1-Dichloroethylene	100	< 14	< 20
Trichloroethylene	100	< 11	< 17
Chlorobenzene	100	< 8	< 12
Toluene	100	< 12	< 18
Benzene	100	< 10	< 14

WATER

Analyte	N	RPD MATRIX SPIKES Quality Control Limits Warning	Control
1,1-Dichloroethylene	90	< 24	< 36
Trichloroethylene	100	< 13	< 19
Chlorobenzene	100	< 10	< 15
Toluene	100	< 13	< 19
Benzene	100	< 14	< 19

VOLATILE ORGANICS by EPA METHOD 624 (8240), cont'd

WATER AND SOIL

Analyte	N	PERCENT RECOVERY MATRIX SPIKE Quality Control Limits Warning	Contro
1,1-Dichloroethylene	100	51 - 155	25 - 18
Benzene	100	73 - 125	60 - 13
Chlorobenzene	100	82 - 109	75 - 11
Trichloroethylene	100	59 - 120	44 - 13
Toluene	100	80 - 116	71 - 12

VOLATILE ORGANICS by EPA METHOD 624 (8240) and 601/602, cont'd

VOA SRM

Analyte	N	Cert Value	Lower Control Limit	Lower Warning Limit	Upper Warning Limit	Upper Control Limit
1,1,2-TCA	100	81.3	74	78	94	98
1,2-DCA	100	55.0	46	49	65	68
1,2-DCB	100	25.1	16	19	29	32
BRCL2METH	100	51.3	42	46	58	62 *
BROMOFORM	100	20.1	14	16	21	23
CARBON TET	100	47.1	41	44	57	60
ETHYLBENZ	100	98.6	82	89	116	122
MIBK	100	80.8	38	52	109	123 *

* Updated 4/93

VOLATILE ORGANICS in AIR

	SAMPLE RPD CONTROL LIMITS
All Analytes	< 35
INTERNAL STANDARDS AREA	50 - 200 % per Day

QUALITY CONTROL FOR IC

LIMITS FOR ANIONS ANALYSIS

		RPD SAMPLES Quality Control Limits		
Analyte	N	WATER	N	OTHER
CHLORIDE	28	< 10	11	< 39
FLUORIDE	15	< 17	3	< 50
NITRATE	32	< 11	2[1]	< 18
NITRITE	10	< 15	0	< 50
SULFATE	32	< 9	11	< 49
O-PHOSPHATE	6[2]	< 35	2	< 50

1. Statistics are for SOIL matrix.

2. Limits were calculated for these data using (3 * S.D.) and not the t-value, because the sample numbers were small and the S.D. values were large.

WATER

MATRIX SPIKES
PERCENT RECOVERY
Quality Control Limits

Analyte	N	Warning	Control
CHLORIDE	100	73 - 111	63 - 121*
BROMIDE	100	83 - 108	77 - 114
FLUORIDE	100	74 - 122	63 - 133
NITRATE	99	77 - 116	67 - 126*
NITRITE	92	80 - 114	72 - 123
SULFATE	95	77 - 112	68 - 120*
O-PHOSPHATE	92	75 - 113	66 - 122

SOIL AND OTHER

MATRIX SPIKES
PERCENT RECOVERY
Quality Control Limits

Analyte	N	Control Limits
CHLORIDE	46	60 - 110
BROMIDE	45	60 - 127*
FLUORIDE	54	57 - 142*
NITRATE	41	63 - 117
NITRITE	29	75 - 112
SULFATE	40	54 - 114
O-PHOSPHATE	37	67 - 116*

* Updated 4/93

CATIONS by ION CHROMATOGRAPHY

WATER

Analyte	RPD SAMPLES Quality Control Limits N	Control
AMMONIUM	8	< 27
CALCIUM	10	< 27
MAGNESIUM	8	< 23
POTASSIUM	11	< 32
SODIUM	15	< 10
LITHIUM		N/A

WATER

Analyte	MATRIX SPIKES PERCENT RECOVERY Quality Control Limits N	Control Limits
AMMONIUM	3	50 - 150
CALCIUM	10	50 - 150
MAGNESIUM	6	86 - 115
POTASSIUM	10	50 - 150
SODIUM	11	45 - 142
LITHIUM	2	50 - 150

HEXAVALENT CHROMIUM by ION CHROMATOGRAPHY

RPD MATRIX SPIKES
Quality Control Limits

Analyte	N	SOIL	N	WATER	N	OTHER[1]
HEXAVALENT CHROMIUM	9	< 12	19	< 13	95	< 13

MATRIX SPIKE
PERCENT RECOVERY
Quality Control Limits

Analyte	N	SOIL	N	WATER	N	OTHE
HEXAVALENT CHROMIUM	28	67 - 128*	43	74 - 117	100	70 -

1. OTHER matrix samples are predominantly 20 mM aqueous bicarbonat impinger samples.

* Updated 4/93

QUALITY CONTROL FOR ICPMS

Internal Standards	Response Relative to Calibration
Sc, In, Tb	50 - 150 %

SOIL AND AIR(CARB436)**

Analyte	N	RPD SAMPLES QC Limits Warning Limit	Control Limit
ANTIMONY	92	25	40
ARSENIC	90	25	40
BARIUM	100	25	40
BERYLLIUM	92	25	40
CADMIUM	90	25	40
CHROMIUM	100	25	40
COBALT	100	25	40
COPPER	100	25	40
LEAD	100	25	40
MERCURY	50	25	40
MOLYBDENUM	100	25	40
NICKEL	100	25	40
SELENIUM	43	25	40
SILVER	79	25	40
THALLIUM	74	25	40
VANADIUM	87	25	40
ZINC	100	25	40

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QUALITY CONTROL FOR ICPMS, cont'd

SOIL AND AIR(CARB436)**

Analyte	N	RPD Matrix Spikes Quality Control Limits	
		Warning Limits	Control Limits
ANTIMONY	90	25	40
ARSENIC	82	25	40
BARIUM	64	25	40
BERYLLIUM	94	25	40
CADMIUM	91	25	40
CHROMIUM	67	25	40
COBALT	88	25	40
COPPER	78	25	40
LEAD	67	25	40
MERCURY	82	25	40
MOLYBDENUM	94	25	40
NICKEL	63	25	40
SELENIUM	97	25	40
SILVER	88	25	40
THALLIUM	95	25	40
VANADIUM	61	25	40
ZINC	63	25	40

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QUALITY CONTROL FOR ICPMS, cont'd

SOIL AND AIR(CARB436)**

Analyte	N	PERCENT RECOVERY MATRIX SPIKES Quality Control Limits: Warning Limits	Control Limits
Antimony	100	40 - 140	20 - 160
Arsenic	100	60 - 140	40 - 155
Barium	17	60 - 140	40 - 155
Beryllium	100	75 - 125	60 - 140
Cadmium	100	75 - 125	60 - 140
Chromium	100	40 - 140	20 - 160
Cobalt	100	75 - 125	60 - 140
Copper	100	60 - 140	40 - 155
Lead	100	60 - 140	40 - 155
Mercury	100	60 - 140	40 - 155
Molybdenum	100	75 - 125	60 - 140
Nickel	100	40 - 140	20 - 160
Selenium	100	75 - 125	60 - 140
Silver	100	60 - 140	40 - 155
Thallium	100	75 - 125	60 - 140
Vanadium	52	60 - 140	40 - 155
Zinc	33	60 - 140	40 - 155

** Page Updated 4/93

QUALITY CONTROL FOR ICPMS, cont'd

WATER AND IH FILTER**

Analyte	N	RPD SAMPLES QC Limits Warning Limit	Control Limit
ANTIMONY	33	35	50
ARSENIC	65	35	50
BARIUM	92	20	30
BERYLLIUM	31	20	30
CADMIUM	50	35	50
CHROMIUM	59	20	30
COBALT	50	20	30
COPPER	65	20	30
LEAD	54	20	30
MERCURY	28	35	50
MOLYBDENUM	60	20	30
NICKEL	52	20	30
SELENIUM	32	35	50
SILVER	35	35	50
THALLIUM	30	20	30
VANADIUM	52	20	30
ZINC	72	20	30

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WATER AND IH FILTER**

Analyte	N	RPD Matrix Spikes Quality Control Limits Warning Limits	Control Limits
ANTIMONY	61	15	25
ARSENIC	61	15	25
BARIUM	58	10	15
BERYLLIUM	63	10	15
CADMIUM	61	10	15
CHROMIUM	56	10	15
COBALT	63	10	15
COPPER	59	10	15
LEAD	62	10	15
MERCURY	59	20	30
MOLYBDENUM	61	10	15
NICKEL	60	10	15
SELENIUM	61	20	30
SILVER	62	20	30
THALLIUM	62	10	15
VANADIUM	58	10	15
ZINC	57	10	15

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MATRIX SPIKES
PERCENT RECOVERY
Quality Control Limits

WATER AND IH FILTER**

Analyte	N	Warning Limits	Control Limits
Antimony	100	60 - 140	45 - 155
Arsenic	100	85 - 115	80 - 120
Barium	100	85 - 115	80 - 120
Beryllium	100	85 - 115	80 - 120
Cadmium	100	85 - 115	80 - 120
Chromium	100	85 - 115	80 - 120
Cobalt	100	85 - 115	80 - 120
Copper	100	85 - 115	80 - 120
Lead	100	85 - 115	80 - 120
Mercury	100	60 - 140	45 - 155
Molybdenum	100	85 - 115	80 - 120
Nickel	100	85 - 115	80 - 120
Selenium	100	60 - 140	45 - 155
Silver	100	25 - 125	0 - 150
Thallium	100	85 - 115	80 - 120
Vanadium	100	85 - 115	80 - 120
Zinc	100	85 - 115	80 - 120

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SRM1646 Quality Control Limits

Analyte	N	Certified Value	Control Limits		Warning Limits	
Antimony	35		0.000 - 0.586		0.000 - 0.442	
Arsenic	35	11.600	0.000 - 18.80		0.000 - 14.53	
Barium	35		26.32 - 61.27		32.14 - 55.45	
Beryllium	35		0.204 - 1.410		0.405 - 1.209	
Cadmium	35	0.3600	0.000 - 0.917		0.000 - 0.719	
Chromium	35	76.000	27.04 - 62.96		33.02 - 56.97	
Cobalt	35	10.500	5.470	11.759	6.518	10.711
Copper	35	18.000	9.919	21.607	11.867	19.659
Lead	35	28.200	15.076	30.226	17.601	27.701
Mercury	35	0.0630	0.000	0.112	0.000	0.077
Molybdenum	35		0.961	2.665	1.245	2.3814
Nickel	35	32.000	15.067	34.151	18.248	30.97
Selenium	35	0.600	0.000	8.169	0.000	5.885
Silver	35		0.000	0.298	0.000	0.232
Thallium	35		0.061	0.317	0.104	0.274
Vanadium	35	94.000	26.198	80.429	35.237	71.391
Zinc	35	138.000	63.461	150.42	77.954	135.926

USGS T111 Quality Control Limits

Analyte	Cert. Value	N	Lower Warning Limit	Upper Warning Limit	Lower Control Limit	Upper Control Limit
Antimony	0.2450	100	0.2363	0.3415	0.2100	0.3678
Arsenic	0.0033	100	0.0026	0.0054	0.0019	0.0061
Barium	0.0270	100	0.0234	0.0290*	0.0224	0.0300*
Beryllium	0.0077	100	0.0071	0.0087	0.0067	0.0091
Cadmium	0.0230	100	0.0208	0.0260	0.0195	0.0273
Chromium	0.0250	100	0.0240	0.0280	0.0230	0.0290
Cobalt	0.0090	100	0.0082	0.0098	0.0078	0.0102
Copper	0.0109	100	0.0098	0.0118	0.0093	0.0123
Lead	0.0188	100	0.0181	0.0213	0.0173	0.0221
Mercury		100	0.0000	0.0018	0.0000	0.0023
Molybdenum	0.0140	100	0.0126*	0.0174	0.0119*	0.0181
Nickel	0.0155	100	0.0137	0.0161	0.0131	0.0167
Selenium	0.0033	100	0.0000	0.0098	0.0000	0.0126
Silver	0.0140	100	0.0121	0.0153	0.0113	0.0161
Thallium		100	0.0000	0.0005	0.0000	0.0007
Vanadium	0.0270	100	0.0251*	0.0302	0.0242*	0.0310
Zinc	0.320	100	0.2767	0.3468*	0.2638	0.3602*

* These limits were widened from the mean ± 2 or 3 SD to allow for the certified value ± 7 and ± 10%, warning and control limits.

QUALITY CONTROL FOR ICPMS, cont'd

MERCURY (CV - GFO)

	Percent Recovery	RPD
MERCURY	75 - 110	< 25

URANIUM IN GROUNDWATER

	WARNING LIMITS	CONTROL LIMITS
RPD	< 12	< 18
PERCENT RECOVERY	94 - 110	90 - 114

QUALITY CONTROL FOR WET CHEMISTRY

CYANIDE (WATER and/or SOIL) (EPA Method 9010)	N	Quality Control Guidelines
RPD	11	<30
PERCENT RECOVERY	26	50* - 135

* Specified by Method 9010

PHENOL (WATER and/or SOIL) (EPA Method 9065)	N	Quality Control Guidelines
RPD	5	<15
PERCENT RECOVERY	6	55 - 125

SULFIDE (EPA Method 376.2)	N	Quality Control Guidelines
RPD	8	<25
PERCENT RECOVERY	25	50 - 125

TOTAL ORGANIC CARBON (Walky-Black Method)	N	Quality Control Guidelines
RPD	2	< 23
PERCENT RECOVERY	9	50 - 150

ALKALINITY (EPA Method 310.1)	N	Warning Limits	Control Limits
RPD	16		<6
PERCENT RECOVERY	44	64 - 126	48 - 142

QUALITY CONTROL FOR WET CHEMISTRY, cont'd

AMMONIA (Standard Method 4500-NH3C)	N	Warning Limits	Control Limits
RPD	5		<25
PERCENT RECOVERY	44	64 - 126	48 - 142

BIOCHEMICAL OXYGEN DAMAND (EPA Method 405.1)	N	Quality Control Guidelines
RPD	11	<33
PERCENT RECOVERY	10	32 - 170

CONDUCTIVITY (EPA Method 120.1)	N	Warning Limits	Control Limits
RPD	24	<3	<5

CHEMICAL OXYGEN DEMAND (EPA Methods 410.1 to 3)	N	Warning Limits	Control Limits
RPD	24	<3	<5

HARDNESS (EPA Method 130.2)	N	Quality Control Guidelines
RPD	3	<5
PERCENT RECOVERY	14	88 - 110

Karl Fischer Water	N	Quality Control Guidelines
RPD	14	<39

QUALITY CONTROL FOR WET CHEMISTRY, cont'd

RESIDUAL CHLORINE (EPA Method 330.5)	N	Quality Control Guidelines
RPD	4	<11

SURFACTANT (Standard Method 5540 C)	N	Warning Limits	Control Limits
RPD	6		<23
PERCENT RECOVERY	43	36 - 139	10 - 165

TOTAL DISSOLVED SOLIDS (EPA Method 160.2)	N	Warning Limits	Control Limits
RPD	27	<9	<13
PERCENT RECOVERY	77	92 - 108	89 - 111

TOTAL SUSPENDED SOLIDS (EPA Method 160.1)	N	Warning Limits	Control Limits
RPD	20	<27	<41

TURBIDITY (EPA Method 180.1)	N	Warning Limits	Control Limits
RPD	10		<26
PERCENT RECOVERY	29	83 - 120	74 - 129

Analytical Balances

Balances shall be checked with class S weights weekly by the extraction lab supervisor. QC limits for balances are:

1 place balance	10g ± 0.1g
	100g ± 0.1g
2 place balances	1.00g ± 0.02
	50.00 ± 0.02
4 place balances	1.0000 ± 0.0003
	50.0000 ± 0.0005
5 place balances	2.0000 ± 0.00009
	50.0000 ± 0.0005

All balances shall be serviced and certified annually by an outside service.

Refrigerators

Refrigerators for storing environmental samples will be monitored periodically by log-in to insure performance between 2-6 ^{o}C.

Sample Containers, Preservatives, and Holding Times

Whenever sub-sampling, follow recommended procedures for storage and preservation (Standard Methods or SW846). Table 2-16 from SW-846 is attached which should be applied to water samples. Soils should be stored similarly but without the addition of chemical preservatives.

APPENDIX C

SOP FOR LEGAL AND FORENSIC JOBS

1. It is preferable for the laboratory to be hired by an attorney rather than a private or corporate party. Work done for a private party can be subject to discovery, whereas an attorney may protect this information. Note that when files are taken into the courtroom, they are available to all parties.

2. Samples must be clearly identified, labeled, and documented. The job envelope should distinguish it from non-legal samples.

3. There should be a chain-of-custody record with legal samples. For simplicity's sake, it is preferable to have the person who will be performing the analyses and testify, also be the one receiving the samples.

4. When possible, the samples should be photographed and the photographs put into the job envelope.

5. The lab work must be of the highest quality to withstand close scrutiny in a court of law. The conclusion must be objective, supported by valid data. Standard test methods, (ASTM, NIOSH, EPA, etc.) and QC experiments are necessary. Deviations from standard methods can prove embarrassing.

6. The test should be performed by the person who may also serve as a witness. If this is unreasonable, the tests should be at least closely observed.

7. A verbal report should be issued first. The attorney may prefer not to have a written report.

8. Legal samples should be returned to the client as soon as possible. The job envelope, data results, etc., should be permanently stored in the legal file.

9. Courtroom testimony should be clear, coherent, and articulate. The questioning can be intense, critical, and very stressful. Dress appropriately. Try to relate to the jury and the judge.

10. The building must be kept secure to protect legal evidence.

11. Whenever possible, the tests should be non-destructive.

APPENDIX D

REQUIREMENTS FOR SPECIAL PROGRAMS

Whenever analyzing samples under these special programs, additional QC steps are required as follows:

A. California Hazardous Waste Testing Laboratory

1. At least 1 sample in each batch of 20 or fewer samples must be analyzed as a duplicate spike.

B. Utah Environmental Accreditation

1. QC Frequency: standards, spikes, duplicates, and blanks must be performed once for each 10 samples; lab control standards must be used where applicable once for each 20 samples.

2. At least 3 point calibrations are required.

3. All refrigerators must be monitored and logged daily.

4. Column performance for EPA 608 using CLP protocol must be monitored daily.

5. A QC action report (attached) should be used to document the use of data obtained from outside warning limits and correction of problems.

6. CLP data qualifier should be used for VOA, Pesticide, and BNA's.

C. Navy Programs

1. The attached QC action report should be filled out for data outside warning limits to document resolution of problems.

D. California Drinking Water Programs

1. Because QC guidelines for RPD's and % Recovery in Appendix A includes wastewaters and other highly contaminated waters, better results should be anticipated for clean drinking water. The following guidelines should be applied to drinking water:

	RPD's	% Recovery
Organic Analyses	25%	75 - 125%
Inorganic Analyses	10%	85 - 115%

2. When the sample concentration exceeds 80% of the Maximum Contaminant Levels (MCL) (See CAC Title 22) the analysis must be repeated to confirm the high level.

3. Detection limits for purposes of reporting (DLR's) have been identified for drinking water pollutants and AB1803. The DLR's are generally set at 1/5 to 1/10 of the MCL. The analysis must demonstrate that the detection limits are below the DLR by analysis of a blank and one standard below the MCL. Do not report data below the DLR. All GC results above the DLR must be confirmed on a second column or by GCMS.

4. Hardness should be analyzed by EDTA titration (Std. Methods 314.B) and checked by calculation (Std. Methods 314.A).

5. Cation and Anion concentrations must balance within 5% (ion balance).

6. Fluoride must be analyzed by selective ion electrode (Std. Methods 413.B).

7. Blank values should not be subtracted from samples. Report blanks separately.

8. Nitrate concentrations >45 ppm must be confirmed by resampling. Alert the client by phone immediately.

E. IH Samples and NIOSH PAT

1. An aqueous LCS such as NBS 1643 or USGS T111 will be used with each batch of filters to verify calibration. The acceptance criteria will be within 5% of the certified value or historical mean, which ever we feel is most appropriate. This criteria reflects the more stringent requirements of the PAT program.

2. With each set of filters, a filter of known concentration must be processed through digestion and analysis. This filter will be either a spiked blank, NIST filter, or a past NIOSH PAT filter. Acceptance criteria for the results will be according to the PAT data or within 5% of the theoretical.

QC ACTION FORM

Job No. _____ Analyst _____

Analysis _____ Supervisor _____

Date _____

1. Describe the out-of-control situation:

QC Results	QC Guidelines

2. Describe possible causes and resolutions of the problem.

_____

_____

_____

3. What data did this situation effect?

Job #	Client	Data

4. Actions Taken: (was the data used as is or reanalyzed/why, why not?)

_____

_____

_____

_____

APPENDIX E

Job Descriptions

Below are general descriptions of the duties, responsibilities, and training required for various employment positions. These positions correlate with the Towers Compensation Survey and WCAS management positions as shown in Table 1. Job responsibilities should be considered cumulative, e.g. a Sr. Chemist has the responsibilities of subordinate positions as well as those particular to a Sr. Chemist. As needed, personnel may also be assigned specific duties which have not been listed here but which are consistent with their training.

1. Attendant
No specific education or training required. Entry level position to assist others in the laboratory performing non-technical tasks under close supervision or to work in Log-in. Reports to Log-in Supervisor, Analyst, or Group Leader.

2. Technician
High School education required. Entry level position to assist others and to be trained to perform routine tasks of a non-technical nature. Reports to either an Analyst, Group Leader, or Log-in Supervisor.

3. Chemist
B.S. in a scientific discipline, preferably chemistry, with 0-2 years experience. In training to perform routine tasks, may perform routine maintenance, prepares data packages for review, notifies supervisor of Out-of-Warning/Control situations. Reports to and is closely supervised by an Analyst or Group Leader.

4. Analytical Chemist
B.S. plus two years direct experience. Trained to perform routine tests, helps evaluate new tests, helps write SOPs, performs routine maintenance, prepares and reviews data packages, requisitions routine supplies. May supervise a Technician or Chemist. Reports to a Group Leader.

5. Senior Chemist
B.S. and five years direct experience. Trained to perform and supervise a variety of routine and some non-routine tasks, evaluates and develops new tests, writes SOPs, performs non-routine instrument repair, prepares and reviews data packages, writes case/data package narratives, calls clients with results or resolution of problems, may be assigned to sign final reports, helps train others, requisitions routine and non-routine supplies and equipment. Reports to Group Leader, Manager, or Director.

6. Senior Staff Chemist
B.S. and 10 years experience. Performs routine and non-routine tasks, develops new tests and SOPs, performs difficult instrument repairs, prepares and reviews data packages and narratives, works with clients on problems, trains others, requisitions non-routine supplies and equipment. Reports to Group Leader, Manager, Lab Director, or President.

The following are management positions which carry some supervisory duties in addition to the responsibilities above.

6. Log-In Supervisor
Two years experience in Log-in. Supervises Attendants in shipping and receiving, logging-in jobs; assigns work to various groups; completion of CoCs and sample disposition; maintains sample storage conditions; maintains Log-in SOPs. Reports to Lab Manager, Technical Director or Lab director. May also assist in report preparation and invoicing.

7. Analyst
Training and responsibilities of Analytical Chemist or above who may be assigned to supervise one or more Chemists or Technicians in performing a routine task.

8. Group Leader
Sr. Chemist or above who is additionally responsible for all SOPs for their group; insures that the analysts have read, understood, and signed-off on the SOP, and that the analysts have the training, information, and resources to perform their assignments; assigns tasks and schedules to those in group; enforces safety policies in group; maintains equipment and calls outside for repair when needed; maintains outstanding job lists, dry boards, and attends staff meetings to insure turn-around-times; reviews and signs data packages; reviews instrument and maintenance logs; approves the use of Out-of-Warning data; approves overtime and time-off requests; works with managers and directors to meet project schedules and goals; administrates personnel policies within group, and conducts semiannual performance and salary reviews for group; approves requisitions of supplies up to $750. Reports to Manager or Director.

9. Chemical Hygiene Officer
Sr. Chemist or above who assists chemists in safely handling chemicals and other hazards and assists in maintaining the Safety Manual. Reports to the Lab Manager and Technical Director.

10. Organics or Inorganics Manager
Sr. Chemist or above who coordinates the work of more than one group, conducts training classes, conducts performance and salary reviews of Group Leaders, approves requisitions of up to $1000, working jointly with Project Manager organizes and directs work on projects. Reports to Lab Director, Technical Director, or President.

11. Safety Officer
Sr. Chemist or above who organizes and conducts safety meetings and training, and maintains the Safety Manual. Reports to the Lab Director or President.

12. Project Manager
Two years experience in environmental/laboratory industry who organizes and directs work on projects through other managers and Group Leaders, handles client inquiries and problems, prepares proposals and bids, develops and markets services through presentations and visits to clients, phones/FAX results to clients. Reports to Lab Director or President.

13. Study Director
Sr. Chemist or above who is assigned projects which must comply with Good Laboratory Practices (GLP). Responsible for overall study from a technical standpoint including conducting the study according to plans, interpreting the results, documenting and verifying results, obtaining approval of protocol changes, selecting corrective action, compliance of study with GLP, and archival of all raw data, documentation, protocol, specimens, and reports at the close of the study. Reports to President.

14. QA Coordinator
Sr. Chemist or above who maintains QA data bases, prepares and reviews QA statistics, performs periodic audits of data packages, may work with clients and Managers to develop project QA plans, helps to train analysts in QA, assists the Technical Director in maintaining SOPs, and helps maintain the QA Manual.
Reports to QA Officer or President.

15. Lab Manager
Sr. Chemist or above who is responsible for scheduling and administration of the entire laboratory, may be final approval of time off and overtime, conducts performance and salary reviews of Group Leaders, works with Lab Director on developing and implementing personnel policies, supports marketing and sales personnel, helps prepare proposals and bids, conducts training, approves vendors, recommends equipment purchases, approves requisitions up to $5000, helps Lab Director maintain Operations SOPs. Reports to the Lab Director.

16. QA Officer
Sr. Staff Chemist responsible for setting and monitoring QA policies for the entire lab, maintains the QA Manual, develops project QA plans, works with other managers and Group Leaders to train personnel, supports sales and marketing, assists the Technical Director in maintaining the SOPs, heads the Quality Assurance Unit for GLP projects. Reports to President.

17. Technical Director
Sr. Staff Chemist responsible for the quality of data, SOPs for laboratory operations, and technical training of personnel; conducts performance and salary reviews of Managers with Lab Director or Lab Manager, approves use of Out-of-Control data, reviews instrument and maintenance logs, keeps the lab current on technical issues, evaluates and develops new tests, prepares technical presentations and papers, maintains Safety Manual, responsible for sample and hazardous waste disposal, first signature on reports, knowledgeable in all methods required by regulations. Reports to President.

18. Lab Director
B.S. degree and 10 years experience in the industry. Chief Financial Officer responsible for administration of the business, maintains Operations SOPs, prepares financial reports, responsible for budgeting and profitability, final approval on capital expenditures, responsible for marketing and sales, personnel, conducts reviews of Managers with Technical Director or President, develops current and long term plans and policies, maintains knowledge of regulations.

19. President
B.S. and 20 years experience in the laboratory industry. Responsible for quality of the services; maintains QA Manual; maintains certifications and accreditations; works with Lab Director on profitability of the business, marketing, and current and long term planning; prepares large bids and proposals; conducts training classes; second signature on reports; prepares technical papers and presentations.

Table 1. Correlation of Training and Positions

Towers Survey	WCAS Training Level	WCAS Management Position
	Attendant	
Lab Attendant	Technician	
Chemist I	Chemist	
Chemist II	Analytical Chemist	Log-in Supervisor
		Analyst
		Section Leader
		Asst. Group Leader
Sr. Chemist	Sr. Chemist	Group Leader
		Chem. Hyg. Officer
		Organics Manager
		Inorganics Manager
		Safety Officer
		Project Manager
		Client Services Rep.
		Study Director
		QA Coordinator
		Lab Manager
		Other Managers
Consulting Chem.	Sr. Staff Chemist	QA Officer
		Technical Director
		Lab Director
		Vice President
		President

Below are job descriptions of support personnel.

1. Computer Specialist.
B.S. in a scientific discipline. Responsible for maintaining hardware and software used by the company to include the Novel Network, Foxbase Job Tracking, spreadsheet and word processing software, printers and workstations. Responsible for maintaining network backups and SOPs associated with the computers and network. May work on software development projects. Reports to the QA Coordinator, Lab Manager, Technical Director, or President.

Job Description and Check List for Laboratory Personnel

Name_____ Title_____

Date_____ File H:JOBDESC.JN

This form can be used to document a persons level of training and responsibilities.

Comments should be added where needed.

1. Laboratory Testing

_____a. Assists in routine tests (list):

_____b. In training to conduct routine tests (list):

_____c. Conducts routine tests (list):

_____d. Conducts non-routine tests (list):

_____e. Supervises tests (list):

_____f. Evaluates published methods from literature (list for past year):

_____g. Develops methods (list for past year):

2. Standard Operating Procedures

_____a. Read and understood specific SOPs for job (list):

_____b. Develops specific SOPs for job (list):

_____c. maintains SOPs for group

_____d. maintains and approves Laboratory or Operations SOPs for entire lab

3. Instrument Operation and Maintenance

_____a. in training to use an instrument (list):

_____b. uses instrument that has been set-up by others (list):

_____c. sets up instrument to use by self or others (list):

_____d. performs daily, routine maintenance on instruments (list):

_____e. runs more than one instrument in group (list):

_____f. runs more than one instrument in more than one group (lis

_____g. performs non-routine repairs on instruments (list):

_____h. authority to call outside instrument repair personnel

_____i. overall responsibility for lab

4. Data Review and Reporting

_____a. generates data package and notifies supervisor of Out-of-Warning/Control situations

_____b. reviews own work

_____c. places results in Job Tracking

_____d. reviews work/data packages of others

_____e. reviews work/data packages of group (list groups):

_____f. prepares case/data package narratives for client reports

_____g. approves use of Out of Warning data

_____h. calls clients with results

_____i. reviews instrument and maintenance log books monthly

_____j. approves use of Out of Control data

_____k. approves and signs final reports when assigned

_____l. approves and signs final reports routinely

_____m. overall responsibility for entire lab data quality

_____n. performs periodic data package audits

5. Work Schedules

_____a. follows schedule set by others

_____b. develops schedule of own work

_____c. develops schedule of several people

_____d. schedules work for entire group

_____e. approves overtime

_____f. approves time off

_____g. coordinates schedules between group

_____h. coordinates schedules for entire lab

_____i. final approval for overtime and time-off

_____j. keeps lab calendar

6. Management

_____a. check CoC and other job information

_____b. assigns jobs to analysts

_____c. provides direction to analysts

_____d. organizes and directs projects

_____e. calls clients to address problems, quotes, and questions

_____f. conducts performance and salary reviews

_____g. visits clients to address problems and market services

_____h. makes presentations to clients

_____i. implements company policies

_____j. develops company policies

_____k. directly responsible for lab profit/loss

7. Training

_____a. in training for (list):

_____b. helps train others in group (list tests):

_____c. responsible for training of entire group

_____d. responsible for training of entire lab

_____e. conducts training classes (list):

_____f. conducts health and safety meetings

8. Works with and supports

_____a. other analysts in conducting tests (list):

_____b. group leader in scheduling and conducting tests

_____c. Organics Manager, Project Managers, and Log-in Supervisor in scheduling and conducting tests for projects, answering client inquiries, and addressing problems

_____d. Safety Officer in conducting safety training or inspections

_____e. Technical Director to develop methods and SOPs

_____f. Lab Manager to schedule personnel and administrate company policies

_____g. Marketing and sales personnel to support and expand sales

_____h. President to develop new tests and improve quality

9. Ordering Equipment and Supplies

_____a. notifies supervisor of deficient supplies

_____b. places supply needed on purchase requisition list

_____c. fills out purchase requisitions

_____d. calls in order

_____e. approves requisitions of up to $750

_____f. approves requisitions of up to $1000

_____g. approves requisitions of up to $5000

_____h. selects and recommends equipment for purchase

_____i. selects vendors for supplies

_____j. final approval on capital expenditures

10. Marketing and Sales

_____a. helps develop sales literature and brochures

_____b. handles routine phone inquiries

_____c. calls clients by phone to develop sales

_____d. visits clients

_____e. makes formal presentations to clients

_____f. overall responsibility for sales and marketing

How does your job description differ from the descriptions above?

Do you have responsibilities not included above?

Are there areas that you feel you should supervise, that you don't currently supervise?

What is your biggest challenge over the next six months?

APPENDIX G

APPENDIX G

Modeling Process

APPENDIX G

Modeling Process

The conceptual model document will include the following items: a description of the model domain, a review and summary of available information, a comprehensive discussion of the conceptual model describing the system, establishment of performance criteria, model validation procedures, selection of governing equations and recommendation of computer codes (groundwater models) which may be selected to simulate the groundwater flow system. A brief listing of groundwater models, that will be reviewed during development of the conceptual model, are included below. Additional groundwater models may also be identified. These models will be reviewed and summarized during development of the conceptual model. A description of the modeling process follows below.

To develop a site specific groundwater transport model, a standard modeling process will be employed. The first step in this process is to define the model domain and conduct a comprehensive review and evaluation of available information. The second step is to develop a conceptual model of the system in order to abstract the available data so that the system can be represented geometrically, the physiochemical processes involved in the system can be identified, and the boundary and initial conditions can be determined. The next step is to establish reasonable performance criteria for the model. Performance criteria are the quantities or parameters of interest that the model is being asked to simulate or predict. The fourth step is to assign governing equations or mathematical relationships that simulate the processes taking place within the system. Such governing equations generally simplify the conceptual model, which is typically complex in nature. After governing equations have been selected a numerical or computer code is developed or chosen, followed by codification of the available data and commencement with computer runs. The next step is to evaluate the results of the computer runs by comparing simulated output with observed conditions. This output, including uncertainties, must also be evaluated against the previously established performance criteria. The outcome of this evaluation may indicate that the model results contain too many uncertainties. In that case additional information may be required to further enhance the model. The final outcome may indicate that the model results along with uncertainties, yield satisfactory output. If the latter is true the model is considered calibrated and can be run in predictive mode. The table at the end of this section describes the steps in the modeling process and characteristics requiring validation.

Since the goal of any model is to ensure that the modeling results present an accurate representation of the actual processes occurring within the real system, validation procedures will be applied to every step in the above modeling process. Each step will be peer reviewed and verified prior to proceeding. A thorough validation procedure will be outlined in the conceptual model documentation.

Groundwater Transport Model Requirements

Mass flux from the vadose zone to the saturated zone may be a source of Skinner List compounds to the uppermost aquifer underlying the Refinery. As part of the GMP modeling effort, this potential loading will be assessed through the use of an unsaturated zone model (analytical or numerical). This will help quantify concentrations of Skinner List compounds that may be arriving at the water table due to concentrations that may be found in overlying coral (caprock). Such information will be integrated with the groundwater flow model, which will be run for various scenarios to predict contaminant fate and transport. The groundwater transport modeling software selected for the GMP should be capable of handling variable-sized source areas, capable of representing biodegradation, absorption, advective-dispersive transport, transient flow, heterogeneities and potentially transient boundary conditions. It is anticipated that numerical, analytical and semi-analytical models may be utilized during modeling activities of the GMP. The following list summarizes models that have already been evaluated, a final listing will accompany the conceptual model documentation:

- *HELP - The Hydrogeologic Evaluation of Landfill Performance Model*
- *SESOIL - Seasonal Soil Compartment Model*
- *SUTRA - Saturated-Unsaturated TRAnsport (Voss, 1984)*

Available Groundwater Transport Models

Although numerous groundwater transport codes are available only a select few are likely to satisfy the modeling objectives for this GMP and be able to effectively simulate the conceptual model that will be developed and approved by the EPA. Computer codes that are capable of representing chemical retardation and degradation, advective/diffusive transport, hydrodynamic dispersion, mixing and dilution from recharge, chemical reactions, and biodegradation and are able to represent transient and temporally and spatially heterogenous conditions will be selected for review. Of those codes which meet some or all of these capabilities, only a few are publicly available, well documented, PC-compatible, and accepted by the scientific and regulatory communities. Several groundwater transport models that generally meet most of the above requirements have been evaluated for their use on this project. The following list summarizes several models that have already been evaluated, a final listing will accompany the conceptual model documentation:

- *TDAST - Two Dimensional Analytical solution for Transport (Javandel et al., 1984)*
- *AT123D - Analytical Transport in 1-, 2-, 3-dimensions (Yeh, 1981)*

- *SUTRA - Saturated-Unsaturated TRAnsport (Voss, 1984)*
- *HST3D - Heat and Solute Transport in 3-Dimensional groundwater flow systems (Kipp, 1987)*
- *USGS 2-D Solute Transport Model (MOC) (Konikow and Bredehoeft, 1978)*
- *BIOPLUME II (Bedient and Rifai, 1987)*
- *MODFLOW / MODPATH (McDonald and Harbaugh, 1984)*

Brief Description of Models

TDAST provides for chemical retardation and degradation, although it is limited to two-dimensional transport modeling. Thus, chemical loading from soil leachate at the water table must be represented by instantaneous and uniform vertical distribution of the chemical through the entire aquifer thickness. Also, TDAST is not as user-friendly as the other models described below.

AT123D was developed by G.T. Yeh of the Oak Ridge National Laboratory (Yeh, 1981). It is a semi-analytical model for transient simulation of 1-, 2-, or 3-dimensional transport of solutes in groundwater. It can represent advective-dispersive transport with adsorption and biodegradation in homogeneous aquifers of simple geometry. It allows proper representation of the soil leachate loading at the water table, and it is very flexible and user-friendly.

SUTRA is a numerical modeling code capable of simulating advective-dispersive transport of a single component undergoing retardation and degradation within a complex two-dimensional aquifer system. If the need arises to characterize complex hydrogeologic conditions on a site, SUTRA would be a useful to the extent that no significant three-dimensional effects need representation. Because significant three-dimensional effects are likely to be encountered, SUTRA may be of limited use.

HST3D was developed by Kenneth Kipp of the Water Resources Division, USGS. It is fully three-dimensional, and has all of the capabilities required for our anticipated uses as a rigorous benchmark model that the simpler AT123D can be compared to. In such a role, HST3D would be used to assess the errors associated with the use of AT123D and its implicit assumptions of simple aquifer geometry and homogeneous, isotropic media.

MOC is a two-dimensional model developed by the USGS for simulation of non-conservative solute transport in saturated groundwater flow systems. The model is flexible in its design and therefore can be applied to a wide range of scenarios. The model computes changes in the spatial concentration distribution over time caused by convective transport, advection, dispersion, mixing, dilution and chemical reactions. MOC couples the groundwater flow equation with the non-conservative solute-transport equation. The program uses the strongly implicit procedure or the alternating direction implicit method to solve the finite difference approximation to the groundwater flow equation.

BIOPLUME II simulates solute transport in a saturated porous media. The model is based upon the USGS 2-D Solute Transport Model (MOC). The model solves the transport equation twice, once for the contaminant and once for oxygen. The model assumes an instantaneous reaction between the two components at every time step. The model simulates aerobic biodegradation, first order decay to estimate anaerobic biodegradation, advective and dispersive transport and instantaneous reactions between the contaminant and oxygen.

MODFLOW/MODPATH (McDonald and Harbaugh, 1984) MODFLOW is a 3-dimensional modular groundwater flow model that uses a block centered, finite difference approximation in solving the groundwater flow equation. Distinct and/or arbitrary hydrogeologic units are represented in the model as layers which can be simulated as unconfined, confined or a combination of both. External stresses, such as evapotranspiration, flow into and out of the aquifer from surface water features and other stresses can also be simulated. The model utilizes the strongly implicit procedure (SIP) or slice successive over relaxation (SSOR) to solve the finite difference equations. MODPATH is the companion to MODFLOW and utilizes the head distribution estimated by MODFLOW to estimate migration of particles from a source area. The particle tracker estimates transport by advective mechanisms and is very convenient for evaluations of flow systems that are somewhat dynamic in nature.

HELP is a quasi-two-dimensional deterministic water budget model. Using daily climatologic data as input, the program performs a sequential daily analysis to determine runoff, evapotranspiration, percolation and lateral drainage. The program reports daily, monthly, annual and long-term average water budgets. Daily precipitation may be input manually, selected from a historical database, or generated stochastically. Other daily climatological data are generated stochastically. The WGEN model of the Agricultural Research Service is used to generate the daily weather variables. Hydrologic modeling procedures used in the HELP model were adapted from the HSSWDS model of the U.S. Environmental Protection Agency and the CREAMS and SWRRB models of the Agricultural Research Service. Runoff is computed using the runoff curve-number method of the U.S. soil Conservation Service. Evapotranspiration is computed by a modified

Penman method developed by Ritchie and adapted for limiting soil moisture by Shanholtz and Saxton. Growth and decay of surface vegetation is modeled using a routine adapted from the SWRRB model. Vertical drainage is computed using Darcy's law, modified for unsaturated conditions. The lateral drainage model is based on the assumption of quasi-steady flow.

SESOIL is a mathematical soil compartment model designed for long-term environmental hydrologic, sediment, and pollutant fate simulations. It can describe: water transport (quality and quantity); sediment transport (quality and quantity); pollutant transport and transformation; soil quality; pollutant migration to groundwater; and other processes. Simulations are performed for a ;user specified soil column extending between the ground surface and the lower part of the unsaturated soil zone of a region. The simulations are based upon a three-cycle rationale, each cycle being associated with a number of processes. the three cycles are the: (1) hydrologic cycle which takes account of rainfall, soil moisture, infiltration, exfiltration, surface runoff, evapotranspiration, groundwater runoff, (2) sediment cycle which takes account of sediment washload (from storms) and sediment resuspension (due to wind), and (3) pollutant fate cycle which takes account of advection, diffusion, volatilization, adsorption and desorption, chemical degradation or decay, biological transformation, hydrolysis, photolysis (not operational), oxifixation (not operational), complexation of metals by organic ligands, cation exchange, fixation (not operational) nutrient cycles (not operational) and other processes. Model development has been sponsored by the U.S. Environmental Protection Agency and validation studies have been performed for the hydrologic part of the model (in estimating basin water balances), and for the unsaturated soil zone part of the model (pollutant transport model at waste land treatment disposal sites). the model has been also applied to estimating volatilization of solvents from leaking buried barrels, and to conducting exposure assessment studies. The entire model development has not yet been fully accomplished; however, most model features are operational.

The preceding models have been presented and will be evaluated and summarized further in the conceptual model documentation. However, additional modeling software packages are likely to be identified and evaluated as well. Such additional models will also be include in the conceptual modeling documentation.

TYPICAL MODELING PROCESS
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII
DELTA NO. 45-93-033

STEP NUMBER	MODEL PROCESS	MODEL CHARACTERISTICS REQUIRING VALIDATION
1	Establish problem domain	Data review and evaluation
2	Conceptual model development	Conceptual model accuracy and probability of scenarios
3	Establish performance criteria	Is performance criteria reasonable?
4	Establish/select model governing equations; Select modeling computer code	Abstraction of Conceptual model
5	Model runs/sensitivity analyses	Uncertainty in input data and mathematical relationship choices
6	Evaluation of model results i. If uncertainty too high, then define new model data needs and go to step 1 - if feasible. ii. If observed and simulated conditions correlate favorably and uncertainties are acceptable, then model is considered calibrated and validated.	

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APPENDIX H

APPENDIX H

Health and Safety Plan

Mercury

Mercury is a silvery, mobile, odorless liquid.

Short-term exposure to inhaled mercury vapors may cause headache, cough, chest pains, chest tightness, and difficulty in breathing. In addition, it may cause soreness of the mouth, loss of teeth, nausea, and diarrhea. Liquid mercury may irritate the skin.

The PEL TWA for mercury is 0.1 mg/m^3.

Selenium

Selenium is a black, gray, or red odorless solid.

Prolonged exposure to selenium can cause paleness, coated tongue, stomach disorders, nervousness, metallic taste, and a garlic odor of the breath. Fluid in the abdominal cavity, damage to the liver and spleen, and anemia have been reported in animals.

The PEL for selenium is 0.2 mg/m^3.

Toluene

Toluene is a colorless liquid with a benzol-like odor.

Inhalation of high vapor concentrations may cause impairment of coordination and reaction time, headaches, nausea, eye irritation, loss of appetite, a bad taste, and lassitude.

The PEL for toluene is 100 ppm.

Xylenes

Xylenes are clear, colorless liquids.

Exposure to high concentrations of xylene vapor may result in eye and skin irritation. Eye irritation may occur at concentrations of about 200 ppm.

The PEL for total xylene is 100 ppm.

Cyclohexane

Cyclohexane is a colorless, mobile liquid with a pungent odor, and is moderately toxic by ingestion. It is a systemic irritant by inhalation and ingestion and a skin irritant.

The PEL for cyclohexane is 300 ppm.

Anthracene

Anthracene is a colorless crystal, violet fluorescence. It is an experimental tumorigen and neoplastigen. It is also a skin irritant and allergen.

The PEL for anthracene is 0.2 milligrams per cubic meter.

Barium

The soluble barium salts, such as the chloride and sulfide, are poisonous when ingested. Some salts are skin, eye, and mucous membrane irritants producing dermatitis.

The PEL for barium is 0.5 milligrams (Ba) per cubic meters.

Cobalt and Compounds

Cobalt and Compounds are gray, hard, magnetic, ductile, and somewhat malleable metals.

Cobalt is moderately toxic by ingestion. It is an experimental neoplastigen. Inhalation of dust may cause pulmonary damage. The powder may cause dermatitis.

The PEL for cobalt is 0.1 milligrams per cubic meter.

Chrysene

Chrysene occurs in tar. Orthorhombic bipyramidal plates from benzene. An experimental carcinogen by skin contact.

The PEL for chrysene is 0.2 milligrams per cubic meter.

Cresols (all isomers)

Cresols can be colorless, yellow, brown, or pinkish oily liquids or solids with a sweet, tarry odor. Contact with skin or eyes can cause burns and/or dermatitis.

The PEL for cresols is 22 mg/m^3 per cubic meter.

Pyrene

Pyrene is a colorless or white solid.

Pyrene is moderately by ingestion and poisonous by inhalation. Exposure to pyrene may cause skin irritation.

The PEL for pyrene is 0.2 mg/m^3 in air.

Naphthalene

Naphthalene is a white crystalline solid used as moth repellant. Initial symptoms resulting from exposures to high concentrations include eye irritation, headache, confusion, malaise, profuse sweating, nausea, and vomiting.

The PEL TWA for naphthalene is 10 ppm in air.

Phenanthrene

Phenanthrene is a white crystal.

Phenanthrene is moderately toxic by ingestion.

The PEL for phenanthrene is 0.2 mg/m^3.

APPENDIX B

OSHA Notice

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Requirements of the Act include the following:

Employers

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to employees. Employers must comply with occupational safety and health standards issued under the Act.

Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

Complaint

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discrimination.

Citation

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

Proposed Penalty

The Act provides for mandatory penalties against employers of up to $1,000 for each serious violation and for optional penalties of up to $1,000 for each nonserious violation. Penalties of up to $1,000 per day may be proposed for failure to correct violations within the proposed time period. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to $10,000 for each such violation.

Criminal penalties are also provided for in the Act. Any willful violation resulting in death of an employee, upon conviction, is punishable by a fine of not more than $10,000, or by imprisonment for not more than six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

Voluntary Activity

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

Such voluntary action should initially focus on the identification and elimination of hazards that could cause death, injury, or illness to employees and supervisors. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for help such as training.

Consultation

Free consultative assistance, without citation or penalty, is available to employers, on request, through OSHA supported programs in most State departments of labor or health.

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:

Atlanta, Georgia
Boston, Massachusetts
Chicago, Illinois
Dallas, Texas
Denver, Colorado
Kansas City, Missouri
New York, New York
Philadelphia, Pennsylvania
San Francisco, California
Seattle, Washington

Telephone numbers for these offices, and additional area office locations, are listed in the telephone directory under the United States Department of Labor in the United States Government listing.

Washington, D.C.
1988 (Revised)
OSHA 2203

Ann McLaughlin, Secretary of Labor

U.S. Department of Labor

Occupational Safety and Health Administration

Under provisions of Title 29, Code of Federal Regulations, Part 1903.2(a)(1) employers must post this notice (or a facsimile) in a conspicuous place where notices to employees are customarily posted.

GPO : 1988 O - 219-667

The temporary stop-work action level will be 10% lower explosive level (LEL) reading on the combustible gas meter. All operating equipment will be shut down and the Health and Safety Representative will be notified.

6.3 Dermal Protection

Chemicals in the coral or groundwater may come in contact with skin or clothing. To protect against such potential exposure, the following personal protective equipment shall be worn during sampling activities.

- Hard hats
- Chemically resistant steel-toed, steel-shank safety boots (minimum 14 inches in height);
- Safety glasses
- Latex undergloves and Edmont Solvex or equivalent overgloves
- Polyethylene-coated Tyvek coveralls taped at the boots and gloves
- Hearing protection around heavy equipment

6.4 Protection Against Physical Hazards

Noise

Field personnel working near heavy machinery or in locations throughout the Refinery will require hearing protection.

Heavy Equipment

Hazards related to heavy equipment will necessitate securing the work area. OSHA requirements for operating heavy equipment in 29 CFR 1910/1926 shall be observed.

Heat Stress

Field work will begin early in the day, and breaks will be taken at midday, when temperatures normally peak. Personnel shall be provided with liquids to drink throughout the work day. The duration and number of breaks shall be determined by the temperature, humidity, and workload. Personnel will be monitored for symptoms of heat stress, such as increased pulse rate, high body temperature, and hot, dry red skin. Additionally, personnel may be monitored for dehydration by measuring body weight before, during, and after work shifts.

General Safety

Personnel will wear approved head protection while working around heavy equipment at the Site. Fire hydrants will be identified before field activities begin. Two (2) 10-pound fire extinguisher will be kept on Site near the working area.

6.5 Entry Procedures

At a minimum, all visitors entering the sampling area must wear the same protective clothing and equipment as on-site personnel, or equivalent protective gear. Permission to enter the work area must be obtained from at least one (1) of the personnel named in Section 4.0. Visitors' names and the purpose of their visit will be recorded in the field notes.

6.6 Decontamination Procedures

Personal protective equipment such as disposable gloves, disposable coveralls, and other disposable clothing or equipment worn by on-site personnel will be placed in a suitable container on site at the end of each work day. Protective clothing and equipment will be replaced if its protective function is compromised by holes or tears.

6.6.1 Personnel

A formal decontamination area will not be required, but anyone entering the Site shall follow decontamination procedures before leaving the Site. All personnel will be required to wash their hands and faces before leaving the Site at the end of each work day. Personnel should shower after leaving work. In addition, no drinking, eating, or smoking will only be allowed in appropriate areas, and personnel shall wash their hands before conducting those activities on their breaks.

All disposable protective equipment shall be left on site and bagged for appropriate disposal. Boots shall be washed with an non phosphate detergent and rinsed before being removed from the Site.

The following decontamination equipment shall be present on site:

- Two tubs for washing and rinsing boots
- Alconox (non phosphate detergent)
- Two brushes with handles for washing and rinsing boots
- Small table to support hand/face wash/rinse basins

- Wash basins
- Rinse basins
- Plastic garbage bags for disposal of used protective clothing

6.7 Disposal Procedures

Sample analysis results will be used to assess the appropriate disposal method for material. Disposable gloves, coveralls, and other disposable clothing or equipment worn by on-site personnel will be placed in a suitable disposal container on site at the end of each work day.

7.0 EMERGENCY PROCEDURES

7.1 General Injury

Step 1: Use first aid kit on site, if appropriate.

Step 2: Use off-site help and/or assistance, if appropriate.

Step 3: Notify SSO, Project Manager, and Health and Safety Representative.

7.2 Specific Treatments

Eye exposure: Flush eye with eye wash, call ambulance.

Skin exposure: Wash immediately with soap and water; call ambulance if necessary.

Fire (localized): Use fire extinguisher.

Fire (uncontrolled): Call fire department.

Chemical spill: Call fire department and National Response Center for Toxic Chemical and Oil Spills.

Inhalation: Move person away from source of chemicals.

Swallowing: Call ambulance service.

7.3 Emergency Phone Numbers

Medical/General Services

Police Department	911
Fire Department	1-808-523-4411 or 911
Ambulance	911
Saint Francis West Hospital	1-808-687-7001

Hospital

Saint Francis West Hospital 1-808-687-7001

91-2141 Fort Weaver Road

Ewa Beach, Hawaii

Figure 1 shows the route from the Site to the hospital.

Hazardous Materials Response/Reporting

National Emergency Response Center: 1-800-424-8802

National Response Center for Toxic Chemical and Oil Spills: 1-800-424-8802

7.4 Accident Reporting Procedures

In the event of an emergency, call 808-547-3900.

If chemical exposure or injury occur, work shall be halted until the SSO in consultation with the Health and Safety Representative decide that it is safe to continue work.

8.0 DOCUMENTATION

The SSO will record field observations of health and safety procedures by workers conducting the planned activities, including necessary deviations from the recommended health and safety procedures.

9.0 MEDICAL MONITORING

Personnel who use or may come in contact with hazardous materials will undergo compulsory routine medical surveillance. The surveillance should include but is not limited to the following:

- A one-time baseline medical history and physical examination, chest x-ray, pulmonary function test, audiogram, electrocardiogram, complete blood count, chemistry panel, and urinalysis.
- Annual medical examination.
- Exit physical examination upon termination of employment.

10.0 TRAINING PROGRAM

1. All Site personnel shall have completed 40-hour Health and Safety requirements and refresher courses as specified in 29 CFR 1910.120.

2. The SSO shall have fulfilled all appropriate training requirements specified in 29 CFR 1910.120 (e), including the 40-hour training requirements, 8-hour supervisory training requirements, and required annual refresher courses.

3. A tailgate session to discuss this HSP will be held before field activities begin. All personnel and contractor/subcontractor employees shall receive, at a minimum, the following information:

   - The names of personnel and alternates responsible for site safety and health
   - Safety, health, and other hazards at the Site
   - Instruction on use of personal protective equipment
   - Instruction on work practices that will minimize risks from on-site hazards
   - Action levels
   - Instruction on safe use of engineering controls and equipment on site
   - Site control measures
   - Emergency plans

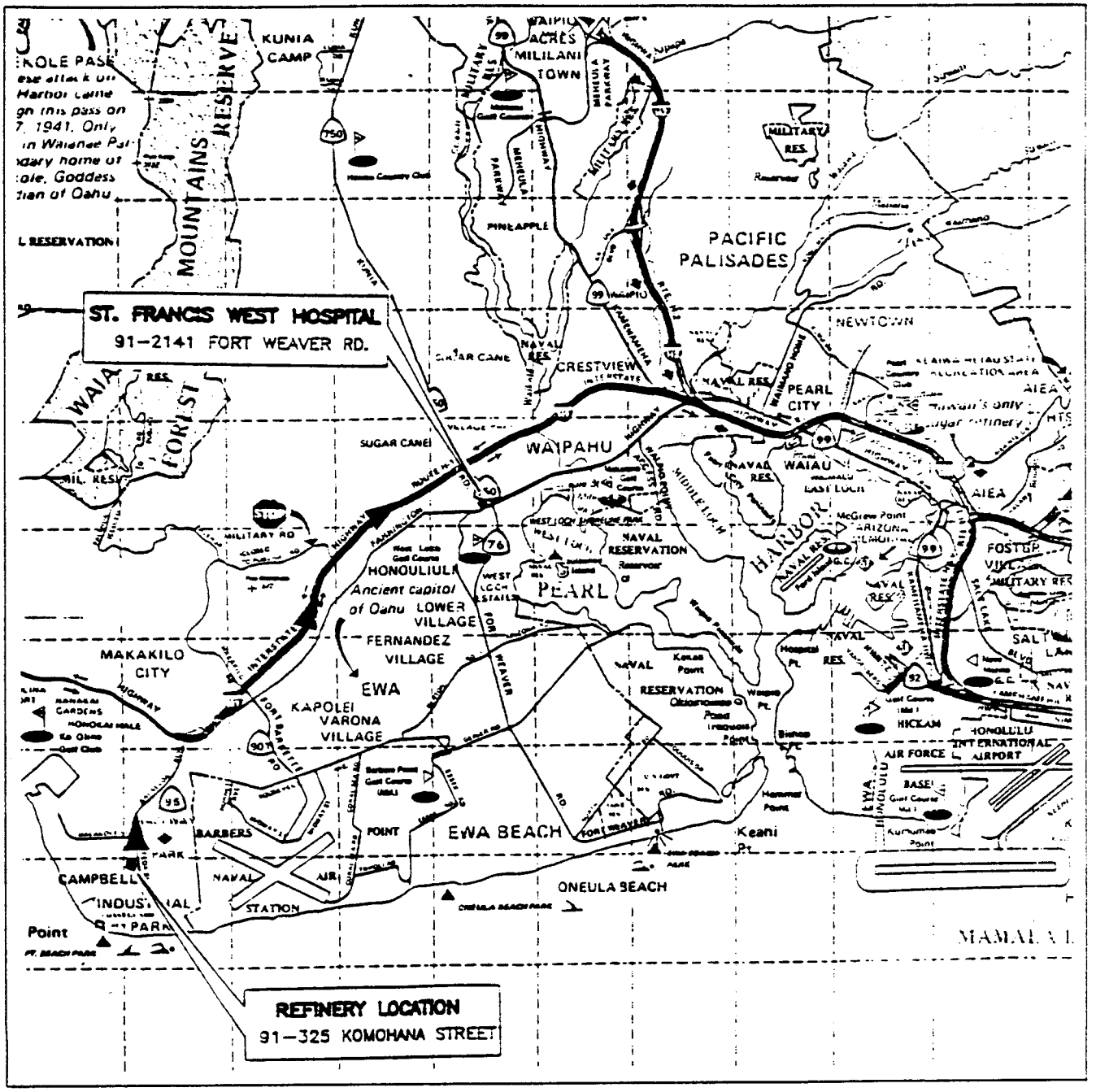

FIGURE 1

SITE/HOSPITAL LOCATION MAP
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII

PROJECT NO. 45-93-033		DRAWN BY M. ENTERLINE
FILE NO. 3-033-M1		PREPARED BY S. COLE
DATE 17 OCT 93	REV. 0	REVIEWED BY

Delta Environmental Consultants, Inc.

APPENDIX A

Chemical Descriptions

CHEMICAL DESCRIPTIONS

Antimony

Antimony is a silvery, white solid.

Short-term exposure to antimony can cause gastrointestinal pain, cough, loss of appetite, itching, skin eruptions, and irritation of the eyes, nose, and throat.

The permissible exposure limit (PEL) time-weighted average (TWA) for antimony is 0.5 mg/m^3.

Arsenic (All Forms)

Metallic arsenic is most commonly a gray, brittle, crystalline solid. It can also occur in a black or yellow amorphous form. Arsenic is commonly found in its volatile white trioxide form. It is used in several insecticides, herbicides, silvicides, defoliants, desiccants, and rodenticides and appears in a variety of forms.

Arsenic is classified by the U.S. Environmental Protection Agency as a known human carcinogen.

Short-term exposure to arsenic can cause marked irritation of the stomach and intestines with nausea, vomiting, and diarrhea. In severe cases, the vomiting and stools are bloody and the exposed individual goes into collapse and shock with weak, rapid pulse, cold sweats, coma, and death. Inorganic arsenicals are more toxic than organic arsenicals, and the trivalent form is more toxic than the pentavalent form. Acute arsenic poisoning usually results from ingestion exposures.

The PEL for arsenic is 0.01 mg/m^3 and for organic arsenic the PEL is 0.5 mg/m^3.

Benzene

Benzene is a clear colorless liquid.

Exposure to high concentrations (3,000 ppm) may result in acute poisoning, characterized by the narcotic action of benzene on the central nervous system. Chronic poisoning occurs most commonly through inhalation and dermal absorption. Benzene is also a recognized carcinogen.

The PEL for benzene is 1 ppm.

Beryllium

Beryllium is a silvery gray metal.

Short-term exposure to beryllium can cause pain below the sternum, weight loss, nonproductive cough, shortness of breath, and irritation of the eyes, respiratory system, and skin.

The PEL TWA for beryllium is 0.002 mg/m^3.

Cadmium

Cadmium dust is an odorless gray powder.

Short-term exposure to cadmium dust can cause irritation of the nose and throat. If enough has been inhaled, after a delay of several hours, a person mal also develop cough, chest pain, sweating, chills, shortness of breath, and weakness. Death may occur. Ingestion of cadmium dust may cause nausea, vomiting, diarrhea, and abdominal cramps.

The PEL TWA for cadmium dust is 0.2 mg/m^3.

Chromium

Chromium is a greenish-blue, odorless solid.

Exposure to chromium has been associated with lung changes in workers exposed to chromium alloys. Chromium dust exposure may cause minor lung changes.

The PEL for chromium is 1 mg/m^3.

Lead

Lead (inorganic) is a bluish-white, silver, or gray odorless solid.

Short-term exposure to lead can cause decreased appetite, insomnia, headache, muscle and joint pain, colic, and constipation.

The PEL for lead is 0.05 mg/m^3.

HEALTH AND SAFETY PLAN

GROUNDWATER MONITORING PLAN
BHP PETROLEUM AMERICAS REFINING INC.
91-325 KOMOHANA STREET
KAPOLEI, HAWAII

October 19, 1993

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HEALTH AND SAFETY PLAN

GROUNDWATER MONITORING PLAN
BHP PETROLEUM AMERICAS REFINING INC.
KAPOLEI, HAWAII

1.0 INTRODUCTION

This Health and Safety Plan (HSP) addresses the hazards associated with the field activities planned to collect samples at BHP Petroleum Americas Refining Inc. (BHPPAR) property in Kapolei, Hawaii. The field activities include the installation of groundwater monitoring wells at various locations around Pond Nos. 1, 2A and 2, and the collection of groundwater samples from those wells. The samples will be shipped from the site to an analytical laboratory. For the purposes of this HSP, the Site is defined as the Refinery property.

This HSP is to be used as a guidance document for contractor personnel. It presents baseline health and safety requirements for establishing and maintaining a safe working environment. In addition to the procedures and safeguards outlined in this HSP, contractor/subcontractor personnel shall follow applicable federal, state, county, and city regulations and the refinery safety procedures. In the event that requirements conflict, the procedures that provide the highest degree of personnel protection shall be implemented. Deviations from this HSP must have prior approval from the designated Health and Safety Representative.

If work plan specifications change during or after the preparation of this HSP, or if, during the course of the work, site conditions encountered are found to differ substantially from those anticipated, appropriate changes shall be made to this HSP.

At a minimum, every contractor and subcontractor working on site must do the following:

1. Ensure that its personnel have read and understood the requirements of this HSP and the Refinery safety procedures.

2. Ensure that its personnel have completed all training requirements in 29 Code of Federal Regulations (CFR) 1910.120 and all applicable state regulations.

3. Provide its own health and safety equipment as indicated in this HSP. If a contractor or subcontractor has prepared its own HSP, that HSP, at a minimum, must meet requirements contained herein and all applicable federal, state, and local health and safety requirements.

A copy of this HSP shall be kept on site, easily accessible to all employees and government inspectors, and in the prime contractor's files during the course of the project.

This HSP was prepared using the following documents:

- 29 CFR 1910, Occupational Safety and Health Standards.
- 29 CFR 1926, Safety and Health Regulations for Construction.
- American Conference of Governmental Industrial Hygienists (ACGIH), Cincinnati, Ohio. Threshold Limit Values and Biological Exposure Indices for 1991-1992.
- National Institute for Occupational Safety and Health (NIOSH); OSHA; U.S. Coast Guard (USCG); U.S. Environmental Protection Agency (EPA). 1985. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. Washington, D.C.: U.S. Government Printing Office. October.
- NIOSH/OSHA 1992. Occupational Health Guidelines for Chemical Hazards.
- Sax, N. Irving. 1984. Dangerous Properties of Materials, 6th edition. New York, New York: Van Nostrand Reinhold Company, Inc.
- U.S. EPA, Office of Emergency and Remedial Response, Hazardous Response Support Division. November 1984. Standard Operative Safety Guides.

2.0 SITE CHARACTERISTICS

2.1 Site Description/History/Background

BHPPAR operates a crude oil refinery at the Site which produces gasolines, propane, butane, fuel gas, kerosene-type jet fuels, and fuel oils. The refinery has been in operation since 1972. The refinery property occupies approximately 150 acres at Barbers Point in the southwest portion of the island of Oahu.

3.0 WORK DESCRIPTION

The activities planned at the Site will include the following:

- Installation of groundwater monitoring wells.
- Collection of groundwater samples.
- Management of Free-Product (sample collection and disposal).
- Disposal of wastes (coral, groundwater and free-product).

4.0 KEY PERSONNEL AND RESPONSIBILITIES

4.1 Project Manager

The Project Manager shall be responsible for the health and safety of personnel on site. As part of his or her duties, the Project Manager shall ensure that:

1. The Health and Safety Representative is informed of project developments;

2. Personnel on site receive the proper training and are informed of potential hazards anticipated at the Site and the procedures and precautions to be implemented on the job;

3. Contractors and Subcontractors are informed of expected hazards and appropriate protective measures at the Site; and,

4. Resources necessary for a safe and healthy work environment are available to personnel.

4.2 Health and Safety Representative

The Health and Safety Representative shall be responsible for:

1. Monitoring the health and safety impacts of this project on personnel working at the Site;

2. Assessing potential health and safety hazards at the Site;

3. Recommending appropriate safeguards and procedures;

4. Modifying the HSP when necessary; and,

5. Approving changes in safeguards or operating procedures used at the Site.

The Health and Safety Representative shall have the authority to:

1. Require that additional safety precautions or procedures be implemented;

2. Order evacuation of the Site or any portion(s) of the Site, or shut down any operation, if he or she believes a health or safety hazard exists;

3. Deny unauthorized personnel access to the Site;

4. Require that any worker, including subcontractor personnel, obtain immediate medical attention; and,

5. Approve or disallow any proposed modifications to safety precautions or working procedures.

4.3 Site Safety Officer

The Site Safety Officer (SSO) or a trained designated alternate will be present at the Site during work activities. The SSO shall be notified of and approve activities during which personnel may be reasonably expected to be exposed to contaminated soil and/or groundwater.

The SSO shall be responsible for:

1. Ensuring that personnel on site comply with the requirements of the HSP;

2. Limiting access to the Site;

3. Reporting unusual or potentially hazardous conditions to the Health and Safety Representative and the Project Manager;

4. Reporting injuries, exposures, and illnesses to the Health and Safety Representative and the Project Manager;

5. Communicating proposed changes in work scope or procedures to the Health and Safety Representative for approval; and,

6. Recommending to the Health and Safety Representative and the Project Manager additional safety procedures or precautions that might be implemented.

The SSO shall have the authority to:

1. Order an evacuation of the Site or any portion(s) of the Site, or shut down any operation, if he or she believes a health or safety hazard exists;

2. Deny site access to unauthorized personnel; and,

3. Require that any worker, including subcontractor personnel, obtain immediate medical attention.

5.0 HAZARD ANALYSIS

Potential chemical hazards are attributed primarily to residual chemicals that remain in the environment from operation of the ponds. Physical hazards arise from the planned sampling activities.

Procedures to protect personnel from chemical and physical hazards are discussed in Section 6.0. Potential chemical and physical hazards during the activities planned at the Site are as follows.

5.1 Chemical Hazards

- Respiratory (exposure to volatile organic compounds [VOCs]; and,
- Dermal (contact with petroleum products).

According to the records of previous investigations and activities at the Site, chemical hazards arise primarily from the following chemical constituents:

VOCs

Benzene

Cyclohexane

Toluene

Xylenes

Polycyclic Aromatic Hydrocarbons

Anthracene

Chrysene

Cresols (all isomers)

Naphthalene

Phenanthrene

Pyrene

1,Methylnaphthalene

2,Methylnaphthalene

Metals

Antimony

Arsenic

Barium

Beryllium

Cadmium

Chromium

Cobalt

Lead

Mercury

Nickel

Selenium

Vanadium

Descriptions of the suspected chemicals of concern are included in Appendix A. Each chemical description includes available physical characteristics, the short-term exposure effects, and the time-weighted average (TWA) permissible exposure limit (PEL) (OSHA Standard, 29 CFR 1910.1000).

5.2 Physical Hazards

The physical hazards at the Site during the planned activities include working around vehicles, and heavy equipment in the refinery. The planned field activities will be conducted as outlined in the GMP.

6.0 WORK REQUIREMENTS

6.1 Respiratory Protection

All field personnel in the work area initially will use modified Level D personal protective equipment (PPE). Air monitoring activities will be conducted as described below which may increase this level of PPE.

6.2 Air Monitoring

The primary route of exposure for chemicals is inhalation. Inhalation hazards due to volatilization will be monitored during soil boring and groundwater sampling activities using a photoionization detector or a flame-ionization detector. If ambient air concentrations of VOCs are above background over a 5-minute average, a temporary stop-work will be observed and a measurement of possible benzene concentration conducted. Detector tubes specifically designed to measure benzene concentrations will be used to assess benzene concentrations in the ambient air. If benzene concentrations exceed 0.5 parts per million (ppm), stoppage of work will continue and a PPE upgrade to supplied air will be considered, or the sampling activities modified to reduce benzene exposure to less than 0.5 ppm.

In the absence of benzene, should airborne organic concentrations in the breathing zone exceed 25 ppm, Level C protection using a NIOSH-approved air purifying respirator APR with organic cartridges will be required.